UNIVERSITY OF LIVERPOOL

The Adoption of Cloud Computing: Towards Enhancing E-Government Systems in the Saudi Public Sector

This thesis is submitted for the partial fulfilment of the degree

of Doctor of Philosophy

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Abstract

Governments are always trying to find ways to improve their services to citizens; and in order to achieve this they need to restructure their processes and use information technology (IT) effectively. Pressure to do this comes from citizens who increasingly have access to digital technologies and expect better e-services from their governments. Public sector organisations in Saudi Arabia, therefore, need to proactively implement technological innovation to enhance their services. One way to achieve this is to develop a cloud computing infrastructure and the appropriate applications. Cloud computing is understood, however, more needs to be known about how it impacts public service organisations and the provision of services. This research aims to identify and discuss the importance of particular factors pertaining to the fitness and viability of adopting the cloud for Saudi public organisations. The model that forms the theoretical framework for this integrates the Diffusion of Innovation (DOI) theory and the Fit-Viability Model (FVM). The cloud computing adoption performance within Saudi public organizations, together with determining the best cloud model for these organizations are also discussed in this research.

This research adopts a mixed methodology which includes one survey conducted with 408 IT staff and 21 IT experts for the second and third surveys. The analysis of quantitative data was processed by structural equation modelling (SEM) and descriptive statistics.

The qualitative analysis phase was conducted using semi-structured interviews with IT heads and experts in four government organizations to deeply understand and analyse the research problem and to find the optimal solution that would lead decision makers to cloud adoption. The thematic analysis approach was chosen to analyse the qualitative data.

The outcomes confirmed that the proposed model worked well and the quantitative data collected showed that fit, viability, task, relative advantage, compatibility, trialability, top management support, IT skills, ROI and asset specificity had a direct and significant effect on the adoption of cloud computing while IT policy, IT infrastructure, cloud knowledge, security, complexity and uncertainty had no direct and significant effect. The qualitative data largely confirmed these findings but shed further light on cloud adoption and suggested that other factors such as trust, service quality, accessibility and ease of interaction also needed to be considered.

DECLARATION

This study is my own work and papers contained herein have been published, presented and submitted in the following forms.

Al Yami, M. and Schaefer, D., 2019, April. Fog computing as a complementary approach to cloud computing. In *2019 International Conference on Computer and Information Sciences (ICCIS)* (pp. 1-5). IEEE.

Signature: Mohammed Al Yami

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List of Abbreviations

ASP– Applications Service Provider

AVE–Average Variance Extracted

CA – Cronbach's Alpha

CR – Composite Reliability

CR–Critical Ratio

CRM –Customer Relationship Management

CSCC – Cloud Standard Customer Council

DOI–Diffusion of Innovation Theory

FVM–Fit Viability Model

GAE – Google App Engine

GATZA– Zakat& Tax

GoF–Goodness of Fit of SEM

HAM – Hosted Application Management

IaaS – Infrastructure as Service

IDC – International Data Corporation

IT – InformationTechnology

MCIT – Communications and Information Technology

MOI – Ministry of Interior

MOH–Ministry of Health

NCA – National Cybersecurity Authority

NIST - National Institute of Standards and Technology

NM–Najran Municipality

NU–Najran University

OP – Operating System

Oss – Operating systems

PaaS – Platform as a Service

PCs – Personal Computers

PLS–Partial Least Square

ROI – Return on Investment

SaaS– Software as a Service

SAW–Simple Adaptive Weighting

SEM – Structural Equation Modeling

SHPGC – Self-Hosted Private Government Cloud

SMS–Short Message Service

SR – Saudi Riyals

TAM–Technology Acceptance Model

TOE–Technology-Organisation-Environment

TTF – Task-Technology Fit

UNP – Unified National Portal

UTAUT– Unified Theory of Acceptance and Use of Technology

VM –Virtual Machines

VPN – Virtual Private Network

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Chapter 1 : Introduction

This chapter provides an introduction to the research by outlining the rationale for the study, the research aim, reseach questions and research objectives before briefly describing the structure of the thesis chapter by chapter.

1.1 Introduction to the Study

Several governments are currently looking for implementing e-government systems that reduce cost and enhance the quality of the government services. E-government refers to the use of Information and Communication Technologies (ICT's) to enhance the delivery of information and services to the citizenry, the business sector and the government sector (Jeong, 2006). In addition, (Guo, 2010) defines e-government as "a way for governments to use the most innovative information and communication technologies, particularly web-based Internet applications, to provide citizens and businesses with more convenient access to government information and services, to improve the quality of the services and to provide greater opportunities to participate in democratic institutions and processes. "Through the use of ICT, public organizations are able to improve their performance more effectively and efficiently (Ali et al, 2014). Governments are thus able to make use of emerging technologies to offer these fully customised e-services. Cloud computing is one of the new technologies that can create and deliver cost-effective, user-centred public services; and it may revolutionize e-government implementation in the matter of actual and professional use of resources as well as cost-saving (Alshomrani & Qamar, 2013; Bansal, Sharma & Sood, 2012; Nasr & Galal-Edeen, 2012).

Cureton, (2009), defines cloud computing as "a paradigm in which information is permanently stored in servers on the Internet and cached temporarily on clients that include desktops, entertainment centres, computers, notebooks, wall computers and handhelds". The U.S. National Institute of Standards and Technology (NIST) also defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of services (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". Cloud computing has already revolutionised the way technology is used by individuals and

organisations in other sectors, and established high efficiency in terms of scalability and availability (Tripathi & Parihar, 2011). The key characteristics of cloud computing make it fit with e-government services requirements, see figure 1.1. Moreover, due to its advantages, many governments are applying cloud computing for providing e-services (Bansal, Sharma & Sood, 2012). By using cloud services, organizations are seeking to control and disseminate their information, enhance IT infrastructure and reduce the cost. The Cloud is giving governments the opportunity to customize and improve their e-services (Fethey & Othman, 2015). There are several examples of this, one such being the US federal government information portal (USA.gov) which adopted the Cloud to deal with long downtime, delays, massive network traffic loads and the resulting inefficient services. As a result, their downtime went down 99.9%, and site upgrade time reduced from 9 months to a single day with savings of 72% per annum.

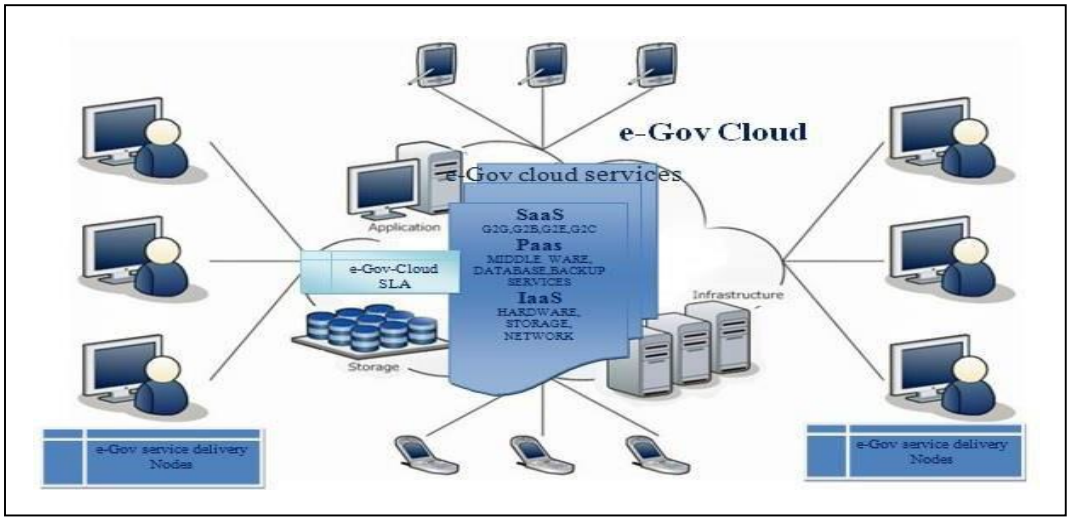

Figure 1.1: E-gov cloud using cloud infrastructure (Dash and Pani, 2016)

In 2010, Saudi Arabia was spending about SR (Saudi Riyals) 27 billion on IT and this grew by 10.2 % in 2011. In 2015, there was also a strong growth rate which increased to 11.4%. This strong growth was because of the increased expenditure on hardware and IT services, which took IT costs to SR 46.3 billion in 2015 (Communication and Information Technology Commission (CITC), 2015). According to the CITC, total IT expenditure in Saudi Arabia was SAR 111.98 billion in 2014. Based on this report forecast, Cloud solutions represent the strongest spending from 2012-2017 in the kingdom.

Many developing countries are facing issues in operating e-government services, such as the absence of basic IT infrastructures and knowledgeable staff, and the lack of financial resources (Rana, Dwivedi & Williams, 2013; Al-Rashidi, 2013; Bwalaya & Mutala, 2015, Al-Wazir & Zheng, 2012). These countries are still at the early stage of developing e-government systems; and, as they have made a huge effort to launch these systems, they may benefit by considering the opportunities offered by cloud computing.

Saudi Arabia is considered to be a technologically developing country (Saleh, Prakash & Manton, 2014); thus, cloud computing adoption in Saudi Arabia is presumed slow compared to the developed countries (Alkhater, Walters & Wills, 2014). One study conducted a survey to investigate the awareness of managers and employees regarding cloud computing; and the results showed that cloud computing is a new direction in Saudi's organizations (Yamin, 2013) . Since then, several other studies have addressed the issue, largely in other contexts, but these have left knowledge gaps that this study aims to fill (see Chapter 2, Section 2.4).

1.2 Research Background and Problem

Governments across the world are increasingly considering cloud computing services to improve the delivery of public services, reduce costs and achieve better data control and fast scalability (Alsahli & Al-Sabri, 2013). According to a report by the United Nations, cloud computing can help governments improve the efficiency of their operations, reduce costs and improve citizen access to public services (United Nations, 2014). Many countries are using Information and Communication Technology (ICT) in the form of e-government to facilitate the delivery of government services, improve efficiency and transparency, and promote citizen participation (Basamh, Qudaih & Suhaimi, 2014). Moreover, the adoption of cloud computing is part of a broader trend toward using information and communication technology (ICT) to transform public sector functions, resulting in more effective, efficient, and reliable services for citizens (Davies, 2005; Hashem et al., 2015). Again, this transformation is not without its challenges, including concerns about data privacy, security and regulatory compliance (Hsiao et al., 2018; Islam et al., 2020). As governments continue to embrace the potential of cloud computing, it is crucial to address these issues proactively to ensure the success of this transformative technology in the public sector.

Further, governments worldwide are implementing various programs to implement e-government strategies to provide citizens with better, seamless and simple services (Al-Sabti, 2007). In addition, several other countries have implemented similar programs to improve e-government services, including the United Arab Emirates (UAE) and Malaysia. For example, the UAE government launched their 'mGovernment' initiative to provide citizens with access to government services via their smartphones and other mobile devices (Alameri et al., 2016). Similarly, the Malaysian government has implemented the 'MyGovernment' initiative to provide citizens with online access to government services (Chowdhury & Marthandan, 2016). These programs reflect the global trend toward the use of cloud computing to enhance public sector services, and they demonstrate the potential for e-government to improve the delivery of public services, reduce costs, save time and deliver efficient e-services across all public entities. To achieve this goal, many countries have launched various e-government programs and strategies. One such example is Saudi Arabia's 'Yesser' program, which showcases the government's interest in adopting the concept of e-government (Ministry of Communications and Technology, 2006). *Yesser* serves as a controller and facilitator, combining all public sectors into one platform. The primary goal of this program is to improve public organization productivity and deliver services to citizens in a better, seamless and simple way (Al-Sabti, 2007). Figure 1.2 below depicts the principles and role of the *Yesser* program.

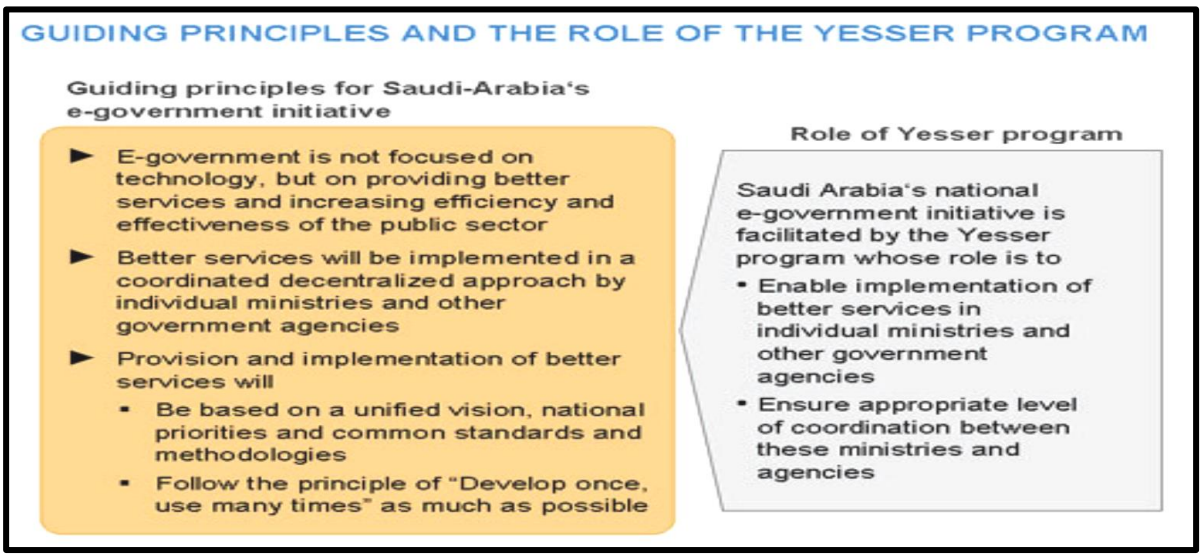

Figure 1.2: Guiding Principles and the role of the *Yesser* program (Saudi Ministry of Communications and Technology, 2006)

Hence, many countries are moving towards digitization and modernization of their public services to improve efficiency and reduce costs. In many countries, Information and Communication Technology (ICT) is being used in the form of e-government to help deliver government services (Basamh, Qudaih & Suhaimi, 2014). In line with this trend, Saudi Arabia has set a goal to establish a digitalized e-government system as part of its Vision 2030 initiative. This shift has led to the delivery of more effective, efficient, and reliable services to citizens. Cloud computing is a technology that has the potential to support the realization of this goal by providing scalable, flexible and cost-effective solutions for delivering public services (Alfayad & Abbott-Halpin, 2017). Storing data in the Cloud may also be the solution to some of the issues encountered by e-government.

Digital government systems are not without their difficulties, one such being that the different systems are not always easily interoperable. Lack of interconnectedness between systems, is not a problem unique to any specific country, as every country in both Europe and Asia has faced similar challenges. For instance, in 2019, Estonia faced challenges in the interoperability of their e-government systems, which led to delays in delivering public services (Aaviksoo, 2019). Similarly, in South Korea, despite significant investments in e-government infrastructure, interdepartmental data sharing has been difficult due to issues with data standardization and system integration (Lee & Song, 2018). These examples highlight the importance of addressing interoperability challenges in e-government systems to provide efficient and effective public services. Interoperability problems in digital government systems could be solved by cloud computing. However, according to a study conducted on the current state of cloud computing in several Saudi government ministries by Al-Ruithe, Benkhelifa and Hameed (2017) 54.37 % of the ministries had not yet adopted cloud computing within their environment, 16.50 % were not aware of the cloud and 19.13% stated that they had adopted the cloud services.

Further, according to Alfayad and Abbott-Halpin, (2017), a report conducted by *Yesser* across several government organizations found that one of the main obstacles revolved around the infrastructure and also with implementing technology best suited to this infrastructure. According to Awad et al, (2021), there are still issues with the *Yesser* program`s security policy due to the lack of professionalism, which has been identified as a key vulnerability. Hence, Saudi e-government systems need more development compared to the US and the UK's e-

government systems (Khan, Alsahli & Alsabri, 2013). However, a report conducted by the United Nations on world e-government systems in 2020 showed that Saudi Arabia's position had improved, and it ranked 43rd in the world (See Table 1.1).

Table 1.1: Saudi E-Government System: World Ranking (United Nations, 2021)

Country	Rating class	EGDI Rank	Sub-Region	OSI value	HCI value	TII Value	EGDI (2020)	EGDI (2018)
United Arab Emirates	V3	21	Western Asia	0.9000	0.7320	0.9344	0.8555	0.8295
Bahrain	V2	38	Western Asia	0.7882	0.8439	0.8319	0.8213	0.8116
Saudi Arabia*	V2	43	Western Asia	0.6882	0.8648	0.8442	0.7991	0.7119
Kuwait*	V1	46	Western Asia	0.8412	0.7470	0.7858	0.7913	0.7388
Oman*	V1	50	Western Asia	0.8529	0.7751	0.6967	0.7749	0.6846
Qatar	HV	66	Western Asia	0.6588	0.6698	0.8233	0.7173	0.7132

The evolving nature of cloud computing technology also poses a challenge to its adoption in the region (Noor, 2016). Additionally, the lack of interconnectedness between e-government systems has led to Saudi Arabia being ranked 52nd in the world e-government rankings (Al-Mudawi, 2021). Similarly, according to a study by the United Nations Department of Economic and Social Affairs (UNDESA), India's e-government systems had struggled with interoperability and data sharing between different government departments and agencies, leading to inefficiencies and delays in accessing public services (UNDESA, 2020). However, the Indian government has shared its plan for digital transformation with 9.5 million participants (UNDESA, 2022). Also, World Bank reported that the lack of interoperability between different e-government systems has been a major challenge in Nigeria, hindering the country's progress in improving access to public services and sharing data across departments and agencies (World Bank, 2019). Despite these challenges, there is a growing demand for cloud computing among IT policy makers in Saudi Arabia (US Dept of Commerce, 2019). This demand is not exceptional to Saudi Arabia, as many countries across Europe and Asia are also recognizing the potential benefits of cloud computing for their public sector organizations (Srinivasan & Dey, 2019; Liao & Chen, 2018).

Furthermore, according to a study conducted by Bautista et al (2018) in Indonesia, the government's investment in IT infrastructure has been a major challenge in implementing e-government services. They found that there was a lack of funds allocated for the development of e-government, and a lack of coordination between the government and the private sector in terms of infrastructure development. Similarly, in Malaysia, the government has faced

challenges in developing a robust IT infrastructure to support e-government services due to a lack of funds and skilled personnel (Nasir et al., 2016). Moreover, a study by Karakostas and Giovanis (2019) in Greece found that government organizations face resource constraints when implementing e-government services. They found that IT budgets are often inadequate to support the development and maintenance of e-government systems, and that government IT staff are often overworked and lack the necessary skills to implement and manage e-government services. Another major issue encountered by several countries, including Saudi Arabia, is the huge amount of money that has to be invested in order to build and improve IT infrastructure. Furthermore, government organizations consume far more resources than are needed (Albelaihi and Khan, 2020). To overcome such challenges and implement a high-quality government system, the Saudi government needs to adopt recent technological innovation, such as cloud computing. Also, a report conducted by *Yesser*, on e-government transition to examine the Saudi government organizations transition rate, showed that 119 of these organizations had implemented a complete e-government system while 11 had partially implemented e-government systems and 77 had implemented only the basic services of government systems.

These challenges can result in delays and limitations in the delivery of government services. To improve the government system and overcome challenges faced by government organizations, the adoption of recent technological innovations is imperative. For instance, the use of cloud computing can be beneficial in enhancing the efficiency and effectiveness of government services. A report by the European Commission (2019) highlighted the potential of cloud computing in improving the performance of public services in Europe. In Asia, a study by Zhang et al. (2017) revealed that cloud computing has the potential to improve the quality of government services and reduce operational costs. Furthermore, a report by the National Institute of Standards and Technology (NIST, 2011) highlighted the benefits of cloud computing in terms of scalability, cost-effectiveness, and flexibility.

In the context of government organizations, the adoption of cloud computing is still in its infancy in many countries. For example, a study conducted in the United States by the Government Accountability Office (GAO, 2019) found that the adoption of cloud computing by the federal government was still limited. Similarly, in Australia, a study by the Australian National Audit Office (ANAO, 2018) found that while some government organizations had started adopting cloud computing, others were still in the early stages of planning. Therefore,

it is arguably crucial for any government to consider embracing cloud computing and integrating it into their e-government system. This can lead to significant improvements in the quality and efficiency of government services. A study by Alshuwaikhat and Alalwan (2021) demonstrated the positive impact of cloud computing on the performance of government organizations in the Gulf Cooperation Council (GCC) countries, including Saudi Arabia. Additionally, the adoption of cloud computing can contribute to cost savings and environmental sustainability, as highlighted by a report by the Carbon Disclosure Project (CDP, 2019).

Based on these challenges and gaps, this research is developed to investigate the main factors that might affect the fitness and viability of cloud computing adoption in public organizations to help improve e-government performance and services. Moreover, the suitability of cloud computing for public organization, along with a strategy to find the best cloud model for these organizations are also discussed in this research. By conducting such research, the current systems can be assisted to improve. Through considering the factors affecting cloud adoption along with measuring cloud computing applicability, government organizations will be able to successfully implement e-government systems in place and overcome many challenges related to the e-government implementation overall. Additionally, a consideration of the factors affecting cloud computing adoption in many organizations, is needed for decision-makers to make correct decisions about providing effective public services. Studies that have touched on this important area are reviewed in Chapter 2, section 2.5 where the main findings and the gaps are outlined (Alhassan et al., 2020).

Further, this study will fill an existing research gap through determining the factors affecting cloud computing and assessing cloud suitability from both upper management and IT administration perspectives (Haddad et al., 2021). There is a clear lack of studies investigating cloud computing adoption and applicability from the points of view of upper management and IT administration. Hence, creating a framework that promotes the adoption of e-government systems and outlines a strategy for evaluating the appropriateness of cloud computing and determining the optimal cloud model would be a significant contribution (Haddad et al., 2021). In conclusion, the lack of comprehensive research on cloud computing adoption and suitability from both upper management and IT administration perspectives presents a significant challenge to organizations, including government institutions. Therefore, further research is necessary to develop a comprehensive framework that considers the factors to encourage cloud adoption and implementation.

1.3 Research Aims

As previously stated, Saudi Arabia is still in the early stages of cloud computing adoption particularly and in the implementation of e-government systems in general. Previous researchers have shown that public organizations in Saudi Arabia have not widely adopted or migrated to cloud computing. Hence, this research has the overarching aim: ***to investigate the impact of cloud computing required for the provision of e-government services in Saudi Arabia; and to propose a framework for exploring the factors that influence the fitness and viability of cloud computing in those public organisations***. Achieving this aim involves measuring the performance of cloud computing adoption in Saudi public organizations, along with identifying and proposing the most appropriate cloud model for these organizations in order to meet their organisational needs.

1.4 Research Questions

In order to achieve the study aims, the following research questions will be addressed:

1. What are the factors that influence the fitness and viability of cloud computing for e-government in public sector organizations?
2. Do these factors have a significant relationship with fitness and viability of cloud computing adoption?
3. Do cloud computing factors identified in question 1 influence the performance of cloud computing adoption in Saudi public organisations
4. Which cloud model do policy makers believe is the most appropriate for Saudi e-government?

1.4.1 Research Objectives

The research objectives can thus be expressed as:

- Explore the factors influencing the fitness and viability of cloud computing in public sector organizations.
- Examine the relationship between factors identified in objective 1 and the fitness and viability of cloud computing adoption.
- Examine the effect of cloud computing fitness and viability on the performance of public organizations in Saudi Arabia that have adopted cloud computing.

- Identify what cloud models could be appropriate for Saudi e-government.

1.5 Initial Research Contributions

- ***Theoretical Contribution***

Accepting or integrating a new technology may have some risks. Therefore, the proper decision to accept or reject a new technology is a very important priority for an organization. As a result, this study contributes significantly to the knowledge in the field by proposing a theoretical framework that will help policy makers to identify the factors affecting cloud computing adoption prior to making a decision about whether to accept the technology or reject it. In addition, previous research was mostly focusing e-government acceptance from the citizens point of view only whereas the upper management point of view is included in this research as well.

- ***Practical Contribution***

This study also contributes significantly by suggesting a two-dimensional (fitness and viability) matrix that can guide the decision-makers in predicting the applicability of cloud computing adoption in their organizations. In other words, this matrix can be used as a roadmap for these organizations to evaluate whether their cloud computing is performing successfully and what needs to be done to better improve the performance of the technology. The matrix can also be used to show organisations that intend to adopt how cloud computing would perform.

There was an obvious gap in literature in defining the most suitable cloud model especially as these cloud models have many similarities, so some organizations struggle to determine the best cloud model that suits their requirements. Consequently, this study contributes to literature by helping decision makers to determine the most appropriate cloud model for their organisation's needs.

The overall contribution of this research will be of great help in enhancing the e-government services in the Saudi government's systems. By deeply understanding the factors that influence adoption, the performance of the adopted technology and the most optimal cloud model, an organization is more likely to provide a better service delivery in a timely and seamless manner. Performance efficiency and reliability will be increased, which consequently will lead to a better work productivity in the e-government systems.

1.6 Thesis Structure

This thesis has been written in 8 chapters explained as follows:

Chapter 1 presents an introduction about the research study, problem, aim, objectives, and briefly discusses the current state of cloud computing and e-government implementation in Saudi Arabia focusing on public organizations. In chapters 2 and 3, a comprehensive review of previous studies that discussed cloud computing adoption has been presented together with a detailed explanation of how the initial research model was developed. Chapter 4 discusses research methods in details and presents a justification of the selected approaches. Further, Chapter 5 presents the analysis of qualitative data and its outcomes while Chapter 6 presents the findings of the quantitative data analysis. Chapter 7 explains the research findings. Chapter 8 discusses the conclusion, research contribution and the recommendations for future work.

1.7 Chapter summary

This chapter has shown a brief background of cloud computing and e-government context and outlined the relationship among these two concepts. Further, this chapter provides details related the research problem and its motivation. This chapter also includes the research aim, objectives and contribution. Finally, this chapter outlines the structure of this researcher.

Chapter 2 : Background of the Research

Chapter 2: Introduction

This chapter address two fundamental aspects of the background to the research. Firstly, an overview is provided of the Cloud in terms its history, deployment and cloud computing service models (in particular those used for e-government); as well as its key characteristics, the need for implementation and its advantages and disadvantages. Prior studies on cloud computing adoption are critically assessed in order to identify the knowledge gaps. Secondly, the e-services currently provided by the Saudi government are described. Thirdly, this chapter provides details of e-government implementation, along with type of interactions of e-government. It also sheds light on the implementation of e-government in the Saudi context by further explaining the extent to which the Saudi government has implemented e-government, and how far is it now from its plans and those described in the Saudi Vision 2030. The conceptual links between cloud computing and e-government are also outlined.

2.1 Understanding Cloud Computing

Twelve years ago, introducing cloud computing became an area of significance for both academics and technicians (Baker et al, 2007). Today, cloud computing has its focus on the value derived from the consumer through administrating IT infrastructure that is done by an internet access provider (Federico, 2009). The initial stage in cloud computing helps in controlling IT assets such as introducing equipment to automated environments where facilities involved in computing are stored. the generation of virtual resources (Boss et al. 2007); and network presentation, among other technological revolutions (Armbrust et al., 2019).

The inception of cloud computing began in the 1960s with John McCarthy's ideas about mainframe time-sharing (Srinivasan, 2014). In 2007, the concept of cloud computing started to become popular and attracted more attention; and in 2008, the first paper about 'cloud computing' was published; and such publications and proposals made Google come up with the term 'Cloud' (Srinivasan, 2014). Prior to the emergence of cloud computing, the usage of servers was relatively low; however, due to the Internet availability, the notion of virtual servers started and was offered via cloud computing (Srinivasan, 2014). The rate of using servers started to increase due to the multiple Virtual Machines (VM) that were proposed at that time (Srinivasan, 2014).

Dominant companies such as Amazon, Google and Microsoft started to take advantage of cloud potentiality to offer their services to consumers. Such services include Google applications, Microsoft 365, and Windows Azure (Srinivasan, 2014).

Today, cloud computing can offer many advantages to users through the utilization of other emerging technologies (El Mhouti et al, 2018). Basically, via cloud computing users can have the potentiality to pay only for the services that they access to and they no longer need to pay huge amount of money for building IT infrastructure or fixing it. In other words, they can only access to services and applications according the requirements they set with the third party. This paradigm has come to be known as 'cloud computing' (Srinivasan, 2014).

Cloud computing allows consumers to utilize a third-party infrastructure, platform or applications as services offered in a pay-as-consume scheme. Cloud computing has been defined in the literature in many ways. For instance, the Berkeley Report, (2009) hails cloud computing as:

"Cloud computing, the long-held dream of computing as a utility has the potential to transform a large part of the IT industry, making software even more attractive as a service."

Cloud computing has been ranked among the latest technologies that serve in facilitating and offering services running on the internet (as shown in Figure 2.1). Cloud computing can be offered by a third party (services provider). Services can include Software as a Service (SaaS), Platform as a Service (PaaS)and Infrastructure as a Service (IaaS) (Kapil et al, 2017). Cloud computing is defined by NIST (National Institute of Standards and Technology) as

"Cloud computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, server, storage, application and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". (Mell and Grance, 2011, 145)

Moreover, cloud computing has been defined by Buyya et al. (2008)

"A type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements".

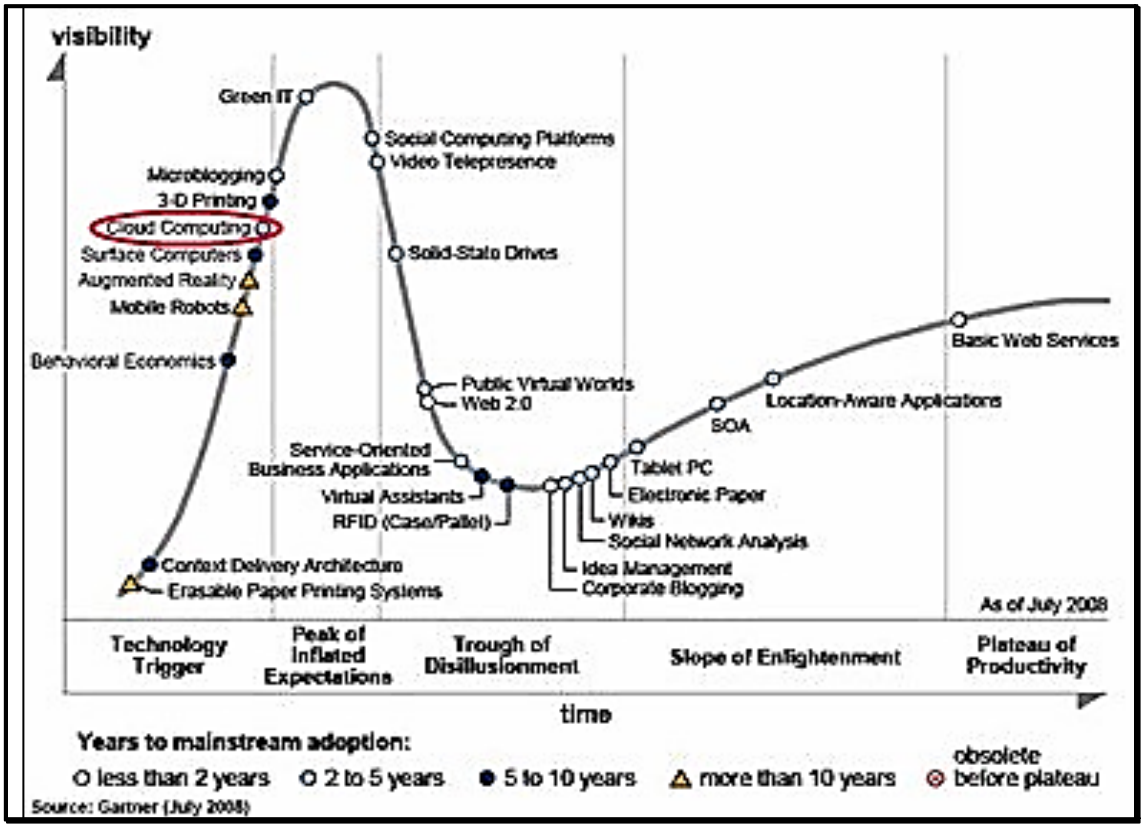

Figure 2 .1: Cloud computing growth among other technologies; (Source: Gartner, 2009)

The primary purpose of cloud computing is that it transfers data centres and physical equipment (servers, PCs, applications, databases, etc) from specific locations and makes them available virtually so that users can access them anytime and anywhere (Qian et al, 2009). Furthermore, several market researchers have reported the huge investment on cloud computing and its services. Worldwide end-user spending on public cloud services is forecast to grow 20.4% in 2022 to total $494.7 billion, up from $410.9 billion in 2021, according to the latest forecast from Gartner, Inc. In 2023, end-user spending is expected to reach nearly $600 billion (Gartner, 2022).

2.1.1 Cloud Computing Deployment Models

Cloud computing was intended to promote competition and increase the level of productivity in organizations. Various cloud computing models have been developed as a result of its popularity. These types of models are dependent on various outsourcing requirements. The first model of cloud computing enables the accessibility of cloud facilities to organizations or persons that share a common interest. These organizations and persons are allowed to access applications and databases from an ordinary location. The other model involves an organization and its workers where the workers access applications and databases owned by the organization. The devices allowed access to a private organization's applications and the datacentres are within the organization or outside the organization's premises. Besides, such devices can be under the organization's management or managed by a third party. The National Institute of Standards and Technology (NIST) gives four deployment designs derived from different needs of firms. The designs include private, public, society and hybrid clouds (Mell & Grance, 2011).

2.1.1.1 Public Cloud

In a public cloud also known as an ‘external cloud’, computing resources are available and can be used by public over the internet (Furht and Escalante, 2010). Applications and services are stored on third-party equipment. The public cloud is built for public usage in a pay-as-you-go manner (Lewis, 2010). However, despite the considerable benefits gained through using the public cloud, there are some drawbacks. Mostly, security and privacy are the major issues of public cloud in terms of data storage, management and accessibility (Veruscorp, 2013). The most common public providers are Amazon and Google (Kapil et al, 2017) Microsoft (Mather et al, 2009) and examples of public cloud include Salesforce.com, Microsoft BPOS, and Microsoft Office 365 (Goyal, 2014).

2.1.1.2 Private Cloud

According to Furht and Escalante, (2010), the private cloud, also known as the ‘internal cloud’ refers to computing resources that are running in a private network. Users can have complete control over the data and security in the private cloud. A private cloud can be developed by either an organization owning a self-data centre or by third-party devices; additionally, a private cloud can be built just for a single organization (Mell and Grance, 2011). In private cloud, only the individual members of the organization, or whoever is given permission, can

access the cloud infrastructure (Hamrén, 2012). The cloud infrastructure is more protected and cost-effective in a private cloud than in the public cloud. A report posted by the Aberdeen group states that users running a private cloud can save about 12% more than those operating a public cloud. However, a private cloud is still relatively expensive in terms of purchasing physical devices, hiring staff and software upgrade and licensing (Goyal, 2014).

2.1.1.3 Hybrid Cloud

A hybrid cloud is combination of two or more clouds (private, community or public). It is known for its complexity due to the many parties involved (Jansen and Grance, 2011). A hybrid cloud consists of a minimum of one private cloud and a minimum of one public cloud. Partnership in hybrid cloud can be done in two ways. One is that a third party has a private cloud and shares it with another vendor who has a public cloud or alternatively a vendor has a public cloud and needs to partner another supplier who owns a private cloud (Tec target, 2013). Moreover, some of the resources can be managed by one of the parties on primes while the other outsources the primes (Sarna, 2011). In a hybrid cloud, both parties can share many advantages. The hybrid cloud allows the cost and scalability benefits of a public cloud and offers the secure environment of a private cloud (Emma, 2013).

2.1.1.4 Community Cloud

A community cloud can be in between a private and a public cloud when it comes to consumers. It can be seen as a private cloud but it enables more computing resources to users that have equally the same security, regulations and privacy (Jansen and Grance, 2011). One of the advantages that can be offered in the community cloud is that community cloud management can be given to a third provider. However, it is more expensive than a public cloud and bandwidth usage can be charged equally for all members (Goyal, 2014).

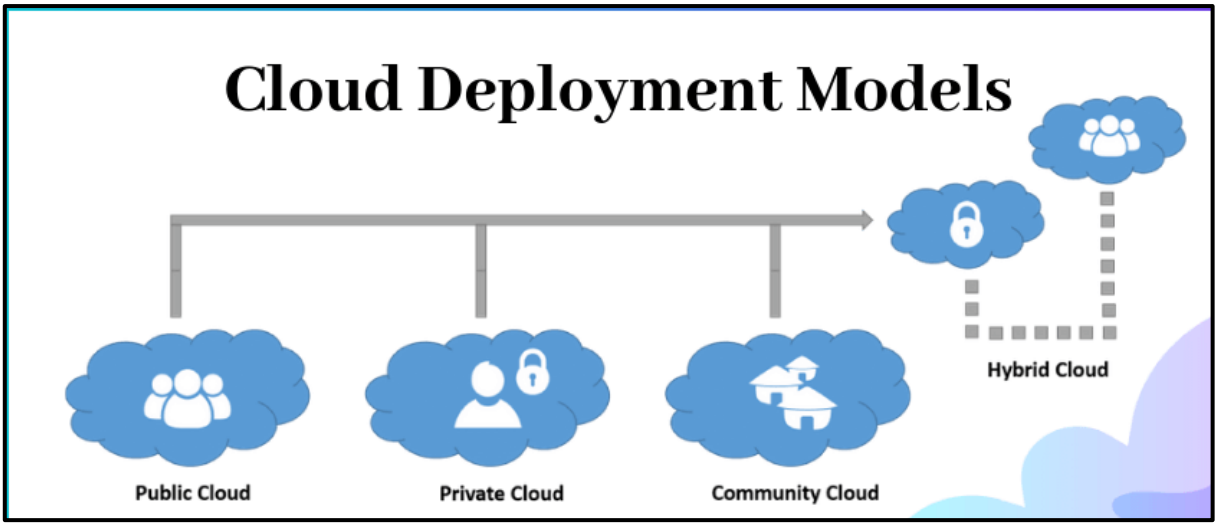

Figure 2.2: Cloud Computing Deployment Models (Source: Rountree and Castrillo, 2013)

2.1.2 Cloud Computing Service Model

The cloud computing model also includes cloud service modes. The major designs of cloud-based services are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). SaaS allows users to utilize software services via the web. The applications are made available by providers with the use of cloud infrastructure to run such applications. This removes the requirement by consumers to install and run applications on their personal computers. Consumers access the services offered by applications from consumer interface such as web browsers. Two good examples of this are Gmail and Hotmail. The suppliers manage the cloud framework while users utilize the available applications (Mell and Grance, 2011). The cloud infrastructure includes virtual devices and components such as personal computers (PCs), servers, memories and operating systems (OSs) among others.

Moreover, Software as a Service is the most usable service among cloud computing services. Typically, there are two different types of SaaS including Applications Service Provider (ASP) and Hosted Application Management (HAM). In the ASP type, consumers are offered the service to use without taking care of its management and maintenance. The management and maintenance are taken care of by the provider while the consumers pay for the applications that they use. However, the concept of HAM is somewhat similar to ASP but the HAM is built and made available over the internet for consumers to use. An advantage of HAM is that end users using an application belonging to a particular customer, can all utilize the same application and have the same management for that application (Srinivasan, 2014). In SaaS, service providers

are responsible for controlling and running applications and other computing resources and display them to consumer in the form of web-based applications. The most common examples of SaaS include Google douc, Gmail, etc., (Youssef, 2012).

The PaaS design avails podiums for computing services. The consumer can deploy the cloud infrastructure applications created from programming languages and other provisions owned by the providers. Here, the consumer has ownership over the installed application and the configuration settings for the application, while the providers control and manage the cloud infrastructure (Mell and Grance, 2011). This allows the consumer to deploy applications eliminating the expenses incurred in the purchase and management of the components and software stratum.

Furthermore, the primary aim of Platform as a Service (PaaS) is establishing the connection among the IaaS and SaaS. Web-based apps can be implemented and tested through a proposed platform provided by a third party (Khot, 2014). According to the Cloud Standards Customer Council (CSCC) the proposed platforms include sophisticated tools that can develop, implement and run customer applications. These tools include a platform of applications, a platform of integrations, analytical platforms and back-end mobile services. The common examples being used currently are Google App Engine (GAE) (Sandersin, 2012) Windows Azure (Brunetti, 2011) and Cloud Foundry (Pastore et al, 2013).

The final model in cloud computing service models is the IaaS model; where consumers can access vital resources involved in computing such as networks, processing and memories for storage. Consumers can also install and run software which can be application software or operating system software. The consumer has control over the fit and running of applications, memories and the operating system. However, the providers manage and control the cloud infrastructure, making the users have limited control (Mell and Grance, 2011). Providers also control the components involved in networking such as host firewalls.

Addtionally, this type can be also known as Hardware as a Service (HaaS) (Khot, 2014). In IaaS, virtualized infrastructures are offered for consumer to use. Instead of having an infrastructure set on primes, customers can rent resources on a pay-as-you-go model. Customers can only pay for what they use and rent as many instances as they want. Some cases,

service providers are required by consumers to connect these instances to their local network via Virtual Private Network (VPN) which is known as “hybrid cloud” (Nair and Nair, 2016). Moreover, storage and backups services can be offered through IaaS in a pay-as-you-consume way (Höfer and Karagiannis, 2011). Other computing resources such as network, bandwidth, and processing power can all be offered in a virtualized environment to consumer so they can release them anytime they want. The common examples of IaaS include Drop Box, Amazon EC2 and Akamai (Youssef. 2012).

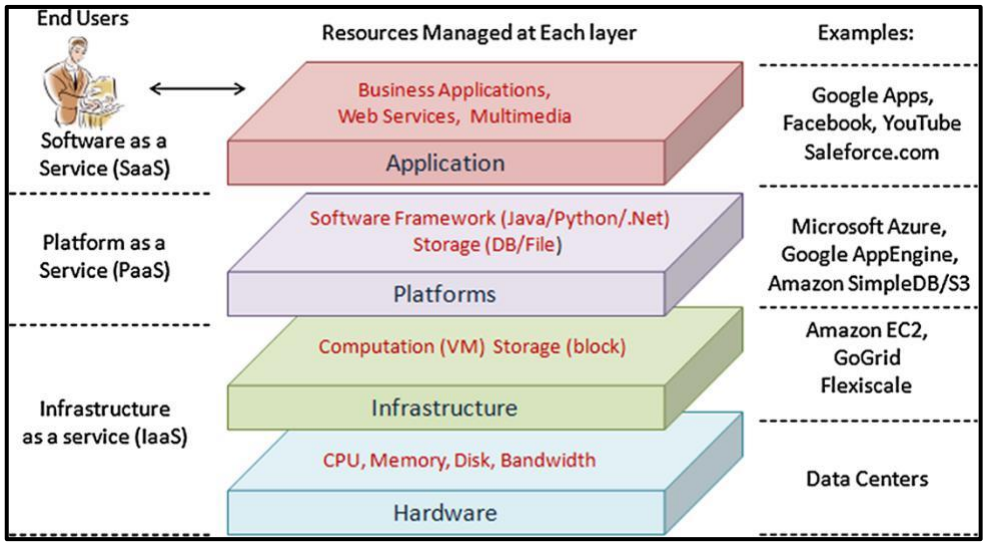

Figure 2.3: Three Cloud services layers, (Source: Höfer and Karagiannis, 2011)

2.1.3 Cloud Computing Government Models

Different problems require specific solutions that can provide answers to the different issues defined. Government organizations derive solutions using a collection of various computing solutions. The services offered by private clouding and public computing include a series of acceptable perils and imminent dangers (Amini et al, 2013). The government incorporates conventional models in the management of cloud computing. A public government cloud can be considered a facility since it uses a public cloud available in cloud computing (Liang , 2012). Offers provided by cloud computing form their ground from the possible answers provided by vendors, services that are offered by datacentres and technologies owned by the sellers. A public government cloud is a simple way for governments to participate in cloud computing (Alexander, 2011). However, when considering aspects such as safety, control and secrecy, this cloud computing model is not recommended. The above-stated model is highly

recommended in instances where there are vast amounts of work and assignments, and where the presence of secured information is not required. It is also useful in cases where some tasks need data processing power (Chen and Zhao, 2012).

Public clouds owned by the government are similar to what is offered to the public by sellers in terms of what is being offered. A public government cloud eliminates the demands for administration, system functioning and the need for Information Technology venture, leading to a reduction in the standard rate of proprietorship. Moreover, users who lack resources or access to a committed PC need these services to be obtained for them.This alternative is of help to consumers who don't take advantage of expensive client-related applications (Zwattendorfer and Tauber, 2013).

From the procurable seller solutions, where services are anchored in the technologies and sellers' datacentres, a private government cloud introduces the ability to access cloud computing. Moreover, for a country to make use of a datacentre facility, it requires datacentres based within the country because of safety and secrecy difficulties (Paladi and Michalas, 2014). The establishment of a committed cloud computing founded on the vendor is quite expensive. Such an alternative may not be considered, despite its similarity to private clouds owned by the government.

A self-hosted private government cloud (SHPGC) defines a podium in which a government body exclusively moderates particular government datacentres. The substitutes and replacements for the hosting government datacentre are restricted for technical reasons. The government has an alternative to enhance its datacentres through the use of an SHGPC. Also, the government can provide cloud services found within the government's corporate services and manage them (Mutavdžić, 2010). The value proposition of an SHGPC gets considered as an enhancement to the corporate government services and cost allowance of datacenters (Aleksandar et al, 2014). Governments usually put in efforts to ensure effective utilization of cloud computing through better control, data supremacy and safety. Such offers get presented in a manner such that they do not interfere with the extent of investments in tangible licenses and frameworks (Liang , 2012). Out of numerous points of view, which involve several essential government bodies, cloud computing has shown significance for development.

An SHGPC is a personal cloud that can provide secrecy and safety or sovereignty of data for a nation; it is also a platform which is useful when the bandwidth involved among nations is not enough when running and maintaining the personal cloud to other nations (Molnar and Schechter, 2010). Further, because of its complicated form, there is a different way which involves a third party within a country to run and maintain a private cloud (Mutavdžić, 2010). Around the world, the significance of cloud computing is evident in most of the public bodies. In areas with broader economies, the government participates significantly in the development of cloud computing (James et al, 2009). It is essential to see how governments use cloud computing for non-military purposes.

2.1.4 Key Characteristics of Cloud Computing

Computing via the cloud is dynamic and has introduced changes in the IT field. It has provided solutions to numerous existing problems. Cloud computing has features that differentiate it from other methods of computing (George, 2009). One of these features is independence, which arises from the location. The users are not able to control the position of their providers although they have information on where the providers are located. This is the main reason for the freedom of place to the consumer.

Scalability is also an aspect of computing using the Cloud; this characteristic enables executing workloads with diverse requirements of servers over a short period at a reduced cost (Cáceres et al, 2010). Scaling can be done through inclusion or elimination at intersections along with servers out of a network; although the variations that can be included in the infrastructure are limited, the changes made on the design can be on the same or at different levels, depending on the demand requirements of the architecture; and the technical needs can be manipulated by either increasing or decreasing them to meet the specific standards in cloud computing (Falatah and Batarfi, 2014).For instance, those who deliver cloud computing services authorize the user to control the demands of new IT resources to allow for incorporation of other business demands (Rob, 2012).

Another significant aspect of the cloud is reliability. The cloud should provide services to ensure continued business proceedings even in extreme conditions (Bauer and Adams, 2012). Reliability is determined by the duration of time when the services are available or the duration when there is no service (George, 2009). Reliability as a characteristic is desirable to

institutions that mostly rely on the quick responses from cloud computing; it is therefore crucial in determining the success of cloud computing (Vishwanath and Nagappan, 2010). Consumers should be able to use cloud resources in the absence of human cooperation. The nature and amount of service required should determine whether the scaling should be horizontal or vertical (Rob, 2012). Cloud computing should be elastic to allow for scaling depending on the service requirements. It should enable consumers to fulfill the goals of their businesses; and those who are using cloud computing should always have access to information at any location or instance in time(Herbst et al, 2013).

The execution of a cloud is comprehensive, despite the type of deployment model and involves proportionate savings obtained from increased production levels. Cloud execution benefits from the economies of scale, making it cost-efficient (Williams , 2012). Clouds are strategically positioned near sources of power such as power stations and buildings to help cut the costs; and researchers have established that financial and economic growth associated with cloud computing arises from the reduction of the capital expenses incurred (Kagadis et al, 2013). Cloud users can avoid incurring many costs in attempts to own computing equipment by having models which are elastic, capable of scaling, with advanced virtualization and where one only pays when they require the service (Zhang et al, 2010). The costs incurred in the deployment of a model can be said to be the expenses involved in operating and managing the cloud computing contract (David , 2009).

The use of better resources, more effective systems and nonpartisanship in carbon activity determine sustainability as a feature of cloud computing. The release of carbon in cloud computing is relatively low due to the low energy required in IT (Doyle et al, 2013). Some researchers have established that by the year 2020 servers at different locations will be able to restrict the emission of carbon to approximately 85.7 million tonnes (Jane et al, 2015). Studies have also have established that cloud-based computing saves energy expenses; and the reductions in energy requirements have an essential influence on the environment (Jane et al, 2015).

Access to a network is a significant feature in cloud computing. The availability of a system enables utilization of cloud computing through podiums such as portable personal computers, smartphones and palmtops; thus one obtains and retrieves facilities in the cloud through the use of various devices, not only via conventional devices such as iPad, laptops and personal

computers but also through accessories like phones (Yang and Huang, 2013). The ability to access and change the size of a network has increased due to the presence of large network bandwidth; and access to an extensive web has made cloud computing possible (Yang and Huang, 2013).

Finally, cloud computing has a feature referred to as 'abstracted infrastructure'. This is the aspect of cloud computing where the geographical position and the kind of server where an application is installed and run are not known (Bhardwaj et al, 2010). However, those delivering the services give the users information relevant in assessing the acceptable performance(David , 2009).

According to NIST, there are five vital features associated with cloud computing: First is on-demand self-service where the user can initiate any activity involving computing without amalgamation between the consumers and the service deliverers; and second is swift malleability, where, scaling is done automatically depending on demand and changes in cloud computing infrastructure are made quickly and imperceptibly (Mell and Grance, 2011). The third characteristic is that cloud computing services can be metered to allow for maximum use of resources; and metering enables the control, administration and management of services promoting honesty between the consumers and the vendors (Mell and Grance, 2011). Moreover, the last characteristic of cloud computing identified by NIST is resource pooling, whereby the resources are allocated depending on the different demands of distinct consumers. In addition, the user has the information on the general geographical location of the provider but cannot identify where the service deliverer is explicitly located (Mell and Grance, 2011).

2.1.5 Evaluation of the Need for the Adoption of Cloud Computing

There is a need for most organizations to have authority over the datacentres they own; and organizations also need to acquire infrastructure at a relatively low cost. To cater to these needs, organizations require computing technologies. Most of the finances spent on IT infrastructure were previously considered to be a capital expense; however, with the incorporation of cloud computing in business organizations, this cost has been categorized as a revenue expense (Nikolov, 2011). Cloud computing has little need for skilled personnel and labour, which is often limited and insufficient in its supply; therefore, this scarcity of skilled workforce renders cloud computing effective in instances where qualified staff and energy is required (Luftman

and Zadeh, 2011). Most of the schools and institutions of higher learning pay to have cloud computing services when the demand arises (Sultan, 2010).

Other factors such as environmental interests motivate the exploration of cloud computing. The expenses incurred in the acquisition of electricity and the cost incurred in the moderation of datacentres is estimated at fifty-three percent of total runing cost, which is a reasonable level (Zhang et al. 2010). Organizations that specialize in the delivery of computing services benefit from economies of scale from appliances, framework and software; and these organizations also enjoy the benefits of having a skilled workforce (Jain et al, 2013). During the establishment of enterprises, it is essential to consider locations that are near power stations and bodies that offer cooling services to reduce the expenses incurred in obtaining electricity and cooling services (Armbrust et al., 2010). Research has shown that organizations that build their infrastructure incur more costs. The assembly of cloud computing has been shown to have no effects on the environment (Armbrust et al., 2010). Most of the providers obtain their energy from sources that are friendly to the environment boosting the capacity of organizations in the protection of the surroundings (Cunitt et al , 2011). Over the years, there have been some conflicts arising from costs incurred in obtaining electricity and the services combined with it. For instance, according to Greenpeace combining the cost of power and cooling has made it difficult to determine the actual amount spend in catering for electricity consumption (Cristina, 2015).

The utilization of cloud computing has meant a reduction in the expenses for procuring the equipment required, the skilled labour and other IT expenses. Computing services providers have the responsibility to maintain and verify the credibility of software packages; and they also control information alternatives, modernization of systems and various functions as predetermined between the provider and consumer (Lawrence, 2011). The consumers pay to utilize the services they require from the suppliers, which helps in reducing the elementary installation costs (Androutselis and Spinellis, 2004). The technological needs of an institution determine the establishment of cloud computing services, where the suppliers have control and authority over the data from users. Cloud computing offers a podium that is cost-effective, reliable and possesses a high degree of efficiency; so this type of computing is useful in various organizations and sectors such as in the healthcare sector, government organizations and organizations dealing with finances (Ramakrishnan, 2012). Moreover, bodies dealing with the storage of data and business practices are currently utilizing cloud computing. However, there

are a few sectors that deal with secrecy and administration systems (Biddick, 2012). Applications that require more security do not incorporate the use of cloud computing when compared to applications that are information-oriented (Biddick , 2012).

2.1.6 The Advantages of Cloud Computing

Cloud computing has several benefits like the reduction of costs and security of data and privacy. However, the expenses incurred in cloud computing are dynamic; and different institutions have varying requirements for cloud computing, therefore, causing the difference in the costs incurred by various companies (Catteddu, 2009). Furthermore, bodies pay for computing services when they need them, hence reducing the perils associated with it. The utilization of the resources available in cloud computing is dependent on the needs of the user. Use of cloud-based technology is independent of the type of devices since consumers can access it from a range of accessories such as tablets, smartphones and laptops (Jackson, 2009). The service providers ensure they supply secure and effective services to their customers; and the provision of information on the processes involved to improve consumer understanding is also crucial (Houidi et al, 2011).

Another advantage associated with cloud computing is agile updating, which allows for the suppliers to automatically modernize the system during installation and running of application in the absence of free time (Yang, 2012). The possibility of achieving this arises from simple combinations and quick deployments. Also, cloud computing enables the utilization of facilities regardless of the current location at any instant assuring utmost security to the users (Ghazizadeh, 2012).

Efficiency of Cost plays a key role when using cloud computing. According to Viswanathan, (2014), cloud computing is the most cost-effective model to utilize. Comparing the traditional computing with the cloud demonstrates that cloud computing saves organizations a lot. In other words, there are many costly steps taken to manage, upgrade and maintain the traditional PCs; and traditional computing can also be more expensive in terms of licencing fees. However, computing resources can be offered much more cheaply by the cloud, as users pay only for the services that they use, which can save enterprises a lot of money (Pastore et al, 2013).

Cloud computing can offer Agility, as the on-demand approach can provide faster setup, i.e., users can start working on their projects as soon as they pay and their contracts can be terminated when their projects are finished (Rajan, 2013). In addition, cloud computing can offer scalable services, whereby users can scale up and down services according to their needs (Malathi, 2011). Furht and Escalante (2010) define cloud scalability as: *"the ability of a particular system to fit a problem as the scope of that problem increases (number of elements or objects, growing volumes of work and/or being susceptible to enlargement" (*Furht and Escalante, 233). Cloud computing can also be faster in terms of application development. Rather than buying dedicated servers and data centres to deploy and run applications, cloud computing can develop these facilities in cheaper and faster ways (Rajan, 2013). Software integration can be done automatically. In other words, end users don`t need to worry about the software customization as it can usually done by service providers (Pastore et al, 2013). Cloud computing can provide more availability of backup and recovery. In the cloud, the process of backup and recovery is much easier than performing it in the traditional devices (Bhuriya and Sharma, 2019).

2.1.7 The Disadvantages of Cloud Computing

There are demerits associated with cloud computing despite the numerous merits stated above (see Figure 2.4). Some of the problems of cloud computing include the maturity of the IT, durations when the servers are out of function and issues relating to performance (Yang, 2012).

Another major issue raised when deciding to adopt the cloud is virtualization. The main idea behind virtualization is that servers are created in one environment, and when a large of services and application are accommodated, problems can be caused in delivering a high-performance service (Dillon et al, 2010). Multi-tenancy has been defined as challenge in cloud computing; and multi-tenancy can result in two possible issues: resources sharing and having to share the same reputation (Dillon et al, 2010)

Giving authority to a third party to access data has some dangerous results. This can be evident in cases where digital data is lost or stolen. The leading cause of data loss and theft is the extensive use of social media and cloud computing by business corporations. The ownership of information has recently become an area of concern. Mostly, external parties control the deployed applications, leaving the consumers with little or no control over the hardware components and the software (Tsagklis, 2014).

A critical limitation of cloud computing is dependency on providers who deliver cloud-based services (Tsagklis, 2014). Changing providers to cloud-based services is challenging; and organizations with the desire to improve service suppliers undergo an exhausting task, which may involve transferring vast volumes of data to their new providers. Notably, consumers will have to choose their vendors carefully to avoid the need to change them in the future (Tsagklis, 2014). This makes the users dependent on the vendors.

Cloud computing also has disadvantages arising for technical reasons (Rad et al, 2017) (Miller, 1992). Such technical limitations are due to the requirement of a permanent connection to the internet at an unchanging speed. The security needs for the organization may not be met by exposing the company's digital data to theft and other factors leading to data loss (Jeffrey and Neidecker-Lutz, 2010). This may be caused by the absence of a suitable technology capable of meeting the organizations' demands. Cloud computing depends on the presence of an internet connection; and sometimes the internet connection may not be available, meaning that cloud-based services will be absent (Huth and Cebula, 2011). This is referred to as downtime, which is an indication of unreliable cloud computing. Most downtimes are due to interruption on the web connection at a specified location (Seshachala, 2010).

Further, security, trust and privacy were determined as another cloud issue (Kapil et al, 2017). When it comes the data sensitivity, cloud providers can be seen a threat. By nature, the structure of cloud computing is managed and owned by service vendors; in this case, trusting a third party over critical data is a key issue that all end users need to be careful about (Pearson and Benameur, 2010). In terms of data storage, storing data with a third party can be accounted as an issue as well. Having data stored locally is a requirement set by governments in some countries; however, there are various architectures proposed to host sensitive data such as Availability zones (Zhou et al, 2010). Availability zones is provided by Amazon which aims to provide an isolated environment to end users that ensures better latency of network, and less system failure (Mathew and Varia, 2014).

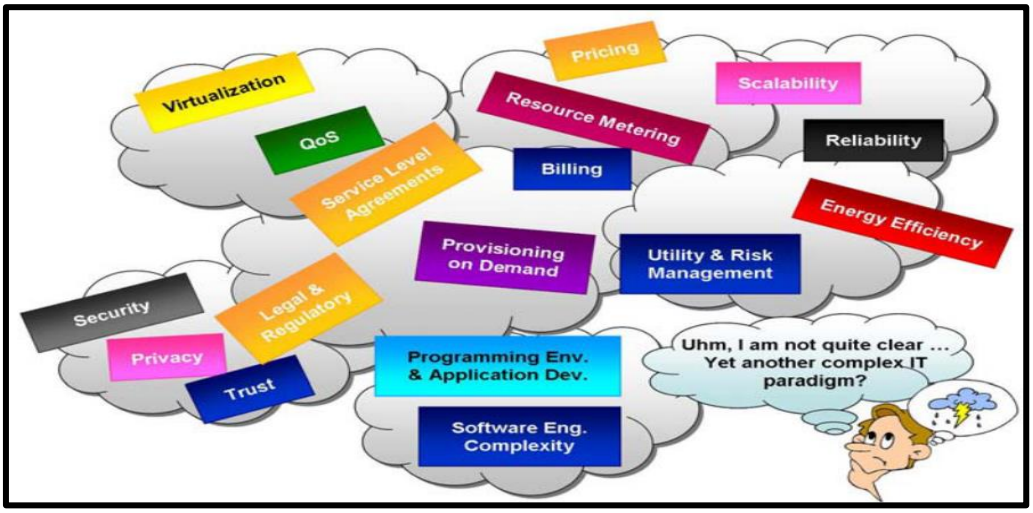

Figure 2.4: Major cloud computing barriers (Source: Kapil et al, 2017)

2.2 Cloud Computing and E-government

Recently, cloud computing has been integrated into e-government systems in several countries across the world. Cloud computing has many advantages that makes it an important asset to the use of government information and services by individuals and organizations. The advantages gained through cloud computing can include scalability, availability and accessibility, flexibility, reliability, cost reduction, pay-as-you-use, quality of service and system integration. Each of these advantages for e-government are discussed below.

2.2.1 Scalability

With its high scalability, cloud computing can be implemented and integrated into e-government systems relatively easily. One of the cloud computing benefits to e-government is that it allows the scaling up and down of computing resources, such as the central processing unit (CPU), servers, storage and hard drives (Alshahrani and Qamar, 2013). In addition, demand and load caused by citizens on e-govement systems requires a technology that can be easily scalable to meet the increasing numbers of citizen users and the resulting high load (Zhang and Chen, 2010). The ability of scaling up and down makes cloud computing an appropriate choice to be included in e-government systems in developed and developing countries (Almarabeh et al, 2016).

2.2.2 Availability and Accessibility

Availability is an important characteristic of cloud computing which makes it suitable for e-government systems. As stated, citizens are considered to be one of the main stakeholoders in the implelemntion of e-government systems, so intergrating a technlogy that caters for citizens' needs is siginficant (Alshahrani and Qamar, 2013). Currently, individuals want to have access to the government services and information 24/7 (Alshahrani and Qamar, 2013). With cloud computing, citziens and business can use applications and services at anytime and from anywhere (VijayKumar, 2011). Addtionally, integrating cloud computing into e-government systems can help reduce the technical issues associated with old systems which may cause data loss or services being unavailable to users (Macias and Thomas, 2011).

2.2.3 Flexibility

Cloud computing integration in e-government systems establish a flexible environment in those systems as cloud-based e-governmentcan be used among various levels and sectors (Almarabeh et al, 2016). Moreover, cloud computing has different deployment models which can ensure that cloud-based e-government is aligned with government needs (Macias and Thomas, 2011). The hybrid cloud computing model can be integrated by governments to benefit from both private and public cloud models (Alshahrani and Qamar, 2013).

2.2.4 Reliability

The reliability of services provided to citizens can be improved through adopting cloud computing in e-government systems. Offering public services effectively to individuals and business is one of the main aspects of e-government; hence, integrating a cloud-based e-government system can make it simpler for governments to deliver e-services (Department of Finance and Deregulations, 2011). In addition, cloud computing can solve problems related to technical and economic issues that can not be resolved by the basic e-government systems (Alshahrani and Qamar, 2013).

2.2.5 Cost Reduction

E-government system implementation requires a huge amount of money to effectively and efficiently deliver government services to citizens and businesses. However, in cloud-based e-government systems, governments do not need to invest in the installation of ICT equipment and software (Alshahrani and Qamar, 2013). Also, adopting cloud computing can reduce the

ICT services cost as governments lease only the resources that they consume rather than purchasing these resources (Computer & Communications Industry Association, 2011). By migrating to cloud computing, a government can save between 50% and 67% of what they might have otherwise spent (Alford, 2009).

2.2.6 Pay-as-you-go

One of the considerable benefits of cloud computing is the flexible pricing model which can allow goverments sectors to pay only for the resources they use (Zwattendorfer et al, 2013). Through using a cloud computing `pay-as-you-go` approach, government operations costs can be reduced. In addition, the utilization of `pay-as-you-go` approach can allow government leaders to cover the cost that is associated with the power and storage required (Alshahrani and Qamar, 2013).

2.2.7 System integration

Cloud computing integration with e-government systems can simplify the system managements; as cloud computing integration eliminates the need for the heavy managemnt over e-government applications (Arpaci, 2019). One of cloud computing's advantages is self-service demand, which enables permiting users to access e-government systems; In other words, goverments no longer need to assign empolyees to authorise access to e-government services and information (Wu et al, 2016). Morover, cloud providers can aid goverments with management in terms of cloud security; as cloud providers own powerful resources that can help maintain security in e-government systems (Al Mudawi et al, 2020).

2.3 E-Government

E-government refers to government agencies seeking to better enhance the relationship with their citizens and businesses through the utlization of Information and Communication Technology (ICT) (Bennett, 2021). E-goverment can be also defined as a means of communicating with stakeholders (government-to-goverment, government-to-citizens and government-to-business) through using ICT to share and deliver services and business.

In brief, e-government provides services to people and organisations through digital interaction with governments. These services are delivered based on these people's needs (Mohammed and Steve, 2010). E-government interactions can be categorized as follows:

2.3.1 Government-to-Government (G2G)

According to Gregory (2007), this type of interactions refers to the online communication that occurs between the government entities, sectors and sections connected on a super-database system. Also, it refers to the interaction that happens between the government and its staff online. The primary objective of G2G is to enhance the internal processes of the government through facilitating communication and cooperation (Gregory, 2007; Mohammed and Steve, 2010). This type can occur either horizontally (between functional areas and government entities) or vertically (nationally).

2.3.2 Government-to-Citizens (G2C)

This type of interaction refers to the accessibility of government services for members of the public. Usually, most government services fall under this type, and offer citizens and other residents and visitors a range of e-services, deal with peoples` inquires and conduct government transactions. According to Seifert, (2003), applying this type of interaction (G2C) allows citizens to obtain responses to their concerns and transactions quickly and conveniently. Moreover, G2C can simplify citizens' communication with the government by overcoming the inconvenience of citizens having to travel long distances to conduct government transactions in person and saving peoples` time (Mohammed and Steve, 2010).

2.3.3 Government-to-Business (G2B)

G2B is considered to be the second most vital type of e-government interaction. Businesses and governments can gain a considerable productivity through applying this type of e-government and businesses can access different services, and information such as government rules, policies and memoranda (Shambour and Lu, 2011). From business perspectives, G2B can enable services, like renewing and issuing licenses, business registration, downloading business forms, etc.; and small and medium organizations can be developed by G2B (Pascual, 2003). Moon, (2003) and Mohammed and Steve, (2010) argued that G2B can play a significant role in increasing the transparency and the quality of government projects.

2.3.4 Government-to-Employee (G2E)

This is considered to be the least common type of e-government found in literature. According to Riley, (2001), some scholars classify G2E as a part of G2G and others believe it is a separate type of e-government. According to Mohammed and Steve, (2010), G2E refers to only the interactions between a government and its staff. The main purpose of this type is to offer

employees online services, such as applying for an annual leave, checking tractions related to salary and reviewing their annual leave balance (Seifert, 2003). According to Mohammed and Steve, (2010), G2E is vital in bringing employees together and fosters the idea of sharing information among them. It can also allow employees to have access to online training and controls they may be entitled to any compensation and benefits.

Many definitions of e-government have been proposed in the literature; and while most scholars offer various suitable definitions of e-government, most of them agree on the idea that e-government includes ICT as one of the key factors (Alateyah Sulaiman et al, 2012). The benefits of e-goverment implementation are arguably the same in both developing and developed countries (Ndou, 2004). However, transitioning from traditional methods, processes and systems to a digitalized environment requires effort, sharing experience and developing new knowledge, especially for the developing countries (Gilbert et al, 2004). For a successful e-government system, there are some tasks that government should carefully take into account if they want to successfully minimize the risks and deal with the complexities involved.

E-government implementation can provide many benefits to governments including cost reduction and the simplifying of procedures and transactions (Seifert, 2005). Applying e-government can also enhance the way government systems function as services can be delivered effectively and efficiently to all stakeholders (Rubin & Wang, 2004). However, despite the considerable advantages obtained through adopting e-goverment, there are some concerns (Al-Shehry, 2008). Increasing users' interest in using e-government is a fundamental factor for the success of e-government adoption (Yonazi et al. 2010). According to Warkentin et al., 2002), while there are a number of online government services available for users, they are not adopting them.

Moreover, Mohammed and Steve, (2010), stated that the challenges and barriers of e-government implementation can be divided into technical, organizational, social, political and financial challenges. In terms of the technical challenges, their paper emphasizes that the lack of shared standards along with the compatability of a government`s infrastructure are the major issues faced once e-government has been adopted. Several developing countries are not able to implement an effective e-government system due to the weaknesses of their infrastructure (OECD, 2003). The paper also outlines that privacy and confidentiality of individuals' data, and security are critical factors that might be encountered in both developing and developed

countries when implementing e-government. Challenges in implementing e-government are not only technical but can also include organizational issues (Feng, 2003).

In regards to the organizational barriers, there are a number of organizational issues, such as top management support, which means the commitment from leaders to support and approve the adopting and implementing of e-government (Mohammed and Steve, 2010). Organizational challenges can also include lack of collaboration and cooperation between stakholders and the absence of qualified and trained personnel. However, in relation to the social and political barriers, the biggest obstacles the paper highlighted were the digital divide, and the cultural implications of adopting a new system. Lastly, there are financial barriers, which include the high cost that is assoicated with implementing a new technology (Mohammed and Steve, 2010). According to Moon (2002), the lack of financial support may result in the failure of e-government implemention. Implementing a new techology can be expensive, so not having a big enough budget allocated to IT can be a major barrier to the implementation of e-government (OECD, 2003). However, according to Alassaf et al (2020), the main issue of the transition to e-government is a combination of all the factors inflencing the adoption of e-government systems (Alassaf and Olah,2020) (as shown in Figure 2.5).

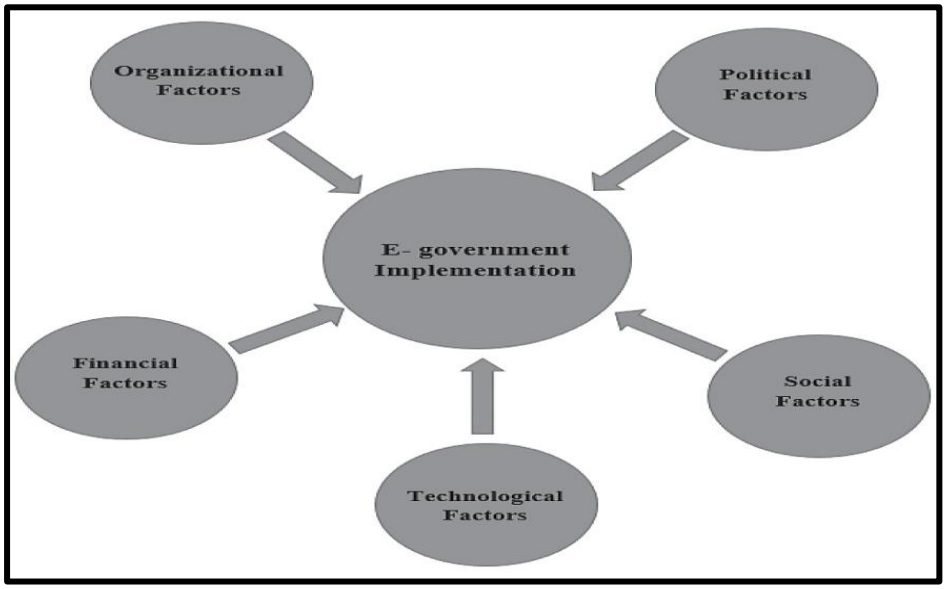

Figure 2.5: Factors affecting e-government implementation in developing countries (Source: Alassaf and Olah, 2020)

A number of studies have emphasized the importance of increasing citzens' awareness of e-government sevices, as this will develop a stimulus for using those services (Torkzadeh & Dhillon, 2002). Trust also plays an important part in influencing the intention of citizens to use electronic services (Bernhard, 2014). The trust factor is essential, as users may have

uncertainties about using the system and the credibility and performance of the service supplier needs to be ensured (Urban et al., 2000). Moreover, another study investigated the most influential determinants of e-government adoption, and the outcomes showed that the ease of using e-government services, the risks, return of investment, system quality and user satisfaction were the most significant influencers of the adoption of e-government systems (Weerakkody et al., 2014). While many researchers have covered the factors affecting e-government implementation overall, a few studies were specifically conducted about e-government adoption by developing countries.

The governments of developing countries are still encountering issues around the digital transition, due to many barriers such as lack of top management support, lack of resources and interoperability (Apleni & Smuts, 2020). Addressing the challenges of e-government implementation should be taken into consideration by the governments of developing countries. as the rate of project failure in developing countries is high (Ziemba, et al , 2016; Napitupulu, et al., 2018 Cloete, 2012). Government readiness is an essential factor in developing countries if the transformation to e-government is to succeed (Apleni & Smuts, 2020). For exampl, Sampson, et al., (2019) examined the factors affecting e-government implementation in Nigeria. Their results showed that human experience, financial cost, resistance to change, technological obstacles, the absence of IT experts, security and privacy, lack of IT infrastructure and issues of top management support were the most sigiifcant elements affecting Nigerian e-government implementation. Despite all the factors found to be affecting e-government implementation in other developing nations, the factors influencing implementation of e-government in Saudi Arabia also need to be examined, as implementation of e-govement still in its early stages.

According to Alassim, et al, (2017), to date, there has not been enough attention on the factors that affect the adoption of e-government in Saudi Arabia. Moreover, a recent evaluation study conducted to identify the most influential factors of e-government adoption in Saudi Arabia stated that the government of Saudi Arabia is still in the process of implementing e-government; Saudi Arabia is thus considered to be a developing conutry when it comes to using internet-based services (Al Mudawi, 2021). In view of this, an investigation of the factors that these organizations' policy-makers could utilize to overcome challenges and address issues related to adopting new services and technologies is worth perfomring. Cloud computing is among the recent technlologies that can heavily contribute to the enhancement of e-government

implementation (Ioannis, et al, 2019). According to many recommendations from European leaders, nations should adopt cloud computing as a part of their e-government processes; and in a study of the relationship between cloud computing and e-government success, Ioannis, et al. (2019) suggest that cloud computing can not only to offer many advantages to the public sectors, but also be a very important part of e-government strategy.

However, cloud computing initiatives in public sectors is still in the early stages due to different factors (Ioannis, et al, 2019). The lack of citizens' awareness, the absence of system compatibility, IT control and security and privacy are all factors causing a delay in cloud computing adoption (Buyya et al., 2009; Paquette et al., 2010; Zissis & Lekkas, 2011; Alshomrani & Qamar, 2013; Shin, 2013). The decision to adopt cloud computing in public sectors needs a comperhesive analysis about optimal cloud deployment and services before migrating to the Cloud (El-Gazzar & Wahid, 2015; Schneider & Sunyaev, 2016).

Hence, this research will contriubute to the literature by identiyfing the number of factors that may help decision-makers to adopt a sucessful e-government system. It will also bring a strategy to policy-makers by which they can predict the success or failure of adopting cloud computing. Finally, as previously mentioned, researchers and practitioners have emphasized the importance of comprehensively analysing the cloud model before deploying the Cloud, and this research will provide a tool using the simple adaptive weighing (SAW) anlysis method that can help policy makers to select the appropriate cloud model that suits their organizational requirements.

2.4 E-government in the Saudi Context

The possible rewards for implementing e-government in a developing country like Saudi Arabia are many, especially as the distances sometimes prevent individuals from commuting to the main government offices located in the centre of country (Al-Shafi and Weerakkody, 2007). Moreover, governments have started to reduce public appointments at their offical departments, especially after the Covid-19 pandemic, this situation can be solved by implementing e-government sysetms. Saudi Arabia is among those developing countries that need to fully implement e-government systems due to having a high population dispersed over a wide area.

2.4.1. The Saudi Context

This section gives an insight into the implementation of e-government in Saudi Arabia which includes location, climate, ICT, cybersecurity, Saudi initiatives, and the Vision of 2030.

2.4.2. Location

Saudi Arabia is considered to be the heart of the Arab and Islamic worlds, and is also considered to be the birthplace of Islam, as it is the site of the two holiest Islamic cities, Mecca and Medina. This has given Saudi Arabia an important position which results in over two million Muslim pilgrims coming to the country every year (The Arab World, 2015). The Kingdom of Saudi Arabia has a very important position among countries around the world due to its strategic location and growing economy, being one of the largest producers of crude oil, it is one of the top countries when it comes to economic growth (Digital Transformation in the Kingdom of Saudi Arabia , 2021). Saudi Arabia is the largest country in the Middle East, occupying 45% of the Arab Peninsula with a total of 2,000,000 square kilometers, and a total population of 35,031, 414 in 2020 and is expected to grow (Saudi General Authority for Statistics, 2021). As shown in Figure 2.6, Saudi Arabia is bordered to the north by Jordan, Kuwait and Iraq, to the east by Bahrain, Qatar and the Emirates, and from the south by Yemen and Oman, while the Red Sea is to the West.

Figure 2.6: Map of Saudi Arabia (Source: US Dept of Health and Human Services, 2022)

2.4.3. Climate

Saudi Arabia's climate is decsribed as mild in the winter; however, it is dry for around 7 months a year with summer temperatures as high as 50 C (World fact book, 2007). This kind of climate plays a very significant role in terms of adopting e-government, as it allows citizens to use e-government services instead of travelling in intense heat to attend appointments at actual government offices. Not only the climate, but also the population numbers can be considered as a vital factor, as it determines the volume of people needing to access government services; and current figures show that the population of Saudi Arabia is around 35,529,400 (Worldometer, 2021).

2.4.4. Information and Communication Technology (ICT) In Saudi Arabia

According to Alrawabdeh, Salloum & Mingers (2012) ICT has changed business enterprises globally and particularly in Arab nations. Saudi Arabia is considered to be largest ICT market in the Middle East, as it represents over 51% of the total Middle Eastern market (International trade Administration, 2019). According to the Ministry of Communications and Information Technology (MCIT), the ICT strategy 2019-2023 is aiming at a target of 50% growth in IT sectors and an increase of 50% in the local IT workforce by 2030 (see Figure 2.7). It also plans to attract external technology investment and to encourage the empowerment and participation of women in the sector. According to the MCIT strategy, the primary beneficiary domains are digital education, smart cities, digital health, e-government, national data and E-commerce.

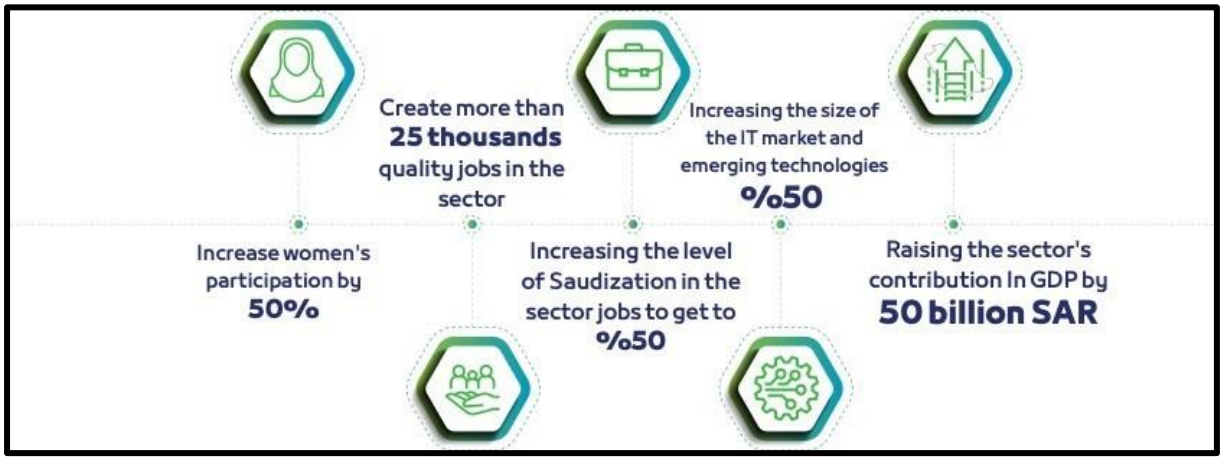

Figure 2.7 Highlights of the ICT Strategy 2023 (Source: Saudi Ministry of Communications and Information Technology n.d.)

Moreover, digital transformation would play a very important role for goverments that aim to enhance services and operations. Digital transformation usually involves across-level changes in the organization, as infrastructure, products, internal and external services and strategies can all be affected by digitial technolgies (Bharadwaj, El Sawy, Pavlou & Venkatraman, 2013; Chanias, Myers & Hess, 2019). With the current rapid technological and governmental improvements and advancement occurring worldwide, The Kingdom of Saudi Arabia is taking a remarkable step forward to evolve. It has developed a five year plan that aims to adopt digital innovations to improve and facililate services. According to Alharbi, (2019), the aim of digital transformation has been a top priority in the Saudi Vision 2030 (see section 2.3.7.1).

2.4.5 Saudi Cyber Security

Crimes involving misuse of information have been recently increasing which can lead to serious consequences for Saudi Arabia as it is one of the fastest countries to exploit ICT advantages (Faisal, et al, 2016). Saudi Arabia has made noticeable changes when it comes to cyber security; and its world ranking has changed from 11th in 2018, to the second of 193 countries in 2020, and it ranked first among the Arab nations (The Global Cybersecurity Index, 2020). The increasing number of digital crimes has prompted the Saudi government to provide a safe and protected environment for their data and digital operations. The Saudi government established the National Cybersecurity Authority (NCA) in 2017 that informs the government about any cybersecurity activities (NCA, 2021). The NCA aims to create and update cybersecurity policies, controls, standards, guidelines, framework and mechanisms which include the following:

- **Organizations' Social Media Accounts Cybersecurity Controls**

In compliance with the government rules for providing a protected environment to operations overall, the NCA has developed governance of organizations' social media accounts and cybersecurity controls. Theses controls are established to help protect the organizations' social media accounts by addressing digital criminal activities, such as misuse of official communication accounts, stealing them or committing identity theft (NCA, 2021). According to the NCA report, (2021) this type of cyber security can be classified into three main domains and subdomains, shown in the table below:

Table 2.1: OSMACC Main Domains and Subdomains (Source: National Cybersecurity Authority n.d.)

1- Cybersecurity Governance	1-1	Cybersecurity Policies and Procedures	1-2	Cybersecurity Risk Management
	1-3	Cybersecurity in Human Resources	1-4	Cybersecurity Awareness and Training Program
2- Cybersecurity Defense	2-1	Asset Management	2-2	Identity and Access Management
	2-3	Information System and Processing Facilities Protection	2-4	Mobile Devices Security
	2-5	Data and Information Protection	2-6	Cybersecurity Event Logs and Monitoring Management
	2-7	Cybersecurity Incident and Threat Management		
3- Third-Party and Cloud Computing Cybersecurity	3-1	Third-Party Cybersecurity		

- **Essential Cybersecurity Controls**

The Essential Cybersecurity Controls have been issued for setting up cybersecurity requirements in order to reduce cybersecurity risks to the assets of organizations (NCA, 2021). This type of control consists of 114 primary controls, categorized into five elements as follows:

- Governance of Cybersecurity
- Defense of Cybersecurity
- Resilience of Cybersecurity
- Cybersecurity of cloud computing and third party
- Cybersecurity of Industrial Control Systems

- **Cloud Cybersecurity Controls**

Cloud Cybersecurity Controls have been issued in order to meet the requirements of cybersecuirty for cloud computing, for both cloud computing providers and the service tenants. This type of control consists of 37 primary controls classified into four main domains (NCA, 2021):

- Governance of Cybersecurity
- Defense of Cybersecurity
- Resilience of Cybersecurity
- Cybersecurity Third-Party

- **Telework Cybersecurity Controls (TCC)**

Telework Cybersecurity Controls (TCC) aims to allow organizations to perfom their jobs remotely within a safe environment. It also aims to improve cyberscurity potentialities and resilience while working remotely. According to the NCA report (2021), the Telework Cybersecurity Controls are classified into the followig domains and subdomains, (see Table 2.2)

Table 2.2: TCC Domains and Subdomains (Source: National Cybersecurity Authority, n.d.)

1- Cybersecurity Governance	1-1	Cybersecurity Policies and Procedures	1-2	Cybersecurity Risk Management
	1-3	Cybersecurity Awareness and Training Program		
	2-1	Asset Management	2-2	Identity and Access Management
	2-3	Information System and Processing Facilities Protection	2-4	Networks Security Management
	2-5	Mobile Devices Security	2-6	Data and Information Protection

2- Cybersecurity Defence	2-7	Cryptography	2-8	Backup and Recovery Management
	2-9	Vulnerabilities Management	2-10	Penetration Testing
	2-11	Cybersecurity Event Logs and Monitoring Management	2-12	(Cybersecurity Incident and Threat Management)
3- Third-Party and Cloud Computing Cybersecurity	3-1	Cloud Computing and Hosting Cybersecurity		

- **Critical Systems - Cybersecurity Controls**

The NCA has developed this type of control to fit the requirements of cybersecurity related to the national critical equipment. This type consists of 32 primary domains, classified into four elements (NCA, 2021):

- Governance of Cybersecurity
- Defense of Cybersecurity
- Resilience of Cybersecurity
- Cybersecurity Third-Party .

The Saudi government is making good progress towards improving the cybersecurity of the kingdom as well as maintaining a secure environment for citizens and all stakeholders. The Ministry of Education and the national Cybersecurity Authority have recently agreed to develop training and research courses collaboratively that cover cybersecurity aspects (Olech, 2021).

2.4.6 Current Saudi Government Portals

Saudi Arabia is like many countries that have recognized the postive impact of empolying e-government services and the benefits associated with it, such as reduction in costs, delivering a high quality of services, and the increase in transparency and accountability. According to Alfayad and Abbot-Halpin (2017), Saudi Arabia commenced its implementation of e-government in 2005 by launching a programme called 'Yesser'. The main idea behind government portals is that indiviuals and busines can have access to online services via the internet. The following are some of the most commonly used portals in Saudi Arabia :

2.4.6.1 The Yesser Program

According to the Yesser website (2021), the Yesser program is a platform that aims to facilitate and enhance digital services in an effective and efficient manner. '*Yesser*' means 'simplify' or 'facilitate' in Arabic (Al Nagi, 2009). The main purpose of Yesser is to transform the public sectors into a digitalized environment so service quality can be improved as well as

productivity. In terms of implenting Yesser action plans, Yesser made two action plans between 2006 and 2016. The first ran from 2006 to 2010 and the main purpose of this phase was to provide e-services to all users through focusing on enhancing public sector performance and productivity (Sulaiman, et al, 2012). At this stage, the framework for deployment of e-government was initiated (Al-Mushayt et al. 2012). This consisted of five domains namely goals and vision, e-services, national apps, organizations and infrastructure (Ayman, 2019). However, in 2011, a report issued by Yesser mentioned encountering some problems with completing the first stage of the implementation, such as absence of trained professionals and the lack of a collaborative environment among government agencies and government sectors. (Yesser, 2011).

The second plan commenced in 2012, and predicted full completion in 2016. The goal of this plan was to focus on the interaction between the government and its stakeholders, as well as to build robust e-government human resources. It aimed also to develop a collaborative environment as well as enhancing public sector efficiency and productivity (Ayman, 2019).

Moreover, implementing the Yesser program effectively has definitely enhanced operational productivity, minimized the reliance on the old-fashion method of paper usage, since all processes are conducted digitally and streamlined communication among government

agencies, as public sectors can easily share and exchange services through the Yesser platform, which can also increase their work efficiency and productivity. According to Hameed et al, (2013), the primary goals of the Yesser program are increasing public sector productivity and efficiency, offering better services to all stakeholders, raising the return of investment (ROI), and finally delivering information in a seamless, user-friendly manner.

Although the Yesser program can streamline the performance of public organizations and lead to stakeholders working collaboratively, it still has some issues (Saleh, et al., 2014). According to Alharbi (2019), Yesser security has been affected by certain issues noted by previous studies. According to Alshehri (2012), resistance to change has been one of the biggest challenges that has impeded the completion of e-government initiatves in the Kingdom of Saudi Arabia. While it is noticeable that the government of Saudi Arabia has made good progress in implementing e-government adoption, e-government intiatives have mostly experienced unfinished deployment and delays (Raed et al., 2016; Alfarraj & Alhussain, 2013; Alfarraj, Alhussain & Abugabah, 2013). This cleary indicates the significance of investigating the digital readiness of public organizations prior to implementation. Many studies have shown that e-government can provide considerable advatanges to public organizations, so their readiness is vital, as it can also affect stakeholders' acceptance and adoption of e-government. Invesigations conducted by Alassim et al. (2017) and Alkhlewi et al. (2020), showed that Saudi Arabia still faces a major issue in terms of the technical infrastructure update, and that currently public organizations are not ready to fully express the Yesser vision. Hence, conducting a study that can contribute to the fitness and viability of organizations is needed, as this can lead to successful e-government implementation by the Saudi public sector.

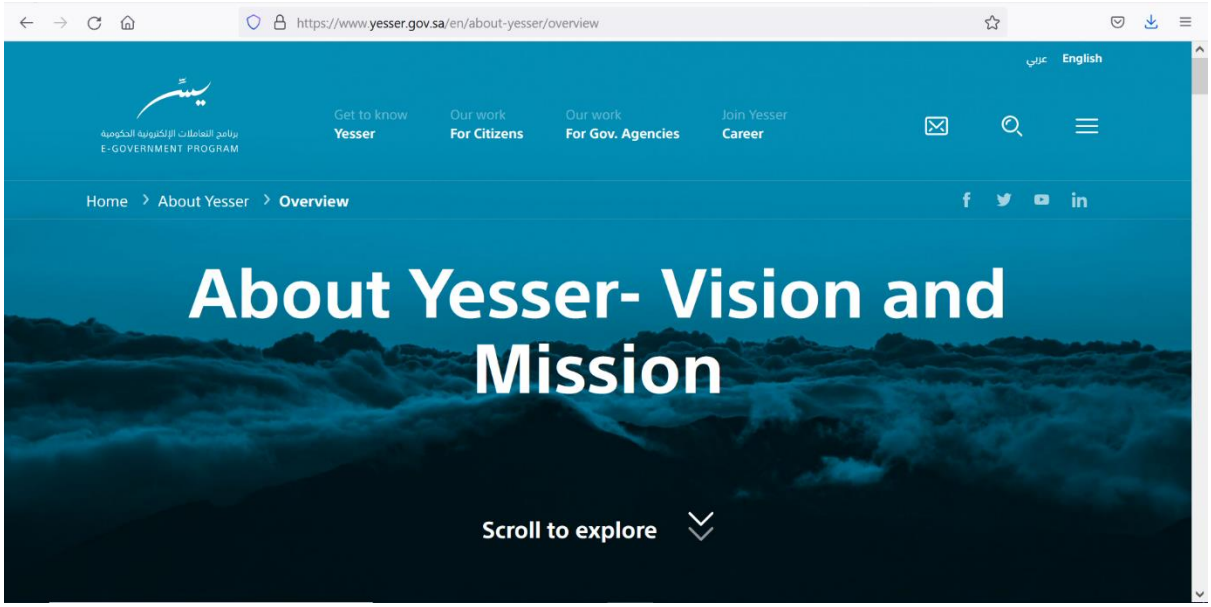

Figure 2.8: Yesser Program Website (Source: Saudi Government, 2020)

2.4.6.2 The Absher Portal Program

This initiative was launched to streamline the online activites related to travel and residence permits and their renewal, visas, passports and other governmental services. Absher can be accessed through an online gate, (see Figure 2.9). Absher was issued in 2013 by the Ministry of Interior (MOI) and not only deals with the local citizens but also with international residents (Aljerais, 2021). The Directorate General of Passports issued statistics concerning local and international residents in 2014, and showed that the number of Absher subscribers has risen to around four million (Ahmad et al , 2015). According to the MOI (2021), Absher comprises three categories including: Absher to Individuals, Absher to Business and Absher to Government.

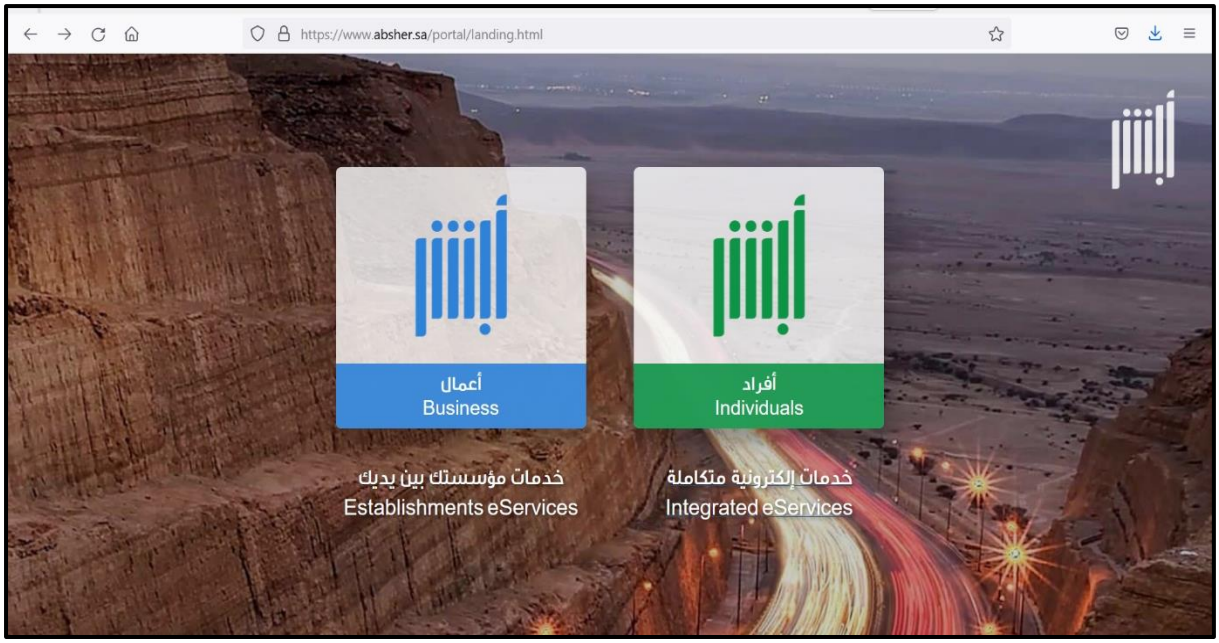

Figure 2.9: The Ministry of Interior Absher Website (Source: Saudi government, 2020)

2.4.6.3 The Unified National Portal (UNP)

According to the UNP (2021), this platform integrates all the government services into one plaform and can be accessed by all citzens, businesses and residents anytime and anywhere. These services include those most commonly used services, services related to family and life events, those related to health, etc. According to Yesser, (2021), UNP was launched to facilitate all individuals' needs through a unified digital identitity (Yesser, 2021)(see Figure 2.10).

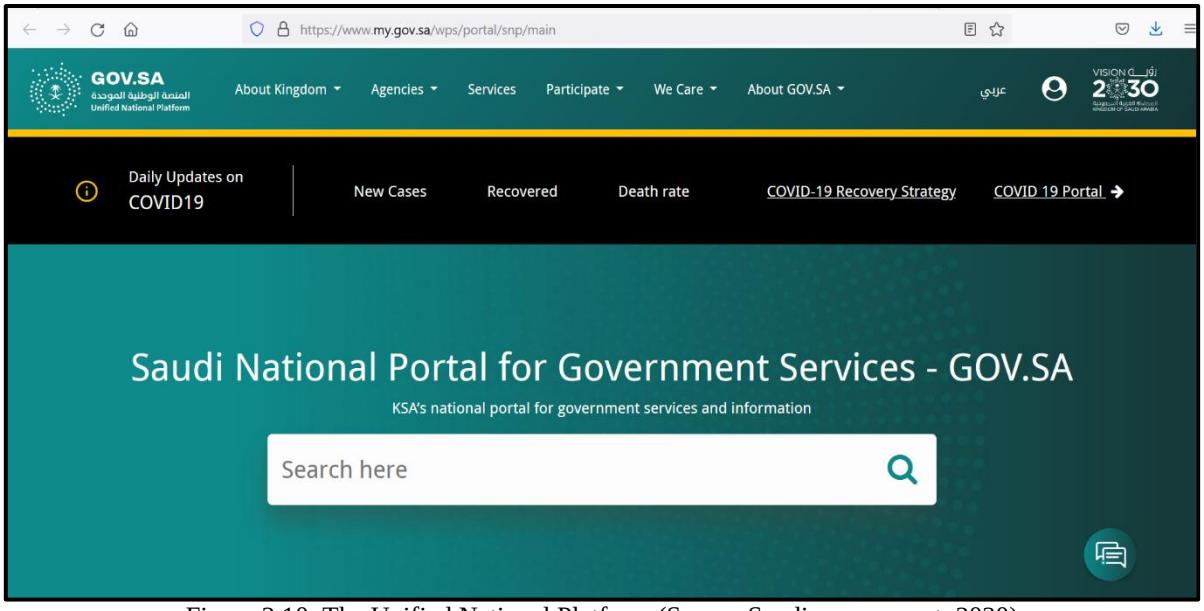

Figure 2.10: The Unified National Platform (Source:Saudi government, 2020)

2.4.6.4 The SADAD E-Payement System

The Saudi Arabian Monetary Agency developed this system in 2004 (SADAD, 2021). The word *Sadad* is Arabic and it means 'payment'. SADAD is consided to be the primary e-payment channel for services related to government. It also connects large sectors including government agencies, telecom and utilities companies with the local banks (Mohammed, 2011).

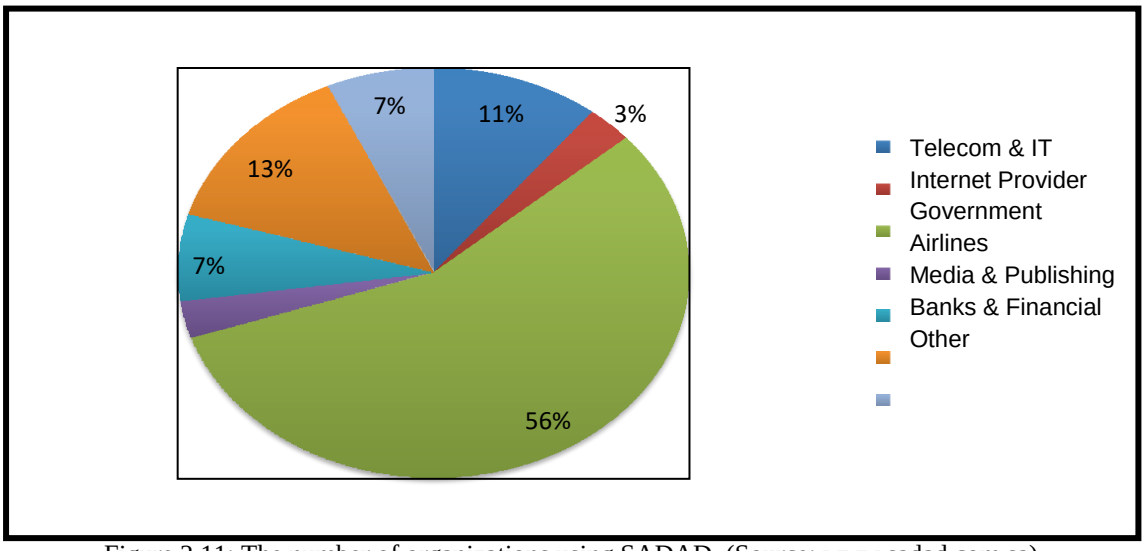

Figure 2.11: The number of organizations using SADAD, (Source: www.sadad.com.sa)

2.4.7 Current Saudi e-Government Services

According to the Unified National Platform (UNP), the following are e-services that are most commonly used by Saudi citizens:

- ***Tabaud***

Tabaud has been developed to detect the spread of Coronavirus. This service provides citizens with the ability to track and trace the status of the COVID-19 infection. It also sends a proactive notification to people in case a person had a contact with others diagnosed as having the coronavirus. This service facilities the communication between citizens and the Ministry of Health by allowing people to send notification of their health situation and to confirm that they have received the necessary support from Ministry of Health staff.

- ***Sehhaty***

Individuals in Saudi Arabia can obtaining health services through this application. The primary objective of this service is to allow people to access to their health information and medical reports from anywhere and at any time. Individuals also can view and schedule appointments online and perform other functions, such as tracking prescriptions, requesting sick leave and viewing details of laboratory tests.

- ***Tawakkalna***

This service has been developed by the Saudi Data and Artificial Intelligence Authority (SDAIA) to depict the national health situation to individuals. This service was established during the Covid-19 pandemic to help support the government to electronically find out who was exempt from the curfew through coloured codes. Tawakkalna works in line with the Ministry of Health by notifying it about individuals suspected to be affected with the coronavirus.

- ***Mawid***

This service was developed by the Ministry of Health to allow individuals to arrange, book, and reschedule appointments in the main health care centres. Through this service, beneficiaries can also allocate the nearest health care centres to their locations and know the number of appointments available to outpatients.

2.4.7.1 The Saudi Vision 2030

"My first objective is for our country to be a pioneering and successful global model of excellence on all fronts, and I will work with you to achieve that"
King Salman bin Abdulaziz Al Saud, Custodian of the Two Holy Mosques

"It is my pleasure to present Saudi Arabia's vision for the future It is an ambitious yet achievable blueprint, which expresses our long-term goals and expectations and reflects our country's strengths and capabilities."

Mohammad bin Salman bin Abdulaziz Al-Saud, Chairman of the Council of Economic and Development Affairs

Figure 2.12: The Saudi Vision Logo (Grand and Wolff, 2020)

The Kingdom of Saudi Arabia has set a plan to the end of 2030 as a road map for the development of the country, and which aims to build a non-oil reliant economy and exploit other opportunties and rich resources. The Vision is based on three main elements (called 'pillars'). The first pillar is the fact that Saudi Arabia is the heart of the Arab and Isamic world, and the homeland of two holy mosques and that Muslims all face Mecca five times a day in prayer. The second pillar is becoming a global investement powerhouse, improving the Saudi economy and diversifying the revenue sources. Thirdly, Saudi Arabia's unique location allows it to act as a central hub for global trade, connecting the three continents, Asia, Europe and Africa (Saudi Vision 2030, 2016).

The Vision has been developed along three main themes, namely a vibrant society, a thriving economy and an ambitious nation (see Table 2.3). To achieve a vibrant society, the focus will be its individuals and the Islamic faith. This can be also accomplished through a series of promises encompassing an annual rise in the number of visitors of Umra from 8 million to 30 millon, developing the largest museum in the world, fostering the opportunities for entertainment and culture and urging a healthier lifestyle. In terms of the economy, this will by achieved by developing more job opportunities for citzens and exploiting the strategic location that the kingdom has. Finally, the kingdom becomes an ambitious nation by focusing on transparency, accountability and success. According to Vision 2030 this will result in very well-educated citzens and a drop in the rate of unemployment and offer better healthcare and housing (Thompson, 2017).

Table 2.3: The Three Main Pillars of the Saudi Vision 2030(Grand and Wolff, 2020)

Pillar	Strategic Goals
Vibrant society	Support Islamic and national identity
	Provide a fulfilling and healthy life
Thriving economy	Diversify the economy
	Lower unemployment
Ambitious nation	Improve government effectiveness
	Allow social responsibility

2.4.8 M-Government in Saudi Arabia

M-government refers to the use of mobile technologies by government agencies to deliver services to all its stakeholders; m-government is therefore similar to e-government in terms of interaction, as shown in Figure 2.13 below. (Desta et al , 2009). As the number of people accessing the internet rise rapidly, the implementation of m-government is inevitable. Not only are individuals currently relying on the internet and adopting it as part of their lives, but also governments are starting to transform and deliver most of their applications and activities via the internet, due to the high pressure to efficiently and effectively interact with all stakeholders. M-government is considered to be a complementary approach to e-government and should not be seen as a replacement. In other words, the benefits of m-government stem from its ability to provision the mobility of people, business and government operations (Ibrahim and Halid, 2003).

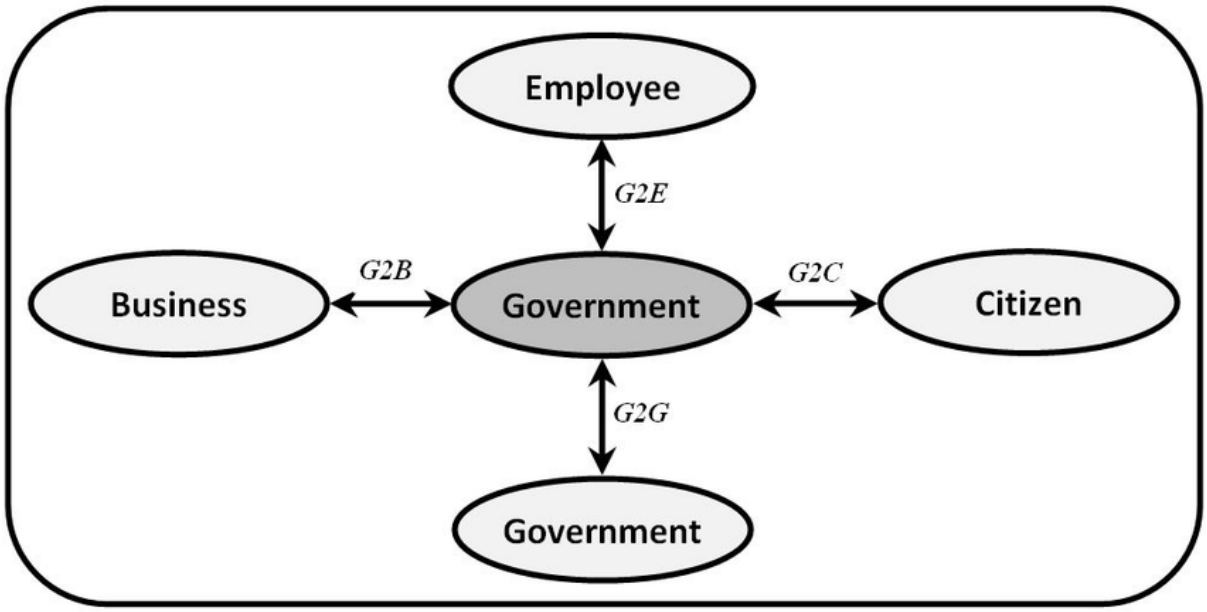

Figure 2.13: M-Government interactions (Source: Firoozy-Najafabadi. & Pashazadeh, 2011)

In the context of Saudi Arabia, as previously mentioned, the growth in internet use is dramatically increasing (see Figure 2.14). M-government has been also implemented and has become a top priority for the government of Saudi Arabia.

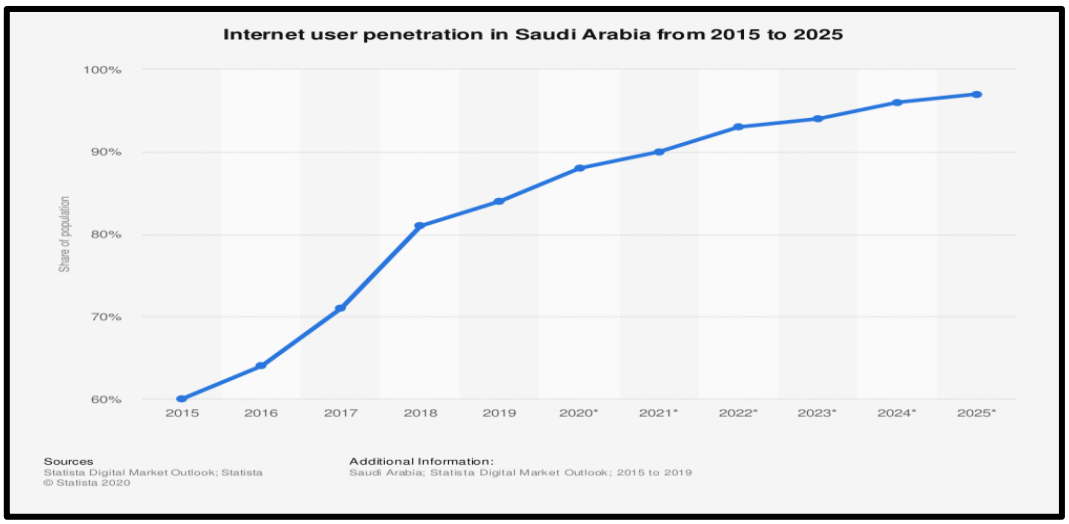

Figure 2.14: The number of Internet Users in Saudi Arabia (Source: Statista, 2020)

Currently, there are many mobile applications being used in Saudi Arabia; the following are the most commonly used mobile applications in Saudi Arabia (Ahmad, 2014):

2.4.81 Health Ministry

Users are offered an interactive service via mobile by which they receive a Short Message Service (SMS) or text, which includes information about appointments and medicine updates.

2.4.8.2 Ministry of Education

Student can now track their grades through mobile apps. and can also receive SMS messages to update them about their educational matters.

2.4.8.3 Supreme Council of Justice

Through this service, individuals can receive SMS messages with information related to their court cases and obtain a case number that can be used to track their case on the system.

2.4.8.4 Ministry of Labour

Beneficiaries are offered this service to inquire about their registration of employment status in the Ministry of Labour through receiving an SMS.

2.4.8.5 Ministry of the Interior

Citizens and residents are offered the ability to inquire about their traffic violations through using their national ID or Iqama umber to obtain an update via an SMS message.

2.5 A Discussion of Cloud Computing and E-government Studies

This section examines prior studies in the adoption of cloud computing, especially in the public sector and in the Saudi context with a view to identifying the knowledge gap which this study intends to fill.

There are relatively few studies, in the literature, that cover cloud computing in terms of its adoption by public organizations. Mostly, previous studies focused on the advantages and costs associated with cloud computing for both public and non-public organizations (Jones et al, 2019; Sallehudin et al, 2019; Al-Ruithe et al, 2018; Al-Hujran etal, 2018; Ali et al, 2018; Parveen, 2018; Shuaib et al, 2019; Awan et al, 2021; Al Mudawi et al, 2020). There are numerous studies that suggested cloud computing adoption models to implement e-government services. However, most of these models are proposed based on service and types of cloud computing model (SaaS, PaaS, IaaS, Public, Hybrid, Private, etc), cloud type-based models (Ali et al, 2018) a component-based model (Nanos et al, 2019), a decision tree algorithm (Ma et al, 2022; Reinhold et al, 2022) or a sub-categories model (Liang et al, 2017).

Since 2008, researchers have been evaluating cloud computing as an alternative paradigm to enhance public organizations and businesses. Numerous papers have conducted reviews in the public organization context (Al-Ruithe et al, 2017; Bhardwaj et al, 2021; Akin et al, 2014; Singh et al, 2018; Jones et al, 2019; Al-Shqeerat et al, 2017; Al-Hujran et al, 2018; Ghorbel et al, 2017; Tabrizchi and Kuchaki, 2020). None of these studies examined the factors affecting cloud computing as they were focused on simply assessing the advantages and disadvantages of implementing cloud computing in the context of e-government and did not examine the issue empirically. Furthermore, Hassan et al (2020) conducted a survey discussing cloud computing and machine learning along with the cloud models and services. They concluded that cloud computing is currently dominating the IT marketplace and it is expected that it will continue domaining the IT marketplace for the upcoming years. Although this study presented an overview about cloud computing and the related technologies, such as Kubernetes, OpenStac, neural network and machine learning, it did not provide any evidence related to the factors

affecting cloud computing adoption. However, it showed that cloud computing technology demand will increase in the next years, so this means that more studies need to be conducted to investigate cloud computing adoption. Moreover, Marwan et al (2018) discussed the security enchainment in cloud computing using machine learning. An approach using Support Vector Machines (SVM) and Fuzzy C-means Clustering (FCM) was proposed based on machine learning techniques to ensure the security of data processing in cloud computing. While this study revolves around an existing issue in cloud computing security, issues related to the organizational and economic factors were not discussed in this study. Issues related to the other technological factors, such as cloud complexity, compatibility and trialability were also ignored. Further, Mudawi et al. (2022) noted there were still relatively few studies that assessed the factors affecting cloud computing adoption in the context of e-government. Clearly, despite the extensive research, the adoption of cloud computing in e-government services remains a challenge. To address this, further research needs to be conducted in cloud adoption models to facilitate the implementation of e-government services.

Of the studies that did look at the factors empirically, Sallehudin et al, (2019) evaluated some cases in the Malaysian public sector with the purpose of measuring the primary factors that affect cloud computing adoption. The findings showed that relative advantage, compatibility and IT personnel knowledge were the main drivers. In this study, Diffusion of Innovation Theory (DOI), and Technology-Organization-Environment Framework (TOE) were integrated in the proposed model. Only the factors of technological, organizational and human characteristics were determined to be the main drivers that influenced the Malaysian organizations to adopt cloud computing. However, while this study explored the factors affecting cloud computing based on the DOI and TOE, only relative advantage and compatibility of the DOI factors were included. Other DOI factors were not examined and those have proven their significance on cloud computing adoption in literature. This study also lacked any qualitative examination of the proposed factors. Also, this study focused on examining the technological side of cloud computing adoption, the technological aspects of organizational readiness factors were excluded.

Another empirical study, evaluated cloud computing factors and concluded that external pressure, confidentiality and loss of governance were the most important factors affecting the cloud computing adoption in public organizations in Pakistan (Tariq et al., 2017). Although this study proposed a framework based on organizational challenges, environmental pressure and security, it did not examine factors such as trialability, IT infrastructure or IT policy and

relative advantage was the sole DOI factor included. This study focused more in investigating the cloud computing factors from the organizational and environmental side. The proposed factors were not examined qualitatively. Technology adoption rests on the attitudes, experiences and perceptions of human beings, and, although, quantitative methods like surveys can go some way to acquiring data on these phenomena, only qualitative methods can provide a deeper understanding of the study subject (Anderson, 2010).

Gao and Sunyaev (2019) identified and analysed the factors affecting cloud computing in healthcare. A framework was proposed based on Technology-Organization-Environment factors. The results showed that cloud computing remains in its infancy and the authors concluded that more research was needed in this regard. Another study conducted by Khayer et al (2020) to investigate they key factors affecting cloud computing adoption in small and medium enterprises. A model was proposed and was tested using structural equation modelling (SEM) and an artificial neural network (ANN). The result revealed that relative advantage, service quality, perceived risks, top management support, facilitating conditions, cloud providers' influence, server location, computer self-efficacy and resistance to change positively influenced cloud computing adoption. However, this study was conducted to assess the factors affecting cloud computing adoption in small and medium enterprises, therefore public organizations were out of scope. In terms of the technological factors, this study focused only on relative advantage and discarded the other related factors, such as cloud complexity, compatibility, trialability and security. Also, this study did not focus on economic factors.

Further, Singh and Mansotra, (2019) suggested a conceptual framework that determined the factors affecting cloud computing adoption in the Indian school education system. The conceptual model was based on the TOE theory and technological, organisational and environmental factors were considered. The result outlined that relative advantage, compatibility, top management support, competitive pressure, external expertise and attitude had a positive impact on cloud computing adoption. While this study provided a framework based on the TOE, it omitted to provide sufficient results from the perspective of organizational readiness. It mainly focused on the cloud computing factors impact. The data were gathered from only 56 schools. This study provided an adoption model for cloud computing based on the TOE framework, however there are limitations to this model (see Chapter 3, section 3.1.1.1). Moreover, the study does not investigate organisational readiness in sufficient depth. This study also investigates the factors affecting cloud computing adoption based on a large context (the Indian school education system), so TOE by itself is not sufficient to provide

accurate results (K et al., 2005) and more factors or theory needs to be incorporated for better results.

Jianwen and Wakil, (2019) also evaluated the factors affecting the adoption of cloud computing. A research model with just 4 hypotheses was developed and these were examined using structural equation modelling. The result showed that personal innovativeness, knowledge, size, adequacy of resources, top management support, compatibility, security, competitive pressure and trading partner were the main drivers affecting the cloud computing adoption. However, from the technological side, this study only examined factors such as compatibility and security. Other DOI factors were not included. This study therefore required more factors to fully cloud computing adoption from the technological side. This study focused more on examining the factors based on organizational and environmental side. This study also did not confirm the proposed factors qualitatively.

In addition, Friedrich et al, (2018) examined the factors affecting cloud computing in German organizations. Data were gathered through interviews and the results showed that trust, privacy and security were the most relevant influencing factors. The findings were not quantitatively validated. Future research could build on this study by conducting a larger-scale quantitative study to validate the results and provide more robust evidence on the factors that influence cloud adoption in German organizations.

Changchit and Chuchuen (2018) investigated the factors that might encourage or discourage users` intentions to adopt cloud computing. The findings showed that perceived ease of use, perceived usefulness, perceived security and perceived cost of usage were the main factors that encouraged users to adopt cloud computing, while perceived speed of access had no influence on the perceptions of IT leaders to adopt cloud computing. Although this study provides a framework based on TAM theory, it did not examine cloud computing adoption from the organizational and economic perspective; and the study did not use a complementary qualitative approach. Also, as mentioned in Chapter 3, one of the major concerns with the TAM model is that it does not examine the actual technology adoption behaviour because it focuses on participants' perceptions of adoption and their intentions. Adopting the TAM therefore would not fully examine cloud adoption.

Further, Ali, (2019) conducted a systematic review of 17 studies of cloud computing adoption in higher education. The review showed that there was a need for further studies to be conducted on public sector domain. In addition, Qasem et al, (2019) conducted a systematic

review aiming to assess existing studies on adopting cloud computing in higher education institutions. A taxonomy of research literature on cloud computing was developed. The authors concluded that the adoption of cloud computing is still a current topic and more attention is needed by researchers. The findings also showed there is a gap in the organizational level that needed to be covered by future scholars.

AlAjmi et al, (2021) proposed a conceptual model based on the Fit-viability model to assess the factors influencing E-learning-based cloud computing adoption in higher education institutions. The data was collected using a survey among 39 participants. Although this study attempted to investigate the factors affecting E-learning-based cloud computing adoption, the number of the selected factors were few. Factors such as trialability, security, IT infrastructure, computability have proven to have an influence on cloud computing adoption but they were not investigated in this study. The data in this study was only gathered from 39 participants and the proposed factors were not confirmed qualitatively which could affect the validity of the study findings. More comprehensive investigation of these factors is necessary to understand their impact on cloud computing adoption in public organisations'.

Polyviou and Pouloudi, (2015) provided a comprehensive analysis of cloud computing adoption in public organizations through considering the organizational and environmental context. The data were gathered from 21 interviews conducted across six European countries. The findings concluded that most factors that impeded cloud computing adoption in public organizations were relevant to the environmental context. Although this study provides a comprehensive understanding of the factors affecting cloud adoption based on organizational and environmental context, no quantitative study was conducted and the findings presented were based on just 21 interviews.

Another study conducted by Hassan et al, (2022) analysed the factors affecting cloud computing in supply chain management in Pakistani enterprises. A model was proposed based on the technology acceptance model (TAM) and the Elaboration Likelihood Model (ELM). The findings showed that perceived security, argument advantage and source credibility were the most influential factors affecting cloud computing. However, the model in this study was validated only quantitatively. Also, this study was heavily focused on the technological factors affecting cloud computing and excluded other factors related to organizational readiness and economy.

Morgan and Conboy (2013) analysed the factors affecting cloud computing adoption through interviews and case studies of cloud service providers. Nine factors were identified as the factors affecting cloud computing including relative advantage, compatibility, complexity, trialability, increased collaboration, increased traceability and auditability, convincing IT managers, security and legal issues and perceptions of the term 'cloud'. In this study, the results were based on case studies and interviews and no model was proposed; also, no quantitative study was conducted. Wu et al, (2016) evaluated the factors of decision-making on cloud adoption. Data were collected from 227 public sectors employees. The factors proposed in this study were based on SaaS, PaaS and IaaS adoption. Although the aim of this study was to investigate the factors affecting SaaS, PaaS and IaaS adoption, the factors were not qualitatively confirmed.

2.5.1 Studies in the Saudi context

Recently, scholars have also explored and evaluated the cloud computing phenomenon in public organization sectors in the context of Saudi Arabia. Alanezi, (2018) investigated a set of factors influencing cloud computing adoption in Saudi Arabia in both private and public organizations. In this study, interviews were carried out with different IT professional representatives and the factors were examined qualitatively. The findings showed that security and privacy were the main issues that impeded Saudi organizations from adopting cloud computing. The results also illustrated that adopting cloud computing could help improve the performance of private and public organizations. However, the proposed model was not quantitatively validated. Therefore, future research could consider validating the proposed model quantitatively to strengthen the study's findings. Additionally, future research could examine the factors that facilitate the adoption of cloud computing in public organizations in Saudi Arabia, as this area remains largely unexplored.

Almaiah and Al-Khasawneh (2020) analysed the factors affecting the decision to adopt mobile cloud computing in higher education in Saudi Arabia. In this study, a model was proposed based some factors extracted from previous studies. The result showed that quality of service, perceived usefulness, perceived ease of use, relative advantage and trust were the direct factors influencing the mobile cloud adoption. While this study was conducted in Saudi Arabia, it was only limited to the higher education sector. Therefore, the results cannot adequately be applied to cloud adoption for Saudi e-government'. Also, this study was focused entirely on factors

related to mobile technology; and factors related to organizational readiness were excluded. Lastly, this study was conducted to examine the adoption of mobile adoption and was gathered only by survey.

Karim and Rampersad (2017) analysed the factors affecting cloud computing adoption in Saudi public universities. Four categories were examined namely: the technological, organisational, environmental and cultural. The proposed model was developed based on the TOE theory and Hofstede's cultural dimensions model. The findings concluded that relative advantage, compatibility, top management support, readiness, competitive pressure, regulatory support, high masculinity and high individualism had a significant impact; while complexity, language and religion had an indirect effect on the adoption of cloud computing. However, factors related to technological aspects from the perspective of organization viability and economic were not examined.

Also, Alhammadi et al, 2015) analysed the factors affecting cloud computing adoption in Saudi Arabia. The proposed model was developed based on diffusion of innovation theory (DOI) and the technology-organisation-environment (TOE) model. The findings showed that security, organisational readiness, firm status, top management support, government support and compatibility were the main factors affecting cloud computing adoption. However, these proposed factors were not qualitatively examined. Also, factors related to economic impact, and technological and organizational readiness were out of scope.

Almubarak, (2017) explored and identified the factors affecting cloud computing adoption by Saudi university hospitals. In this study, the model was constructed based on TOE and DOI factors and decision-makers' innovativeness and knowledge. The data were collected using semi-structured interviews and a questionnaire. The result showed that relative advantage, decision-maker's innovativeness, decision-maker's knowledge in IT, compatibility and top management support were the main factors affecting cloud computing adoption. However, the data were collected only from university hospitals in Riyadh city. Also, factors related to economic impact, technological and organizational readiness were out of scope.

Moreover, Alarefi (2023) assessed the factors affecting the cloud computing usage in Saudi Arabia based in vision 2030. Data were collected from different employees working in IT, and a model was proposed. The result showed that cloud computing adoption in Saudi Arabia is still limited. The findings also showed that perceived usefulness (PU), perceived ease of use (PEOU), external influence, and security are influencing cloud computing usage. However,

this study focused more on investigating the factors from the technological side only. Factors related to organizational readiness were excluded. This study also lacked the qualitative examination for the proposed factors. More research is needed therefore to address the knowledge gap.

Alharbi et al, (2017) identified the key factors for decision makers' consideration when adopting cloud computing in Saudi healthcare organisations. The proposed model was developed based on technological, business, environmental, organisational and human dimensions. The results showed that cost, added values, strategic planning, infrastructure readiness, security, compatibility and availability were the primary factors affecting cloud computing adoption. However, no empirical study was conducted to validate the suggested model.

Further, Al-Ruithe et al. (2017) conducted an analysis of the current state of cloud computing adoption in the kingdom of Saudi Arabia and concluded that the country was still at the phase of considering cloud computing and needed more studies to fully understand the phenomenon and facilitate adoption. In this study, a survey was designed and distributed among a number of government ministries. The results showed that at the time up to 70% of Saudi public organizations did not have cloud computing adopted in place and only 29% of participants said they had adopted some cloud computing services. The authors identified that there was still a gap in the context of examining the factors affecting cloud computing in public organizations. It is also the case that studies of cloud computing adoption for Saudi government ministries are in need of updating as since Al-Ruithe et al. conducted their study much has changed regarding cloud provision and implementation. The current study takes these changes into account.

The abovementioned studies examined cloud computing adoption from different perspectives and had various theoretical backgrounds. However, cloud computing has new characteristics compared to previous generations of computing, the impacts of the cloud computing innovation are not fully understood in public organizations context (Alanezi, 2018) and deserve more attention. There is a lack of studies investigating the effect of cloud computing on public sector organizations performance and the factors that therefore affect the decision to adopt this technology.

2.5.2 Studies on Cloud Computing Applicability

In terms of assessing cloud computing suitability, there are also relatively few studies in literature, that attempt to measure the applicability of cloud computing in public organizations. Previous research mostly focused on the business performance of cloud computing (Priyadarshinee et al, 2018) performance of software based-systems (Ali et al, 2020), and the internet performance of cloud computing (Attaran, 2017). From a different point of view, Khayer et al, (2020) assessed how small and medium enterprises' (SMEs') performance could be affected by adopting cloud computing. In this study, structural equation modelling (SEM) and an artificial neural network (ANN) were integrated as a dual-stage analytical approach. The findings showed that perceived risk, relative advantage and top management support should be given more attention by IT managers. The findings of the neural network analysis also showed that server location, facilitating conditions, relative advantage, service quality, top management support, computer self-efficacy, perceived risks, cloud provider's influence and resistance to change were the main drivers of cloud adoption. Although this study attempted to measure the SMEs' performance, cloud computing applicability specifically for public organizations was not measured which is the main focus for the current study.

In addition, Ali et al, (2018) proposed a model that aimed to measure academic performance through cloud computing adoption. The TAM theory was employed as the theoretical base for this study. A survey was carried out with 322 students in Pakistan and the results showed that the performance was affected by knowledge sharing, learnability and knowledge application which can be carried out through different types of cloud computing services which can be integrated into educational settings without too much difficulty. The main purpose of this study was to measure the extent to which performance was enhanced through cloud adoption so this technology acceptance and use was measured through an adapted TAM model. The factors affecting the performance were thus determined. However, the cloud computing applicability into public organization was not assessed; and the authors suggested that more investigations were required before the results of their study could be generalizable in other contexts.

Alshahrani (2021) investigated cloud computing influence on the performance of small and medium organizations in Saudi Arabia. A framework was developed based on technology-organization-environment. The result showed that cloud computing had a positive effect on the performance of small and medium organizations. As this study focused on assessing small and

medium enterprises performance, large and public organizations were out of scope. Also, date was collected only from enterprises located in Riyad city. This study also lacked any qualitative examination of the proposed factors.

Ataş and Gungor (2014) analysed cloud computing services and proposed a framework for evaluating the performance of PaaS providers. A set of benchmarking algorithms were also proposed to help select the most appropriate PaaS providers. Duan (2017) proposed an evaluation of cloud computing services using a survey from the system modelling perspective. In this paper, the authors focused on status, challenges and opportunities associated with cloud computing adoption. Although both these studies focus on measuring PaaS performance and cloud services, cloud computing applicability was not examined.

A review of these studies shows that there is a gap in the literature with regard to measuring cloud computing suitability for public organizations and for e-government services in particular. Also, the decision about whether cloud computing is suitable and viable with the organizations' current needs and structure is significant, and needs to be considered in some detail. This research therefore fills the gap by measuring cloud computing applicability for public organizations in Saudi Arabia.

2.6 Chapter summary

This chapter provides details of the research background. In this chapter, cloud history, deployment and services are discussed briefly. This chapter also brings into sight details around the deployment model implemented by governments. The current e-services provided in the Kingdom of Saudi Arabia along with the current Saudi e-government implementation are mentioned. The chapter also provides an overview of the Saudi Vision 2030 and the M-government services currently being offered. The literature related to cloud computing adoption in the public sector is reviewed, and the knowledge gap left by these studies, which the current study proposes to fill, is identified. The next chapter reviews the research framework for the study.

Chapter 3: The Research Framework

Theoretical models used for analyzing the adoption of cloud computing for e-government are reviewed with particular reference to Roger's Diffusion of Innovation (DOI) theory (1995), Tornatsky and Fleischer's Technology Organization Environment (TOE) framework (1990), TAM, UTAUT and the Fit Viability Model (FVM) (Liang et al., 2007). These models are reviewed, then model proposed for the current research is then outlined in terms of its relation to prior research and the hypotheses generated by the model are stated.

3.1 Technology Adoption Theories

The adoption process of a new innovation is a sequence of steps of decision-making that individuals have to pass thorough (Rogers, 1995). This process results in a decision (to accept or to reject) which can be made by individuals in a particular organization within a specific context (Li, 2008). In the context of this research, the factors influencing the decision of public organizations in Saudi Arabia to accept or reject cloud computing adoption are investigated. Based on the existing body of literature, there are few studies that have empirically examined the factors affecting the decision to adopt cloud computing in public organizations in Saudi Arabia. However, as an alternative body of knowledge, studies such as those on e-commerce models can be considered to investigate factors affecting the acceptance of e-services in public organizations (Lai & Pires, 2009; Carter & Belanger, 2005).

3.1.1 The Technology-Organisation-Environment (TOE) Framework

The Technology-Organisation-Environment framework has appeared in literature in various ways; and has been used to demonstrate the adoption of new technologies in many domains including health care (Lee & Shim, 2007), manufacturing (Mishra et al. 2007; Zhu et al. 2006) sales and services related to finance (Zhu et al. 2006; Yogesh et al, 2012). According to Boumediene et al., (2013) the TOE was proposed by Tornatzky and Fleischer (1990), and typically aims to streamline the adoption through assessing different factors technologically, organisationally and environmentally (see Figure 3.1). It has been noted that this model is used commonly for technology adoption/diffusion studies (Zhu et al., 2003). The TOE theory has been examined in different regions within developed and developing countries (Zhu et al, 2003). In terms of the factors used when adopting this theory, changes can be made to the original

proposed factors depending on the context of the technology, organisation and environment (Yogesh et al, 2012). In other words, while researchers have no disagreement that the TOE factors (technology, organisation, and environment) have an effect on adopting a new innovation, they argue that the factors and their measurement can be different depending on the context of the technology being investigated (Yogesh et al, 2012).

Moreover, several researchers have defined the conditions of the TOE theory, for instance, Al-Qirim, (2006); Awa, Ojiabo et al., (2015); Jeyaraj, Rottman & Lacity, (2006); Sabherwal, Jeyaraj & Chowa, (2006); Tornatzky & Fleischer, (1990) and Zhu et al., (2003) all point out that technologies are adopted by organisations either internally or externally'. Internal technologies refer to technologies that are already in the organization while external technologies refer to technologies which have not yet been adopted by the organisation (Al-Hujran et al., 2018).

There are numerous other factors presented in the literature in terms of cloud adoption including: relative advantage (Oliveira et al., 2014), security (Palmer, 2019; Alkhater et al 2014), privacy (Alkhater et al 2014), trust (Alkhater et al 2014), compatibility (Palmer, 2019; Wilson et al., 2015), complexity (Wilson et al., 2015) and also uncertainty (Alshamaila et al, 2013). In terms of organizational factors however, studies include factors, such as size of organisation upper management support, culture of the context, managerial complexity and human quality of the capital. Organisational context is very essential to the adoption of any technology. For instance, top management support can play a vital role in the adoption process as it may include system or processes integration, resource allocation and restructuring processes (Low et al., 2011). The environment context relates to the organisation's structure and size, competitors of the organisation and the regularly regulation of the environment (Tornatzky & Fleisher 1990).

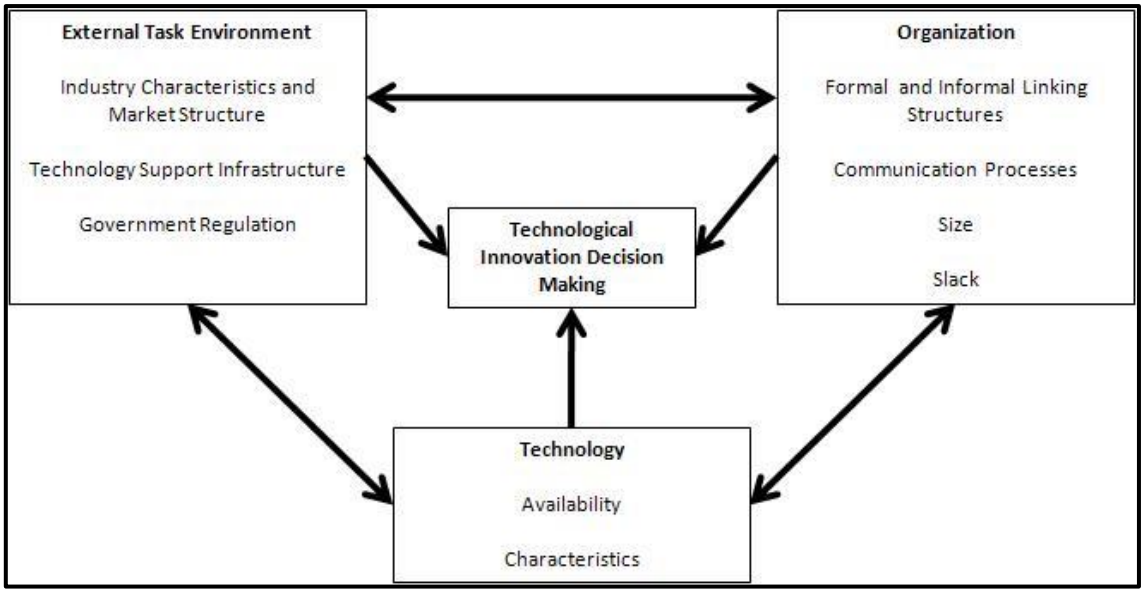

Figure 3.1: The TOE framework. (Source: Tornatzky & Fleischer, 1990)

Many previous researchers have applied this theory in their studies, particularly in the context of cloud computing. For instance, McKinnie (2016) proposed a model based on the TOE framework examining the factors that influence the adoption of cloud computing in US firms. Kumar et al. (2017) also proposed a model for Indian small and medium-sized enterprises using the TOE model. Similarly, Hassan et al. (2017) conducted a quantitative study assessing the factors affecting the adoption of cloud computing in small and medium-sized, enterprises.

3.1.1.1 Limitations of the TOE

According to (M et al, 2010) the factors in the TOE are not clear and need further investigation in order to be applied in a study; the TOE does not provide an accurate result (B et al, 2009); and the TOE model needs more variables and refinement when it is applied to a large context (K et al., 2005). Also, the TOE has a shortage of factors in the technology dimension. It has been further recommended that the TOE should have more factors that can cover other areas, such as sociological factors, the viability of technology and security issues for a more robust investigation (Musawa & Wahab, 2012). In particular, this model was not used in this research due to the lack of consistency in terms of outcomes. Its limitations make it unsuitable for the nature of this study (Fitness and Viability of cloud computing).

3.1.2 The Technology Acceptance Model (TAM)

The Technology Acceptance Model was proposed by Davis in 1987 He stated that technology use is a response that can be measured and predicted through the intention of users (as shown in Figure 3.2 below).

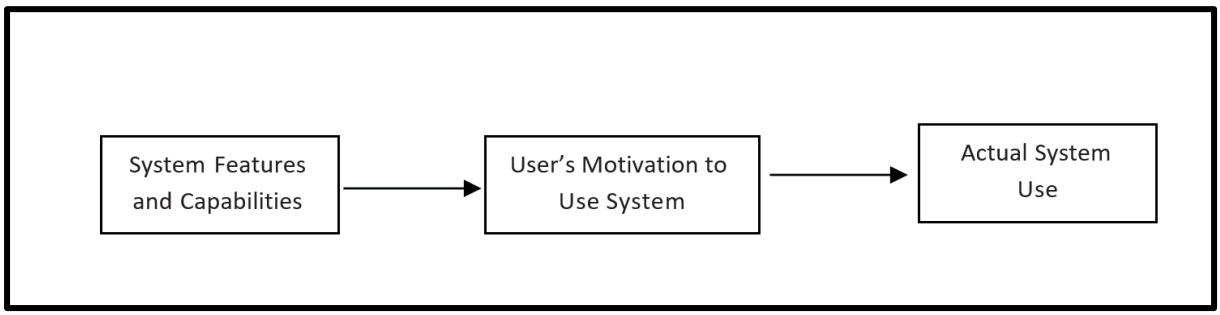

Figure 3.2: The conceptual framework for Technology Acceptance Model (Source: Davis, 1987)

By further investigation in literature and based on previous work by Fishbein and Ajzen (1975), the Technology Acceptance Model (TAM) was modified further by Davis and presented as follows:

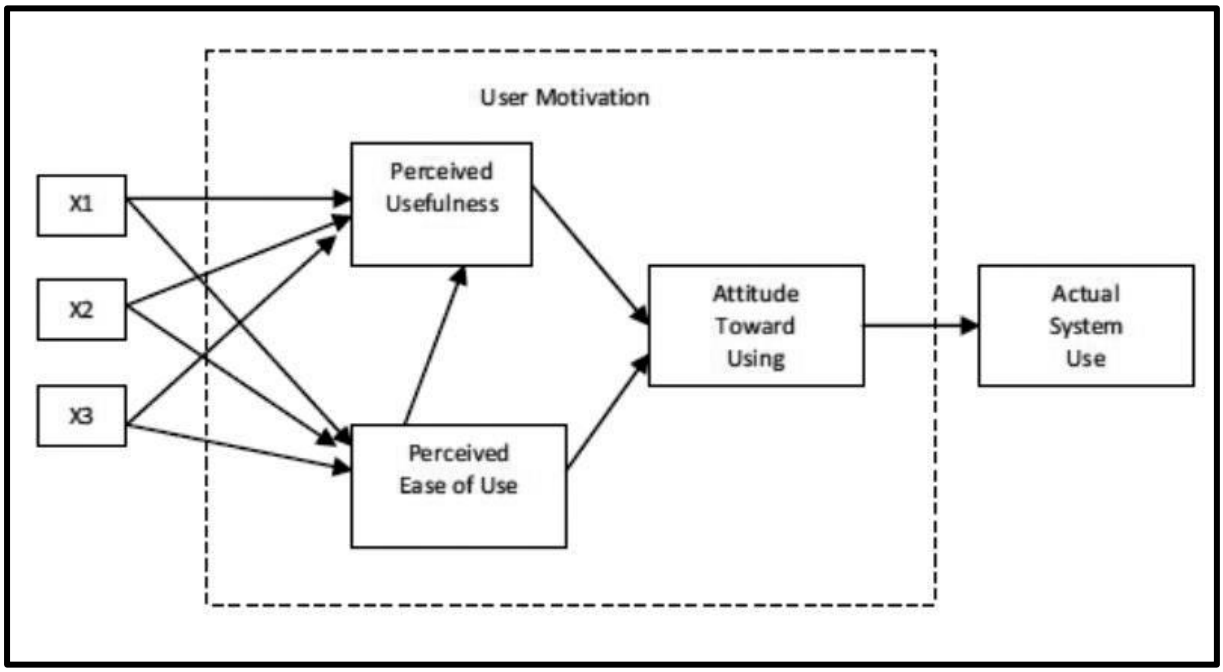

Figure 3.3: The original TAM Model (Source: Davis, 1987)

In this model, Davis outlined that the motivation of users can be measured through three different factors: Perceived Usefulness, Attitude towards Using the Technology, and Perceived Ease of Use. He suggests that the intention of users to accept or to reject the technology is a significant factor. According to Davis et al. (1989), the potential adoption of a new system by a set of people or enterprises can be predicted through this model. The TAM model can be applied to several types of technologies while however a combined or extended model can bring better outcomes than TAM by itself (Lou et al., 2000).

Since its proposal, this model has been applied in various contexts by studies in the literature. For instance, Waleed (2013) examined social media use for collaborative learning using TAM; Liu at el. (2010) also examined the factors influencing the intention to use an online learning community; and similarly, Dash et al, (2011) conducted a quantitative study in India to outline the influence of attitude on the adoption of Internet banking.

3.1.2.1 Limitations of the TAM

According to Chen and Tan, (2004), the TAM has led to misunderstandings in some studies' outcomes. One of the major concerns is that TAM model does not examine actual technology adoption behaviour because it focuses on participants' perceptions of adoption and their intentions (Garacˇa, 2011). The TAM also has a lack of clarification and predication of outcomes. In terms of results obtained through utilizing the TAM model, Williams et al. (2009) argued that due to the number of previous studies using this model, it causes a somewhat weak outcome and repetition. This model is not adopted, as more factors need to be considered and included to obtain a robust result. Also, the factors examining technology viability are not sufficient for our purposes.

3.1.3 The Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) was proposed by Venkatesh et al. (2003) for investigating user acceptance of a technology (see Figure 3.4).

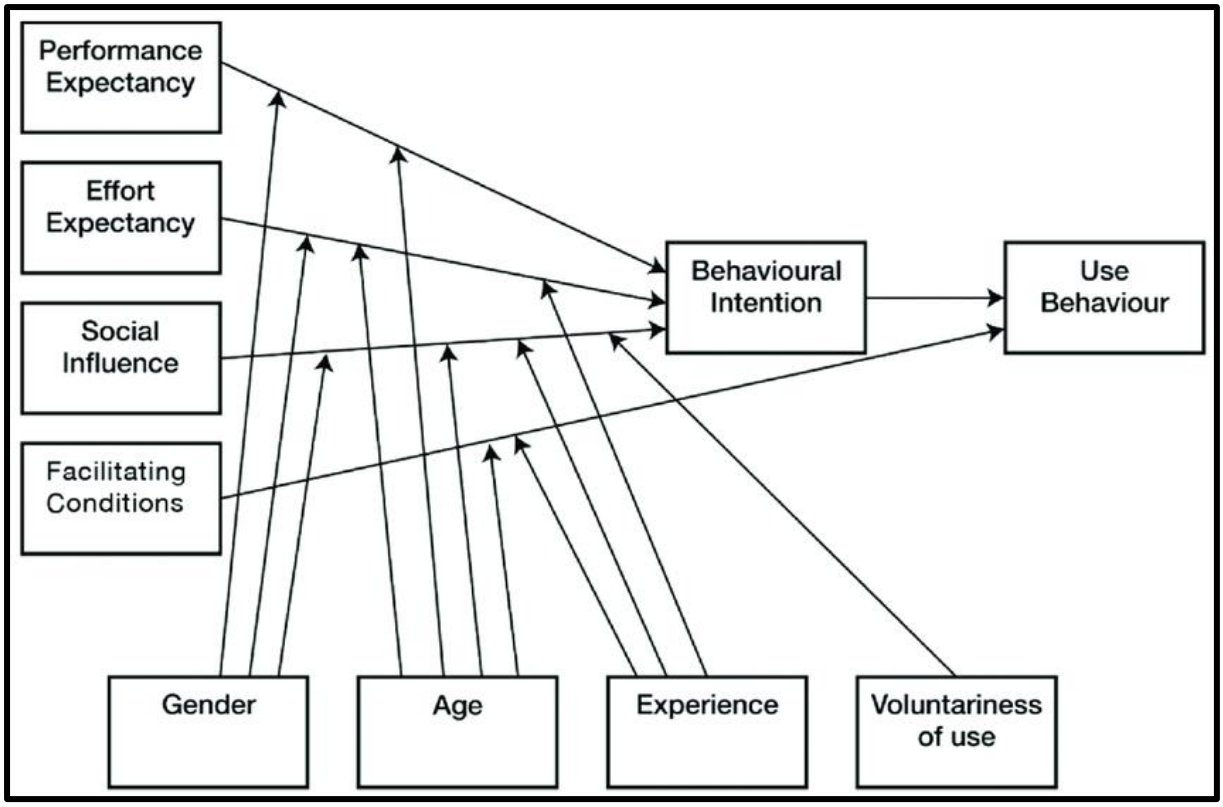

Figure 3.4: Unified Theory of Acceptance and Use of Technology, (Source: Venkatesh et al., (2003)

The authors of the model proposed that four main factors (performance expectancy, effort expectancy, social influence and facilitating conditions) have an influence on behavioural intention and use behaviour (Venkatesh et al., 2003). The UTAUT has been used in several studies that investigate the factors affecting cloud computing adoption. For instance, Alshehri, (2012) used the UTAUT model to identify the factors that affect the acceptance of E-government services in Saudi Arabia. Altalhi, (2021) also used the UTAUT to examine the acceptance of massive open online courses in higher education. Similarly, determinates that influenced the use of m-commerce were examined and the results showed that cost, effort expectancy and performance expectancy were the factors affecting users` motivation to use m-commerce technologies (Alkhunaizan & Love, 2012)

Moreover, the UTAUT has been considerably used in the context of cloud computing. A study conducted to examine the acceptance of cloud computing using the UTAUT factors, added trust as the main factor, and suggested a revised model including adding trust factors to the current factors of UTAUT for cloud computing acceptance (Alharbi, 2014). Another study assessed the adoption factors for using e-learning systems in a Saudi university, and found that performance expectancy and effort expectancy significantly

affected the intention to use the e-learning system. Moreover, a study was carried out to assess the factors that affect the behavioural intention of staff working in healthcare sectors in developing countries focusing on Malaysia, Pakistan and Saudi Arabia. This study concluded that performance expectancy, effort expectancy, facilitating conditions, and social influence were the most important factors influencing staff intentions, and that social influence was the least important factor affecting intention.

3.1.3.1 Limitations of the UTAUT

The UTAUT model has three different limitations. Firstly, it does not provide an emphasis on the external elements that may affect the technology adoption. Secondly, there is a lack on some factors when it comes to uncertainty. For instance, behavioural intention is weak in predicting the period between intention and behaviour. Thirdly, actions or events that are not in control of users cannot be predicted by behavioural intention (Venkatesh et al., 2008).

According to Straub, (2009), there is also an absence of a self-efficacy factor, and this should have been included along with behavioural intention as a direct factor affecting use; i.e., the higher the self-efficacy, the higher the motivation to adopt the technology. The UTAUT needs more factors to be effectively used to measure technology acceptance (Moghavvemi et al., 2013).

3.1.4 The Diffusion of Innovation Theory (DOI)

Diffusion of Innovation is understood as the way that a new innovation is conveyed to people. Innovation can be a notion, object or behaviour that is understood as new by its users (Robinson, 2009). Historically, this method was proposed by Gabriel Tarde in 1903 who presented the first S-shape of diffusion. He was followed by Ryan and Gross in 1943 who suggested the classifications of adopters which were used by Everett Rogers in the current model (Robinson, 2009). The classifications of adopters include innovators, early adopters, early majority, late majority and laggards, and is shown in Figure 3.5 below:

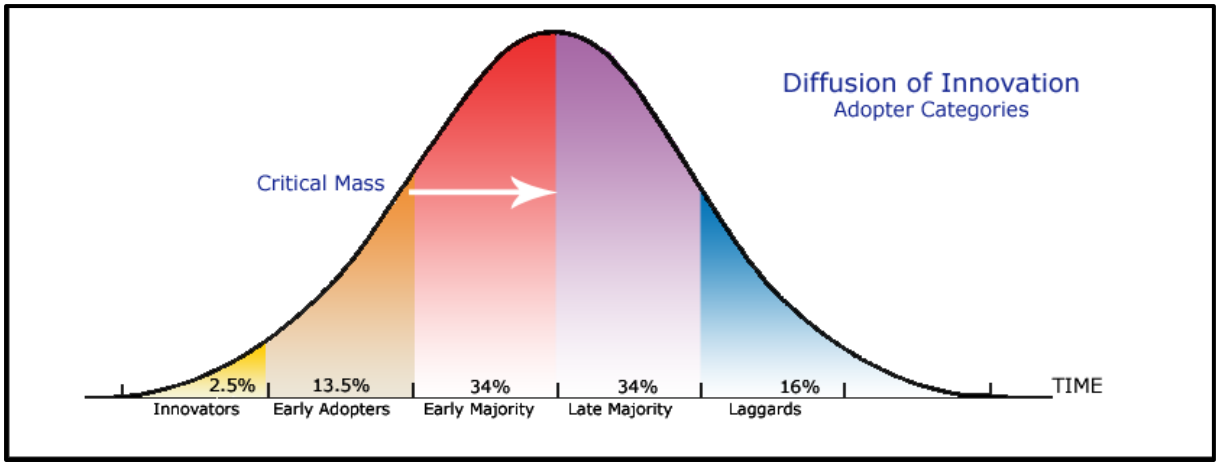

Figure 3.5: Diffusion of Innovation Theory (Source: Rogers, 1995)

The theory of Diffusion of Innovation has been adopted in a wide range of studies in different fields to help understand the way that new innovations are adopted into the wider social network (Moseley, 2004; Rogers, 2004). Furthermore, there are five constructs in the theory of DOI including: relative advantage, compatibility, complexity, trialability and observability (Rogers, 1995).

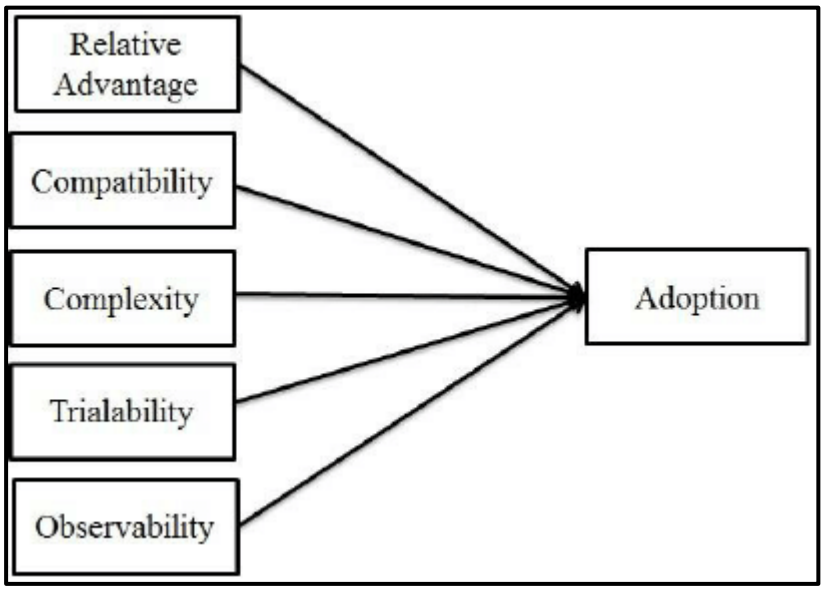

Figure 3.6: Diffusion of Information Constructs (Source: Rogers 1995)

- **Relative Advantage**

Relative advantage refers to the benefits obtained over the current system being replaced. The more benefits are gained, the quicker the system will be migrated to by users (Lundblad, 2003). Relative advantage has been defined differently in literature. According to Hsbollah, (2009), it is the extent to which a user aims to take advantage of the related benefits offered by the innovation and to overcome their uncertainty about it.

It is also defined as the costs that may result from accepting the new innovation (Rogers, 1995). Relative advantage is suggested to have a positive impact on the adoption rate (Al-Jabri & Sohail, 2012). It has been noted that when users well-understood the relative advantages offered by the new technology, the likelihood of adopting is high (McCloskey 2006; Rogers 2003).

Relative advantage has been used widely in the context of cloud computing and has been found to have a positive influence on adoption in many studies (Stieninger et al, 2018; Low et al, 2011; Senarathna et al, 2018; Tehrani and Shirazi, 2014;; Gangwar et al , 2015; Alhammadi et al , 2015)

Further, a study conducted on proposing a decision-making framework for cloud adoption found out that relative advantage is among the factors that positively affect the adoption (Morgan & Conboy, 2013). Another study conducted on examining the factors affecting the adoption of cloud computing revealed that among eight factors, relative advantage has a significant impact on cloud computing adoption (Low et al., 2011). Further, Harfoushi et al., (2016) assessed the factors affecting the intention of Jordanian hospitals to adopt cloud computing. In this study, the researchers used a quantitative methodology surveying 223 IT sectors in Jordan. The result illustrated that relative advantage has an impact on the adoption of cloud computing. Similarly, other scholars attempted to identify the factors affecting the cloud adoption and found that, from the technological perspective, relative advantage has a positive effect (Gangwar & Ramaswamy, 2015).

It can be observed that relative advantage has importance in other contexts in literature. This research therefore considers relative advantage as one of the factors to be examined particularly in the context of Saudi Arabia and proposes the following hypothesis:

***H1b**: Relative advantages positively affect cloud computing fitness for public organizations` computing needs for e-government services implementation.*

- **Compatibility**

This refers to the extent to which the new innovation is compatible and consistent with the adopter`s requirements; the more consistent the new innovation is, the higher the chance of adoption (Lundblad, 2003). Compatibility is also defined as the extent to which the technology is consistent with the current values, experience and needs of the adopter

(Chen et al. 200). According to Al-Gahtani, (2003), the compatibility factor has a significant impact on the acceptance of computer technologies in Saudi Arabia.

Compatibility has been presented and used in different contexts in the literature (Tehrani and Shirazi, 2014; Gangwar et al., 2015; Oliveira et al., 2014; Singh; 2019; Wilson et al., 2015; Odeh et al, 2017)

Further examples include an empirical study using an online survey to understand the determinates influencing cloud service adoption carried out by Stieninger et al. (2018). The outcomes of this study revealed that compatibility can result in a positive attitude towards adopting cloud computing. Alhammadi et al. (2015) also examined the factors that influenced the adoption of cloud computing in Saudi Arabia and found that compatibility significantly affected adoption. Moreover, a study aiming to examine the factors that have a direct effect on the adoption in private sectors in Saudi Arabia similarly outlined the significance of compatibility on cloud adoption (Alkhater et al, 2018). Through an intensive review of the literature, the researcher found that compatibility has mostly affected cloud adoption directly and positively. Previous studies focused on examining this factor in the context of cloud computing adoption for private and medium enterprises; and more investigation needs to be conducted into public sector adoption. As a result, this research embraces compatibility as one of the main factors to investigate the factors affecting cloud computing adoption in public organisations in Saudi Arabia and proposes the following hypothesises:

***H1c**: Compatibility positively impacts cloud computing fitness for public organizations` computing needs for e-government services implementation.*

- **Complexity**

Complexity means the extent to which the new innovation is complex for the adopter (Cheung et al., 2000). Simple innovations are accepted more quickly than difficult ones (Lundblad, 2003). Researchers have shown that adoption is rarely affected by complexity. (Hsbollah, 2009). It is expected that cloud computing is understood and is easy to use, and the Cloud can be complex if integrated with current systems (Tashkandi & Al-Jabri, 2015).

On the other hand, other researchers stated that Complexity is negatively affecting cloud adoption. (Tashkandi & Al-Jabri, 2015) for instance, identified the factors affecting cloud computing in higher education sectors in Saudi Arabia using SMART Partial Least Square (PLS). Their model was proposed based on the TOE model factors. The result showed that complexity had a negative impact on the cloud adoption. Furthermore, another study was carried out in Tamil Nadu using TOE model to investigate the key factors that effect and prevent small and medium enterprises from adopting cloud computing (Wilson et al, 2015). The study highlighted that among the other technological factors, complexity has been found as a major enabler that affects the adoption of cloud computing (Wilson et al, 2015). More research has included complexity to their studies to assess the acceptance and intention of accepting technologies generally and cloud computing specifically Stieninger et al, 2018; Wilson et al., 2015; Swanson, 1995; Tashkandi and Al-Jabri, 2015; Salem and Hwang, 2016). It has been anticipated that complexity negatively affects cloud computing (Tashkandi & Al-Jabri, 2015). Therefore, this research includes complexity and proposes the following hypothesis:

H1d*: Complexity negatively impacts the cloud computing fitness to public organizations` computing needs for e-government services implementation.*

- **Trialability**

Trialability refers to the extent to which the users aiming to adopt the technology can try it out and test it before they fully implement or integrate it. The more ability users have to test the technology, the less uncertainty they have towards it, which results in a quicker adoption (Lundblad, 2003). This point was also supported by Tan and Teo (2000) who emphasised that trying an innovation prior the final employment can reduce fears and raise confidence in using it.

Like the other factors, trialability has been used in several studies in the literature (Isma'ili et al, 2016, Swanson ,1995; Hammouri and Shanab, 2020). However, trialability does not have the same effect as the previous factors (relative advantage, compatibility and complexity), as there is a variance in studies based on the context. and some studies find it significant while others do not. For example, Hsu and Lin (2016) carried out a study to investigate the factors affecting the cloud services using the TOE model in 102 organisations in Taiwan, and found that trialability was not significant as most users were

aware of the cloud services provided and the simple functionalities offered by cloud services due to their experience. On the other hand, Alshamaila et al., (2013) conducted an empirical study on small and medium enterprises in the UK and found that trialability had a direct influence on the adoption of cloud computing. Similarly, Alkhater et al., (2018) proposed an integrated model for adoption in the Saudi private sector collecting 300 samples, and found that trialability can positively impact the intention of the private sector to adopt cloud computing. As stated, trialability was presented differently in literature. As a result, this research includes trialability to further investigate its influence on the fitness and viability of cloud computing within the public organisations in Saudi Arabia and proposes the following hypothesis:

***H1e**: Trialability positively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation.*

- **Observability**

Observability has been defined in various ways. According to Lundblad (2003), observability refers to the extent to which the technology is visible to users. Once the technology is observable, the process of adoption can occur more quickly. Moreover, observability can be simply measured by asking users to imagine and describe the technology that they aim to adopt (Bennett & Bennett, 2003). There is not much indication of observability used in many studies, and researchers tend to replace this factor with other factors found to be significant in literature, such as security, trust, confidentiality and privacy.

This research incorporates the theory of DOI factors, as a positive relationship was found in the literature between the DOI factors (Relative advantage, compatibility, complexity and trialability) and fit (see Table 3.1). Hence, this study uses DOI factors to measure the fitness of cloud computing technology within the Saudi public sector to implement government services.

Table 3.1: Previous Studies on DOI Factors and Fit

Source	Relative Advantage	Complexity	Compatibility	Trialability	Fit	Context
Scott (2017)	√	√				College Instruction
Dishaw and Strong (1999)			√	√	√	Mobile Commerce
Lam, Cho and Qu (2007)				√	√	Software Maintenance
Zhang (2016)	√	√	√	√		Health Care
Nance and Straub (1996)	√				√	IT Adoption
Lien and Jiang (2017)	√	√	√	√	√	Diabetes Care
Qasem et al. (2018)	√	√	√		√	Cloud-based Education
Al-Sharafi et al. (2021)	√	√	√	√	√	Cloud Computing

- **Security**

Security is a vital factor to consider when investigating the factors influencing the adoption of cloud computing, as fears about poor security may deter some agencies from deploying the cloud. Security concerns can include physical security, accessibility to hardware and facilities, and compliance and legal security (Alassafi et al., 2016). In order to adopt a new innovation, users sometimes need to be able to be reassured of its security, so the perceived security can be very significant. In this research, the security factor was incorporated due the significance that it has been found to have on cloud computing adoption in previous studies. The security factor has been examined in several different fields of technology adoption, and appears in a wide range of studies on cloud computing adoption (e.g., Senarathna et al, 2018; Odeh et al, 2017; Alkhater et al., 2014; Salem and Hwang, 2016) also in mobile computing (Almaiah & Al- Khasawneh, 2020); Blockchain (Orji et al., 2020); and Internet of Things (Hsu & Yeh, 2017).

Clearly, security has a major impact on technology adoption overall and specifically in the context of cloud computing. Consequently, this research adopts the factor of security as one of main factors for adoption from the technological perspective. Including security also contributes to the framework by enabling a more comprehensive understanding of the

technological aspects affecting cloud computing adoption in public organisations in Saudi Arabia. This research therefore proposes the following hypothesis:

***H1f**: Security negatively affects the cloud computing fitness to public organizations` computing needs for e-government services implementation.*

3.2 The Theory of Task Technology Fit (TTF)

3.2.1 The Fit-Viability Model (FVM)

According to Zmud, (1982), one theory cannot always be utilized for explaining the acceptance and adoption of all kinds of innovation. In other words, one theory of acceptance may not be sufficient to explain adoption or intention to adopt for a specific innovation, like cloud computing, that is being used for a particular function, like e-government, in a particular socio-cultural context, like Saudi Arabia. A combined model was therefore needed to identify the process of adoption for the specific context in the current study. However, it was important to ensure that there was compatibility between any theoretical models used, that the factors were not replicated and that clear definitions were provided. The factors for the DOI are shown in Figure 3.6 in the previous section and the Fit-Viability factors appear in Figure 3.7 below.

An analysis of literature demonstrates that there is a link between DOI factors and those in the Fit-Viability model. The DOI factors have been employed to examine new technologies' applicability in many contexts, including mobile computing (Magsamen et al, 2020), social networking (Folorunso et al, 2010), virtual decision making, (Turban et al, 2011) and ERP adoption and implementation (AlBar and Hoque, 2019).

This study therefore uses DOI factors to measure cloud computing applicability for Saudi public organizations. However, one of the DOI's drawbacks is that it focuses more on the innovation and disregards economic factors (Patricio, 2017). Another drawback is that DOI only focuses on examining the technological characteristics, and the organizational viability is excluded. Integrating another theory that examines this viability was therefore needed. The suitability of new innovation includes not just the technological features but also the viability of the organization.

A review of the literature showed that FVM was the best theory to combine with DOI since it examined both the technological features and viability of the organization (Goodhue and Thompson, 1995). The Fit and Viability model was therefore deemed suitable to be combined with DOI factors to examine cloud computing applicability and Saudi organizations' readiness. The models are compatible and complement each other.

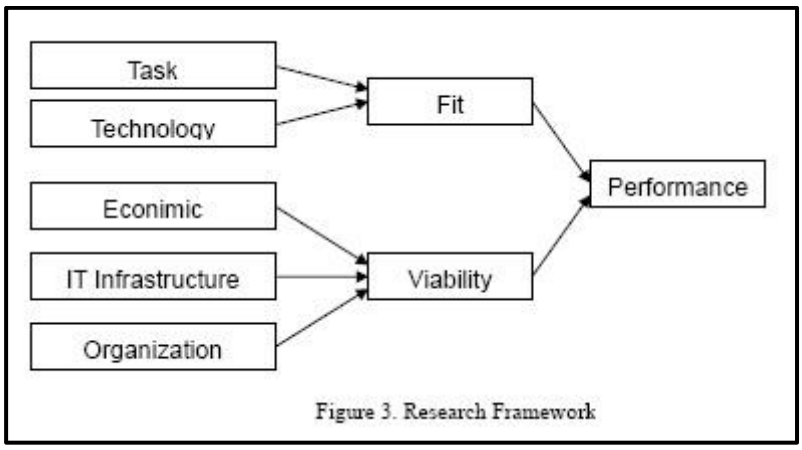

Figure 3.7: The Fit- Viability Model (Source: Liang, et al. (2007)

3.2.2 Review of the FVM Model for Cloud Computing Adoption

The FVM model has been adopted in many disciplines for various contexts; and incorporated into many studies conducted on cloud computing (Qasem et al., 2018; Tripathi & Nasina, 2017), decisions in organizations regarding social software fitness (Turban et al., 2011); business process management software including adoption of Enterprise Resource Planning (ERP) (Muhammad et al., 2013) and government initiatives (Larosiliere & Carter, 2013). An evaluation of previous research demonstrates that based on the context, researchers outline distinct factors to evaluate the fitness dimension (see Table 3.2). Academics thus measure fitness by determining some tasks required in the context, and subsequently choose a technology that has the characteristics that match with the context's tasks or requirements. Therefore, the fitness degree can ultimately be high. For instance, in the study conducted by Liang, et al. (2007), almost all seven evaluated studies showed a high level of fit (see Table 3.2).

Table 3.2: Previous Studies on the Fit Viability Model

Source	Context	Fitness Factors	Viability Factors
Killaly (2011)	Awareness of cloud computing in DOD (USA)	Computing platform Computing needs	Cost Organisational resistance
J. van (2019)	Mobile enterprises technology	Task IT infrastructure	Economic organisational factors
Nilmini (2018)	Mobile Health adoption	Data Format Operating procedures	National Factors Organisational factors
Larosiliere and Carter (2013)	E-Government maturity factors	Characteristics of related e-government tasks	Economic feasibility IT infrastructure Organisational readiness
Liang et al (2007)	Mobile technology adoption in business	Mobility Reachability	Economic feasibility Technical infrastructure
Tripathi and Nasina, (2017)	Cloud Computing	Task Technology	Economic IT Infrastructure Organisation
Turban and Liang, (2011)	Social Networking	information sharing, communication, training, knowledge management	feasibility, misuse and abuse, readiness, security, privacy, readiness, resistance, legal, IP and copyright,

3.2.3 Justification for Adopting the FVM

In this research, the FVM is applied to help illustrate whether cloud computing is an appropriate option to support the implementation of e-government services in Saudi public organisations. ***Fitness*** is described as the extent to which cloud computing is reliable for the particular tasks of e-government concerned; and is thus measured by specifying Saudi government-related requirements and assessing the impact of cloud computing to it by applying DOI factors and other factors found to be significant in the literature. ***Viability*** is defined as the extent to which Saudi public organizational environments are ready for adopting cloud computing. Viability is also measured by the perceived extent of potential value-added when adopting cloud computing within the e-government environment in Saudi public entities.

Moreover, the FVM model has been shown in literature as supporting comprehensive outcomes both in developed and developing countries. Several countries have attempted adopting cloud computing and considering it as a part of their e-government implementation strategies. As a result, this study proposes a model that measures two primary dimensions (Fitness and Viability) of cloud computing adoption into public government organizations in Saudi Arabia.

The FVM model has also been used to help assess other important adoption factors that have been identified. Many researchers have attempted to examine the fitness and viability of adoption into organizations; however, most of these studies focused on areas like adoption of mobile computing for business, and only a few of them addressed the adoption of cloud computing. In this research, therefore; the FVM is applied to help assess performance of cloud computing for adoption by Saudi Arabia public agencies. By examining the performance through the two dimensions of FVM (fitness and viability), the FVM can help address this objective effectively and comprehensively.

To test the fitness and viability of cloud computing for adoption to enhance the e-government systems of Saudi Arabia, this study proposes two main hypotheses:

***H1**: The fit of cloud computing to e-government task requirements positively affects Saudi public sector decisions to adopt the technology.*

***H2**: The viability of cloud computing positively affects Saudi public sector to adopt the technology.*

Fit is proposed by Goodhue and Thompson (1995) as the extent to which the technology capabilities can match the task requirements of an organization. Similarly, Lippert and Forman (2006) and Liang, et al. (2007 described it as the extent to which a technology can offer functionalities that can fit the requirements of the task. In this study, fit is measured by the extent to which cloud computing is appropriate for the requirements of e-government operations. Thus, cloud computing fitness can be measured by specifying e-government-related tasks as well as cloud computing characteristics.

Task features as a construct in the FVM and refers to the task requirements within the organisation (Yoo and Kim, 2019; Liang et al., 2007). According to Zigurs and Buckland, (1998), task requirements can be behavioural requirements or ability requirements. In this study, the task construct measures government requirements and the actions that are conducted to deliver e-government services, i.e., it assesses the computing needs of government organizations to operate e-services. According to the United Nations Department of Economic and Social Affairs, (2010) and Krishnan and Teo, (2011), launching e-government services online requires upgrading and operating the government systems to meet the task requirements. We therefore propose in this study the following hypothesis:

***H1a**: The E-government-related tasks requirements positively affect the fitness of cloud computing for implementing e-government services.*

3.2.4 Technological Context

By analyzing the technological factors affecting the adoption of cloud computing in previous studies in the literature (Alshamaila,et al, 2013; Morgan & Conboy, 2013; Fu & Chang, 2015), this study proposes relative advantage, compatibility, complexity, trialability and security as the factors to assess the technology aspect of cloud computing fitness for implementing e-government services.

Also, reviewing the literature indicates that there is a correlation between the fit construct and these factors (as shown in Table 3.2).

Viability: There are a number of factors affecting the organization's viability when adopting a new technology (see Table 3.2). Viability has been defined and proposed in the literature in various ways (Gangwar et al, 2015; Alhammadi et al, 2015; Oliveira et al, 2014; Feuerlicht and Govardhan, 2010; Yang, 2012; Hammouri and Shanab, 2020; Salem and Hwang, 2016). Liang and Wei (2004) examined viability by assessing economic feasibility, IT infrastructure and top management support. To be ready to operate e-government services, cloud computing, as a new paradigm with open standards, will need knowledgeable individuals and provision from top management. In addition, assessing its economic feasibility and analyzing the technological readiness of the organization is also vital. As a result, this study measures the viability of cloud computing in the public sector by examining the related economic, organisational and technological factors.

3.2.5 The Organisational Context

Based on the literature, the viability of an organization to run a new technology or a new system can certainly be affected by a number of organizational factors. Project team knowledge of IT (Poon & Wagner, 2001; Umble et al., 2003) and top management support (Umble et al., 2003) are influential factors of this type. Factors influencing the readiness of an organization have been presented in different ways. Liang et al. (2007) investigated top management support and user competences to assess the viability of mobile technology in business organizations. Turban et al. (2011) focused on employee training and top management support to measure the viability of an organization to implement social networking. In relation to cloud computing, academics have examined the influence of factors (such as top management support, cloud awareness and prior background on the adoption of cloud computing) in the private sectors, and shown these to be significant (Low et al., 2011; Tehrani, 2013). Thus, top management support and cloud knowledge are key factors to be assessed regarding cloud computing viability for government implementation.

3.2.5.1 Top Management Support

Many studies pointed out the importance of top management support when adopting a new innovation (Swink, 2000; Colwell & Joshi, 2013; Lin, 2010). According to Kandelousi et al., (2011), top management support can be defined in many ways. For instance, top management support refers to the help provided by the upper administration to the project teams and leaders. Another definition is seen as that upper management enables all resources including human, hardware/software and finance. Essentially, top management can make a very important impact on the selection of the project team and the definition of the scope (Boonstra, 2013). Furthermore, top management improves project leaders' relationship with the other parties (Brochta, 2008). Further, top management commitment leads to a completion of adoption implementation process (Dong et al, 2009; Mithas et al, 2011).

Numerous studies have outlined that top management is a key enabler in the success of cloud computing adoption. In fact, researchers rank upper management support as one of the most influential factors affecting cloud computing adoption (Yebah & Essandoh, 2014). Table 3.3 presents studies that have found top management to be significant to the adoption of the cloud computing:

Table 3.3: Previous Studies Review on Top Management Support

Year	Author(s)	Objectives	Context
2016	Malak	Investigate the factors affecting intention to adopt cloud computing	Cloud Computing
2019	Misra et al	Investigate the factors effecting cloud services	Cloud Services
2015	Gangwar et al	Understanding determinants of cloud computing adoption	Cloud Adoption
2016	Al-Jabri et al	Examining the factors affecting cloud computing	Cloud Adoption
2014	Lian et al	Assessing the factors affecting the cloud	Cloud Adoption
2019	Jewan and Vibhakar	Factors affecting cloud computing adoption	Cloud Adoption
2011	Chinyao and Yahsueh	Understanding the determinants of cloud computing adoption	Cloud Adoption
2012	Alshamaila and Papagiannidis	Identify cloud computing adoption factors	Cloud Adoption in SMEs

Clearly, top management support is one of the most important factors that can have an influence on the adoption of any new innovation. Successful and continuous top management support can lead to a better adoption of the technology (Swink, 2000). Top management support has been defined in the literature as a vital factor on the adoption of cloud computing. This research therefore includes it and proposes the following hypothesis:

***H2d**: Top management support positively affects the viability of cloud computing for implementing e-government.*

3.2.5.2 Cloud Knowledge

Adopting cloud computing by an organisation requires knowledge of what benefits can be obtained from the Cloud. Personnel who will be engaging with cloud computing should be also well-educated and trained on all cloud aspects (Buyya et al., 2011). Cloud knowledge can be defined as the degree to which cloud users can perceive the usefulness and the improvement that can affect their work performance (Davis, 1987). The adoption of the technology starts when the users have knowledge about it (Rogers & Shoemaker, 1971). Cloud Knowledge is found to be a critical factor in previous studies conducted on cloud adoption. According to Opitz et al, (2012), awareness of cloud computing is a significant factor that strongly influences the adoption of cloud computing. Researchers also found a strong relationship between perceived knowledge of the Cloud and adoption (Sugandini et al., 2018). Thus, knowledge about cloud computing is a significant predictor of adopting or not adopting cloud computing. This research therefore proposes the following hypothesis:

***H2e**: Cloud Knowledge positively affects the viability of cloud computing for e-government implementation.*

3.2.6 Technological Readiness

This refers to the organizational resources that impact the organization's intention to adopt a new system or a technology. According to Oliveira and Martins, (2010), Pan and Jang, (2008), and Zhu et al., (2006), organizational resources encompass IT staff and IT infrastructure. Due to the lack of standards for utilizing cloud computing, open standards for the cloud should be recommended by governments (Australian Academy of Technological Sciences and Engineering, 2010). In the literature, the influence of technology readiness on the decision of

cloud computing adoption has been examined by different researchers. Low et al. (2011) measured the readiness based on IT human resources and IT infrastructure. Also, Morgan and Conboy (2013), Tan and Lin (2012), and Nkhoma et al, (2013) explored the influence of organizational readiness in respect to knowledge of human resources on the decision to adopt cloud computing and issues of privacy. In terms of this study, IT infrastructure, skills and policies are chosen to examine the effect of technological readiness on the viability of cloud computing.

3.2.6.1 IT Infrastructure

IT infrastructure means the computing resources that are available in an organization (Mutula & Van Brakel, 2006). The capability of the existing ICT infrastructure within the organization to run or not run and integrate the new system has an important impact on the decision to adopt or not adopt the new system.

A review of literature indicates that IT infrastructure is one of the major concerns in terms of connectivity, provision of electrical power and internet accessibility and reliability. (Sugandini et al., 2018). IT infrastructure in organizations should be viable for cloud computing technology in order to successfully run it. It is anticipated that having a complete infrastructure with good internet connectivity is a major task for the adoption of cloud computing (Sugandini et al., 2018). The infrastructure of cloud computing services is complex; and cloud computing can only be used if the organizations` infrastructure is ready for it (Tan, 2012). A study conducted on assessing the success and failure of mobile computing adoption using the Fit-Viability model measured IT infrastructure based on the maturity of equipment and software, data management and IT employee proficiency. The result showed that these three factors are significantly affecting the mobile computing adopting (Liang et al., 2007). Hence, this study proposes the following hypothesis:

***H2f**: The perceived viability of cloud computing for offering e-government services is positively affected by IT infrastructure.*

3.2.6.2 IT Skills

Adopting a new technology and system requires experienced individuals within the organization. The capability and skills of IT employees increase the potential for successful

execution of the new system. According to Saini, (2012), the success of cloud adoption relies on the simplicity of learning it for employees. The more trained and well-experienced employees within the organization, the more likely the viability of cloud computing. Hence, this research proposes the following hypothesis:

***H2g**: The perceived viability of cloud computing for offering e-government services is positively affected by IT Skills.*

3.2.6.3 IT Policies

The adoption of a new system can be influenced by government policies and IT regulations (Alshehri & Drew, 2010). IT policy refers to organizational and government requirements including guidelines, standards, regulations, laws or directives which resolve IT issues such as security and privacy, availability and accessibility. Hence, this research proposes the following hypothesis:

***H2h**: The perceived viability of cloud computing for offering e-government services is positively affected by IT Policies.*

3.2.7 Economic Feasibility

This refers to the degree to which the economic benefits to be achieved exceed the economic cost. Whether or not a specific technology/application is profitable can be determined through its economic feasibility. It also refers to whether or not a technology can reduce the cost and can provide a satisfactory return on investment (ROI). Therefore, it consists of two different parts: ROI and transaction costs. ROI examines the benefit vs. the cost of a specific IT project to demonstrate if the investment can provide acceptable return. Moreover, users` willingness to adopt a technology is likely increase if the transaction costs are reduced. Elements affecting the transaction costs can differ from one technology to another. For instance, in the context of mobile technology adoption, Liang, et al. (2007) discussed asset specificity, uncertainty and frequency whereas Turban, et al. (2011) identified employee training cost, compatibility cost and software/hardware maintenance costs for the adoption of 2.0 tools. In terms of cloud computing adoption, uncertainty

(Alshamaila et al., 2013; Nuseibeh, 2011) and asset specificity (Rieger et al., 2013; Lian et al., 2014) were found to be significant factors affecting adoption.

3.2.7.1 Return of Investment (ROI)

In order to understand the Return on Investment (ROI) obtained from the Cloud, its impact on the business, people and future system integration should be understood. Regarding Return on Investment (ROI) relating to cloud adoption, organizations invest in order to reduce costs, increase profits and streamline the business process (Solovy & Chaiken, 2003; Colkin, 2002). According to Liang et al, (2007) to measure the viability of an organization, assets must be specified, and investment and uncertainty should be taken into consideration. As a result, this research proposes the following hypothesis:

H2a*: The viability of cloud computing to e-government implementation is positively affected by return on investment (ROI).*

3.2.7.2 Asset Specificity

According to Liang et al., (2007), this refers to specifying the assets that are needed for organizations when implementing a new system or adopting a new technology. The cost of obtaining hardware and software as well as the cost of integration of cloud computing adoption in hospitals were investigated by Lian et al. (2014). In this study, asset specificity can be seen and defined as the cost of human (consulting and training) and physical (software, hardware, integrating and licensing) requirements to successfully adopt cloud computing to implement e-government services. Asset specificity can have a positive effect on the viability of cloud computing adoption as cloud computing can reduce the cost of obtaining heavy infrastructures. The following hypothesis is therefore proposed:

H2b: *The viability of cloud computing to e-government implementation is positively affected by asset specificity*.

3.2.7.3 Uncertainty

According to Knight, (1921), uncertainty means the extent to which an adopter has inadequate awareness about describing the outcomes of using a new technology. Uncertainty was also defined by Liang et al. (2007) as an element that economically influences mobile technology for an organization. In term of cloud computing, concerns

about data storage and access control increase the level of uncertainty. In the literature, uncertainty has been examined as a negative factor in technology adoption (e.g., Alshamaila et al., 2013).–Moreover, uncertainty can increase transaction costs. According to Miller, (1992), uncertainty can raise the transaction costs due to the high risk. Subsequently, the transaction costs can be impacted by the cloud computing uncertainty of public sectors which in turn can economically affect the viability of cloud computing in the context of government implementation. The following hypothesis is therefore proposed:

H2c: *The viability of cloud computing to e-government implementation is negatively affected by uncertainty.*

3.3 Simple Adaptive Weighting (SAW)

The SAW method can be defined as a weighting linear combination or scoring method. It commonly addresses issues related to multi-attribute decision-making (Putra & Punggara, 2018). The SAW method is employed in many areas where decision-makers aim to choose among different alternatives; and in SAW analysis, the policy-maker or the person taking the decision gives weight to the attributes (Putra & Punggara, 2018). The total weight of the attributes can be calculated by adding up all the attribute values. The SAW method is accurate as it relies on pre-identified attributes and preference weights (Putra & Punggara, 2018). The calculation of SAW is conducted based on the following formulae:

$$r_{ij} = \frac{x_{ij}}{Max(x_{ij})} \qquad r_{ij} = \frac{Min(x_{ij})}{x_{ij}}$$

Part of the SAW analysis involves calculating the preference value, which can be arrived at through the following formula (Nurmalini & Rahim, 2017):

$$V_i = \sum_{j=1}^{n} w_j r_{ij}$$

The SAW method has been applied in previous research and shown to deliver a precise prediction. Ibrahim and Surya, (2019) applied the SAW method for selecting the best school

in Jambi. The SAW was also applied to examine the selection of product suppliers (Pawan et al., 2020); road selection suppliers (Pavolova et al., 2017); personnel selection (Afshari et al., 2010); selecting the best singer (Cahyapratama & Sarno, 2018); and the selection of a trusted network (Savitha & Chandrasekar, 2011). As a result, this research applies the SAW analysis to help identify the best cloud model for public organisations in Saudi Arabia (see Chapter 6 section 6.13).

3.4 The proposed DOI and Fit and Viability (FVM) framework

After a careful review of the literature, a proposed model for investigating the factors affecting cloud computing adoption in the Saudi public sector has been developed. The model consists of three dependent factors: *Adoption*, *Fit* and *Viability*. The fit construct includes six independent factors namely: *Task*, *Relative Advantage*, *Compatibility*, *Complexity*, *Trialability* and *Security*. These variables were developed from the DOI determinates along with the security factor. Security has been included in the framework due to its significant influence on the adoption of cloud computing in other developed and developing countries.

Viability is examined along three different dimensions (the organizational, technological and economic perspectives). As mentioned in the model below, each of these dimensions has different independent factors. These independent factors were chosen to investigate the viability of cloud computing for public organisations.

The overall model was developed by assessing the significance of factors utilised in previous studies. This model`s factors were also used to address research questions 3 and 4:

- *Do cloud computing factors identified in question 1 influence the performance of cloud computing adoption in Saudi public organisations?*

- *Which cloud model do policy makers believe is the most appropriate for Saudi e-government?*

This is a main contribution by this research. Beside combining DOI and FVM, applying the factors that found to be significant in this research to measure the success and failure of cloud computing adoption as well as to recommend the best cloud model using SAW analysis makes a unique novelty. The framework can provide a holistic guidance to Saudi policy makers to measure the factors influencing the adoption of cloud computing. Applying

this framework would help to enhance the Saudi e-government system overall as it can provide the decision-makers with a deeper insight about what factors they should consider when deciding whether or not to adopt cloud computing or when integrating it into the current systems. It is anticipated that this model can be used globally, although the results obtained through it were in the context of Saudi Arabia. Applying this model elsewhere may provide different results based on the region and organizational requirements.

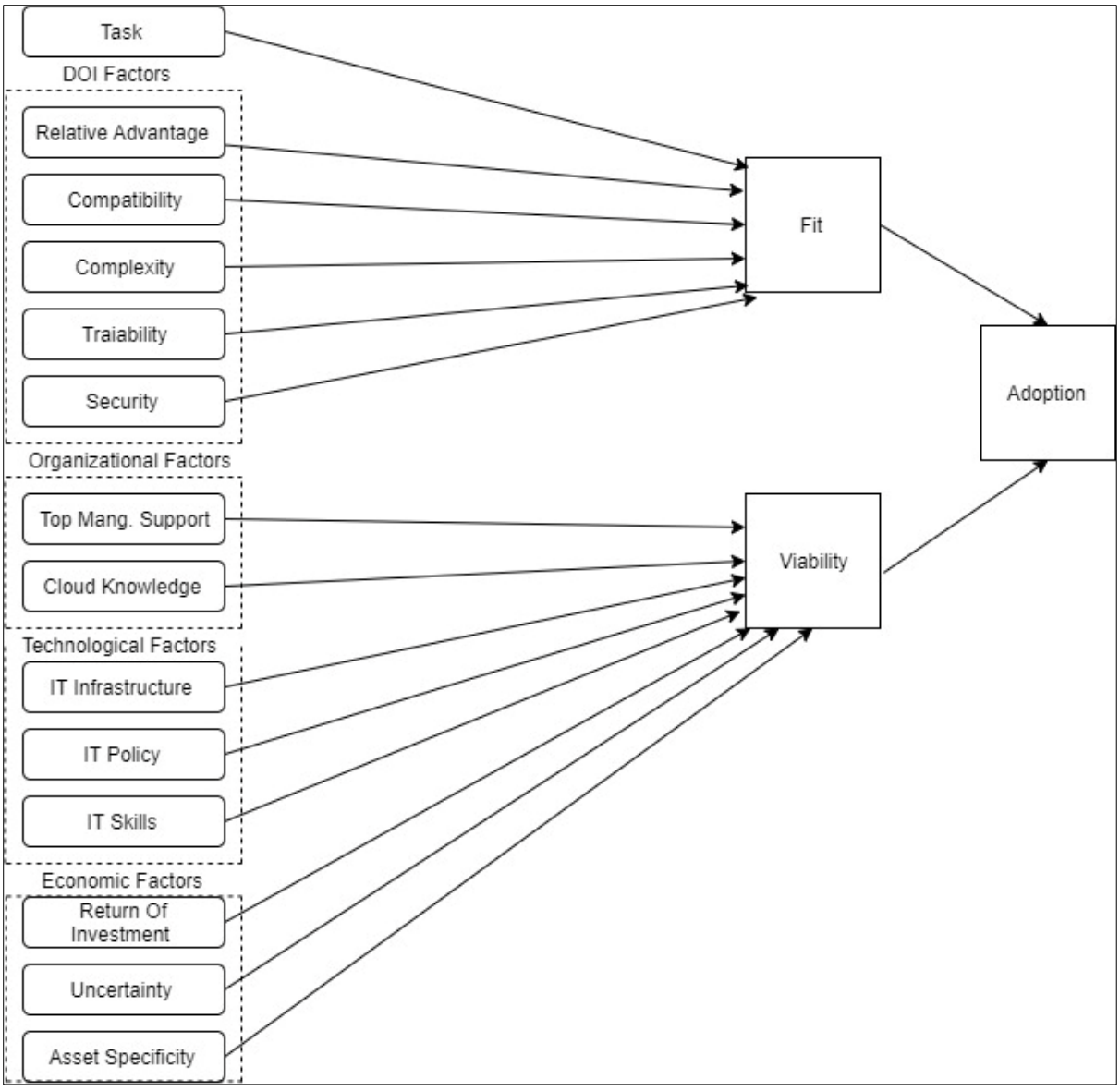

Figure 3.8: The Conceptual Fit and Viability Model

3.5 Chapter Summary

This chapter sheds light on the most common IS theories used in the literature and reviews studies that have investigated the factors affecting cloud computing adoption. Moreover, the combined theories used in this research were also outlined in detail, along with the justification of their selection for this study. Previous studies that were conducted in relation to the selected factors were also analysed and summarised in this chapter. Finally, this chapter explains the suggested model and provides more details on its utilizations locally and globally.

Chapter 4: Research Methodology

4.1 Introduction

This chapter describes the methodology applied to address the research questions for this study. This chapter has been divided into three sections. The first section focuses on the research philosophy, research types, research design, research methodology and research approach. The second section sheds light on the justification of the approach selected for this study along with the data collection and instrument development. Lastly, this chapter describes the reliability, validity and the ethical concerns of this study.

4.2 Research Philosophy

According to Burrell and Morgan, (2016), the term 'research philosophy' means a scheme of principles and assumptions of knowledge development. Researchers make a number of these assumptions at each stage in their research. (Guba, 1990), categorizes assumptions into three areas: Ontology (reality), epistemology (knowledge) and methodology.

4.2.1 Ontology and Epistemology

Ontology refers to the reality or nature of the world, whereas epistemology refers to knowledge validity and beliefs about knowledge and methodology is using systematic methods to solve a research problem (Kothari, 2004; Merriam, 2009; Creswell, 2013). According to Eriksson and Kovalainen, (2008), ontology revolves around the notion about the relationship between people, society and the world and usually focuses on the question of 'what is there in the world?' However, epistemology focuses on the question of 'what is knowledge and its source and limitation?' In other words, epistemology can be defined as how knowledge can be presented and claimed for. From a scientific research perspective, epistemology outlines the roadmap of the availability and limitation of scientific knowledge (Eriksson & Kovalainen, 2008).

Furthermore, Saunders et al. (2009) also classifies ontological and epistemological philosophical assumptions into four types: positivism, interpretivism, realism and pragmatism. According to Remenyi, (1998), positivism and interpretivism philosophies are the most commonly used by scientists.

4.2.2 Paradigms

- ***Positivism***

According to Remenyi, (1998), positivism is an objective analysis and interpretation of a tangible social reality where the process of obtaining knowledge is ideally not influenced by the researcher, which lowers bias. Moreover, positivist researchers believe this approach is optimal for hypothesis testing: to explore a phenomenon and to make a prediction (Collins & Hussey, 2003). Social phenomena are therefore always explained in this approach by researcher by testing their hypotheses statistically (Henn et al., 2006).

- ***Interpretivism***

However, in an interpretivist philosophy, according to Merriam, (2009) and Matthews & Ross, (2010), researchers are seen to be part of the social world and believe that reality is developed through social interaction. The work of these researchers is conducted within a phenomenological framework and therefore make a subjective interpretation of social reality (Creswell, 2012). Henn et al., (2006) states that the researcher tends to be unstructured. According to Merriam (2009), the drawbacks of this interpretive approach are its subjective nature and potential bias.

- ***Realism***

"The essence of realism is that what the senses show us as reality is the truth: that objects have an existence independent of the human mind" Saunders et al. (2009). Realism takes the same approach as positivism in terms of utilizing an objective scientific method for knowledge development. Realism is similar to Positivism, but the latter is more focused on the idea that logic, observation and experimentation can reveal whatever exists, whereas the former will allow non-scientific sources of knowledge (Hasa, 2017).

- ***Pragmatism***

According to Saunders et al., (2009), the pragmatist philosophy is a suitable paradigm where a particular philosophy is appropriate to address one research question whereas the other research questions can be addressed by a different philosophy. Therefore, the pragmatist philosophy can be seen as an integration of two philosophies such as positivism and interpretivism.

4.2.3 Justification of research philosophy used in my research

The positivist approach largely suits the research objectives of the current study. The aim of the research is to explore the factors affecting the adoption of cloud computing in Saudi Public organizations. Hence, this research tends to examine the relationships among variables and their influence on the adoption of cloud computing. Moreover, this research proposes hypotheses and these hypotheses have to be examined statistically; as a result, this appears to be in line with the ideas of positivist paradigm. Studying existing studies to propose a theoretical research model along with proposing hypotheses and examining them are all strategies associated with a positivist paradigm (Collis & Hussey, 2009). Overall, the method used in this study fits well with this philosophy based on the fact that this paradigm has been applied widely by research in the field of cloud technology (Legris et al., 2003; Ahmed & Ward, 2016).

4.3 Research Types

Research has been presented in the literature in many ways. (Sekaran, 1999) for instance, describes it as "an organized, systematic, data-based, critical, objective, scientific inquiry or investigation into a specific problem, undertaken with the purpose of finding answers or solutions to it." Ultimately, information gained from research can help decision-makers to address their problems (Sekaran, 1999). Research types can be categorized based on the purpose, process, logic and outcome of each research. Moreover, if research is categorized according to the purpose, it can be explained as exploratory, descriptive, analytical, or predictive (Collins & Hussey, 2003). They all involve either one or a combination of qualitative and quantitative approaches (Almogbil, 2005).

- ***Exploratory Research***

This purpose of exploratory research is to search for hypotheses, patterns or ideas rather than examining or approving a hypothesis (Collins & Hussey, 2003). Exploratory research can commence with a literature investigation, a discussion by a focus group, or a case study. Typically, data obtained from this type of study are qualitative (Sue & Ritter, 2012). In exploratory research, the aim is to gain more understanding and awareness of the subject that can be used at a later stage for further investigation (Collins & Hussey, 2003). Conclusive solutions to problems are seldom gained in exploratory research (Alsaif, 2014). So, exploratory research outcomes are not typically suitable for the decision-making cases. Further, the

research scope is not yet known by the researcher nor the full extent of the actual research problem (Sebunje, 2015).

- ***Descriptive Research***

In descriptive research, a phenomenon is simply described. The purpose of this type of study is to define and look for information about a problem and identify the characteristics of the issues. The research problem in descriptive research is defined and data are analyzed using statistical methods (Sebunje, 2015). According to Blumberg et al, (2005), descriptive research aims to convey the view of how things are connected to each other. Descriptive research can fall under either qualitative or quantitative research. In descriptive research, the aim is to answer the question of what is?'. As a result, descriptive data can be gathered using observation and survey techniques (Glass & Hopkins, 1984). Kahn and Best, (1993) have defined descriptive research as "it deals with the relationships between variables, the testing of hypotheses, and the development of generalizations, principles or theories that have universal validity." Descriptive research includes the following features:

- Descriptive research includes testing and hypotheses formulation
- Descriptive research utilizes inductive and deductive reasoning logical methods
- Variables are explained precisely and entirely so other researchers can replicate the study.

- ***Analytical or Explanatory Research***

In explanatory research, a further explanation goes beyond just describing the characteristics to examining and outlining why and how these characteristics are occurring. Hence, the purpose of explanatory research is deeply reviewing the research problems and examining casual relations among them (Collins & Hussey, 2003). Explanatory research can be conducted using either qualitative or quantitative techniques (Heppner et al, 1999). Defining the variables and managing them is a vital process in explanatory research (Collins & Hussey, 2003).

- ***Predictive Research***

Predictive research goes further than explanatory research. Explanatory research describes what is occurring in a specific event whereas the predictive research predicates the likelihood

of a similar event occurring in another context. As a result, a solution for a specific research problem can be applied in another study (Collins & Hussey, 2003).

This research is a combination of exploratory and descriptive or explanatory. The exploratory stage was adopted in the first stage which involves reviewing existing literature and former studies and collecting qualitative and quantitative data. The exploratory stage also helped in clarifying the research problem as well as helped in constructing the research model and hypothesis. However, the second stage is the descriptive approach which was employed to test the relationship among the factors.

4.4 Research Design

Research design refers to the process of data collection, analysis, presentation and discussion in research studies (Creswell & Plano Clark, 2007). In order to commence a study, a researcher follows a set of steps. However, these steps vary from one study to another based on the research context (Lawrence, 2014). A research design can be considered as a bridge between the research questions and the research implementation (Creswell, 1994). It is also the plans that leads to the process of data collection and analysis (Selltiz et al., 1965). Research design is aimed at explaining how the research questions can be addressed through systematic steps based on previous studies in literature (see figure 4.1). The following are the steps taken to determine the research design:

Steps 1, 2 and 3

An initial proposal including the aim and objectives for this study was proposed. This was developed through an intensive search in the literature on topics related to the adoption of cloud computing. Also, other studies conducted around the technology adoption in other areas were all reviewed (Chapter two). Research gaps and questions were all also developed and framed based on previous literature. The significant factors that affect the adoption of cloud computing in other studies were identified and reviewed.

Step 4

Extensive research was conducted in the literature in order to explore the research models used in other studies in order to develop the conceptual model for this study (shown in Chapter 3).

Steps 5-11

The model was developed by integrating the DOI and FVM theories **(Step 5)**. **Step 6** illustrates that research hypotheses were developed based on the research model suggested in **Step 5**. **Step 7** shows that the research instruments were developed according to the studies found in literature. The survey was reviewed by experts in the field including the research supervisor and some IT experts from different areas (pilot study). Data were collected using paper-based questionnaires (**Stage 8**). **Stage 9** outlines the process of data collection and analysis of the qualitative data. **Step 10** shows the analysis and collection of the data which was analyzed using SPSS and SMARTPLS tools. **Step 11** includes the interpretation of the qualitative and quantitative results. All steps are presented in the following figure (4.1.)

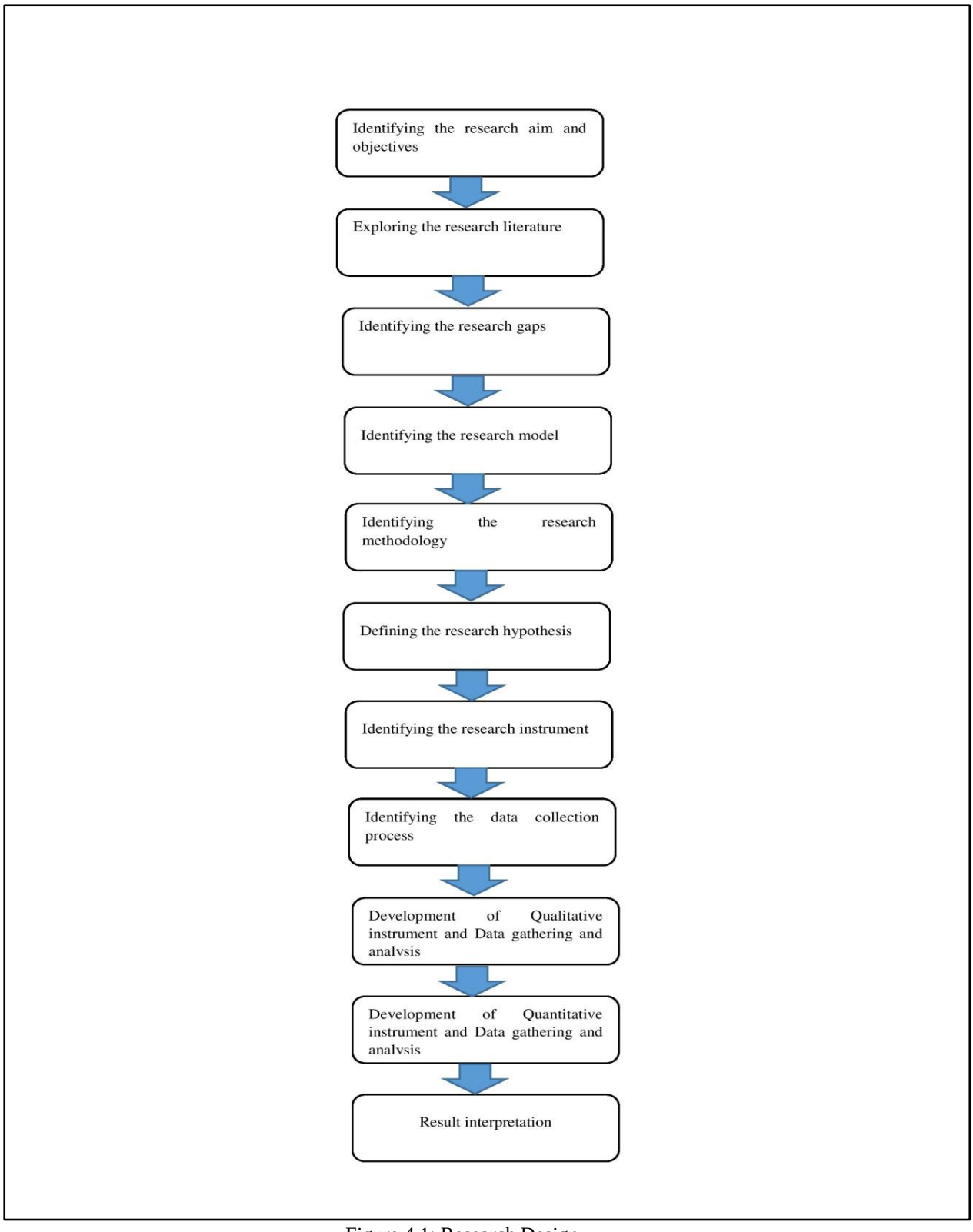

Figure 4.1: Research Design

4.5 Research Methodology

In order to understand the notion of a research methodology, the word 'research' needs to be understood first. According to Goddard and Melville, (2004), research is not only about collecting data but also addressing as yet unanswered research questions. Research means the process of discovery and creation of new knowledge. Research is deemed rigorous when it is 'systematic' in terms of having a clear plan and determined goals (Leedy, 1989). In general, research can be either pure or applied research (Goddard & Melville, 2004). Pure research or basic research is not appropriate for research problems that need an instant solution (Abbott & McKinney, 2013). Pure research means the research that is conducted in order to address a single goal of obtaining knowledge (Goddard & Melville, 2004).

In contrast, applied research is conducted to resolve a particular practical goal (Goddard & Melville, 2004). This type mainly focuses on problems in a field of study which exist in the real-world. Applied research may occur when organizations seek assistance from scholars to address specific problems and find answers to these problems (Abbott & McKinney, 2013). Moreover, applied research has two different types including evaluation research and action research. Evaluation research aims to ensure the success of a particular intervention based on a list of criteria. Action research however, aims to present views and answers in a cascading manner. Its purpose is to use the research outcomes for solution refinement. Participants are involved in action research in order to help the sponsoring group to execute new methods, collect more info, and also for the further development of the change process (Abbott & McKinney, 2013).

4.6 Research Approach

Generally, research approaches are classified into three categories including qualitative, quantitative, and mixed methods. The mixed method approach can include both quantitative and qualitative approaches (Creswell, 2003).

4.6.1 Qualitative Research Approach

Qualitative research relies on data that are extracted from text and image (Creswell, 1994). Research questions answered using qualitative methods differ from those answered using quantitative methods. Questions, like 'How many?', 'What are the causes?', 'What is the

strength of a particular model variable?', cannot be addressed by the qualitative approach; however, it can provide an insight into some of the reasons behind the influence of factors in the proposed model. According to Sekaran, (1999) "Data can be qualitative (as generated from the broad answers to specific questions in interviews, or from responses to open-ended questions in a questionnaire, or through observation, or from already available information gathered from various sources."

Qualitative methods can also include hypotheses testing. Generally, case studies are more related to qualitative methods (Sekaran, 1999). Qualitative research falls more into a description of event with no numerical data being generated (Kahn and Best, 1993). Qualitative studies can generate different types of data and the data collection can be divided into three forms: in-depth open-ended interviews, direct observation and written documents (Kahn & Best, 1993). Furthermore, researchers who tend to use qualitative methods encounter three different types of issues including: establishing a comprehensive model, preparing a systematic and manageable design, and integrating the previous challenges into a document that convince the reader (Marshall & Rossman, 2010). In terms of data sampling, the nature of sample collected in the qualitative data is typically small as larger samples will result in more cost and expenditure of energy (Sekaran, 1999).

Ravitch and Carl, (2019) argue that the qualitative research process is not a linear process. They believe that all elements of qualitative research interact with each other continuously in a circular way as shown in Figure 4.2.

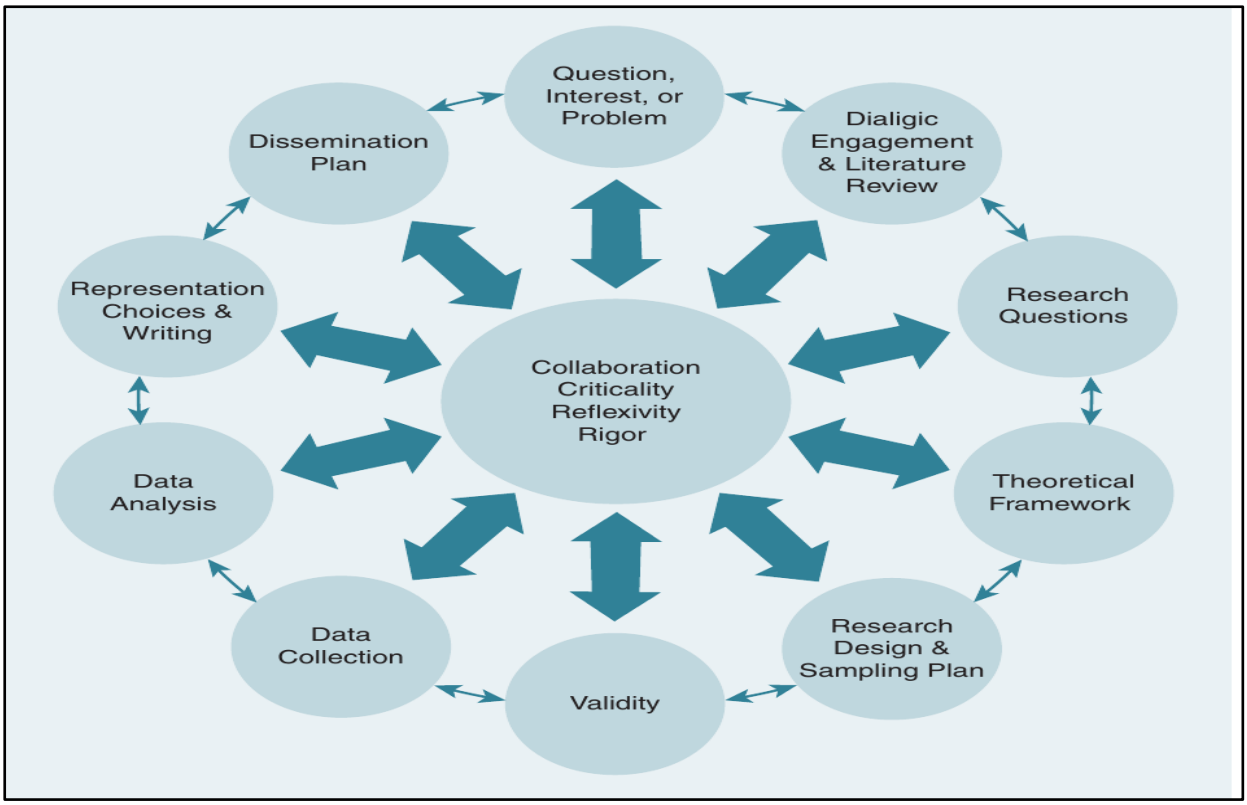

Figure 4.2: The Dynamic Elements of Qualitative Research (Source: Ravitch and Carl, 2019)

4.6.2 Quantitative Research Approach

According to Kahn and Best, (1993) "Quantitative research is designed to test hypotheses that are theoretically derived. Whether the hypotheses are supported or refuted, the researcher reports the results objectively. Qualitative researchers, on the other hand, do not bring such hypotheses to their research." Moreover, in quantitative research, data can be gathered in the form of structured questions (Sekaran, 1999). In quantitative research, there are four different types of measurements, namely nominal scale, ordinal scale, ratio Scale, and interval Scale (Kahn & Best, 1993).

- **Nominal Scale**

The nominal scale illustrates the variance between objects by organizing them into components. Each attribute can be a member only of a one group and all attributes of the group have the same features. Some questions in the survey used a nominal scale: e.g., 'What is you field of study? Computer Science □/ IT □/ Engineering □/ Management □'.

- **Ordinal Scale**

An ordinal scale allows ranking from the bottom to the top for items and people. No absolute values are defined in the measurement of the ordinal scale and the variance between the rank of adjacent sometimes is not equal. Some questions in the survey used an ordinal scale: e.g., What are you Qualifications? Diploma or less □ Bachelor □ Masters □ Doctorate □ .

- **Interval Scale**

According to (Sekaran, 1999), an interval scale is "a multipoint scale is that taps the differences, the order, and the equality of the magnitude of the differences in the responses." A good example of a measurement using an interval scale is temperature.

- **Ratio Scale**

This type of scale has two features. Firstly, unlike an interval scale, the ratio scale has a value of true zero. In other words, complete absence can be indicated; secondly, ratio numerals can be added, subtracted, multiplied, and divided and there are real numbers in a ration relationship (Sekaran, 1999). An example of a question in the survey that used the ratio scale was: How many years have you worked in this organisation?

Less than 1 year □ / 1 – 5 years □ / 6 – 10 years □ / More than 10 years □.

Moreover, researchers have different views of the definition of quantitative approach. For example, Yilmaz, (2013) defines it as an approach that describes a situation based on numerical data which are assessed by statistical methods. It also has been defined by Bryman, (2012) as an approach that ensures quantification in the process of data collection and analysis. This approach attempts to address research questions that include questions, such as 'how many?', 'how much?', and 'to what extent?' (Rasinger, 2013). A quantitative approach is generally considered to be a deductive approach (Sekaran, 1999). In the quantitative approach, the relationship between the participants and the researcher is typically separate, and no direct interaction between them is needed. After collecting the data, a researcher needs to acquire a deep understanding of the relationship between variables (Soiferman,2010). According to Creswell, (2003), a quantitative approach aims to examine theories through testing the relationship of variables. These variables later can be measured by statistical methods.

4.6.2.1 A Comparison between the Qualitative and Quantitative Approaches

The variance between these two approaches is clear and it has been articulated in literature in several ways. In terms of the data collection process, numbers and analytical tools are used

when it comes to the quantitative process whereas in the qualitative process the data is collected as notes, observation or recordings and transcripts (Blanche et al, 2006). Table 4.1 distinguishes the differences between the qualitative and quantitative approach by emphasizing the advantages and disadvantages of both approaches.

Table 4.1: The Advantages and Disadvantages of the Qualitative and Quantitative Approaches (Ramona, 2011)

Approach	Quantitative approach	Qualitative approach
Advantages	—Risks are sorted by their financial impact, assets by theirfinancial value —The results can be expressed in a specific managementterminology —The evaluation and the results are based on objectivemethods —Security level is better determined based on the threeelements: availability, integrity and confidentiality —A cost-analysis can be implemented for choosing thebest suited measures —Management performance can be closely watched —Data accuracy improves as the organization gainsexperience	—This approach makes easier to understand andobserve the level of risk —Methods of calculation are simple to understand andimplement —It is not necessary to quantify frequency occurrenceof the threats —It is not necessary to determine the financial value ofthe assets —Monetary value of information is not determined,which makes the analysis process easier —Quantitative calculation of frequency and impact arenot necessary —Estimated cost of the measure that should beimplemented are not calculated —The most important areas of risk are evaluated
Disadvantages	—The methods of calculation are complex —Without an automatic tool the process can be reallydifficult to implement —There are no standards and universally accepted information for implementing this method —The values of risk impacts are based on subjectiveopinions of people involved —The process handles a long time —The results are presented only in monetary values andare hard to understand by persons without experience —The process is very complex	—The evaluation of risk and its result are subjective —It is possible that the reality is not defined correctly because of the subjective perspective of the author —The performance of risk management are hard to follow because of their subjectivity —A cost benefit analysis is not implemented, only a subjective approach of the author and that makes difficult the implementation of controls —Insufficient differentiation between major risks —Results depend on the quality of risk management team

4.6.3 The Mixed Methods Approach

Mixed methods refer to the combination of a qualitative approach with a quantitative approach. According to Ghauri and Grønhaug, (2005), by mixing the two approaches in a study, scholars can obtain more insight, a clear vision of the problem, and accurately observe the result. Moreover, researchers use the qualitative method so they can obtain a comprehensive view of the problem while the quantitative can provide them an in-depth understanding of the results

(Mack et al., 2005). In this study two main techniques were used to gather the qualitative and quantitative data. The tools used will be discussed the following section.

The study uses a mixed approach (qualitative and quantitative methods). The qualitative approach allows respondents to respond to questions that are often open-ended so researchers are able to obtain information about human opinions and attitudes, existing situations and decisions (Creswell & Clark, 2007). This approach can also provide a deep understanding of the study's subject (Anderson, 2010). However, the other approach used in this research is a quantitative method. In terms of data collection, Creswell and Clark (2007) state that in this approach data is often collected using closed-ended questions and the respondents are not elaborating their responses and answers. Quantitative data can be gathered through various methods such as questionnaires and scientific experiments; and can be evaluated by researchers who can use various strategies to analyze the numerical data generated (Mack et al., 2005).

4.6.4 Research Methods for this study

This exploratory/descriptive research uses mixed methods: qualitative and quantitative. The author decided to utilize mixed methods as this approach can extensively address the research aim and objectives, and improve the research model for cloud computing explained in Chapter one. According to Tashakkori and Teddlie (2010), using mixed methods allows researchers to satisfy their research goals as well as raising the research confidence and results accuracy.

In this research, the mixed approach has been employed through using semi-structured interviews and questionnaires. The interviews were with IT managers and IT experts in various sectors in Saudi public organizations; involved both closed- and open-ended questions. The aim of these interviews was to evaluate the significance of the suggested factors in cloud computing adoption on e-government performance and to identify other factors that were not investigated previously in literature review. Moreover, for confirming the suggested model for cloud adoption, the quantitative research method was utilized i.e. a survey was conducted.

4.6.5 Type of Mixed Methods for this study

There have been numerous typologies that classify and define the mixed methods categories. However, Creswell, (2014) proposes the most common types that are applied in research, namely: convergent parallel, explanatory sequential and exploratory sequential. In the ***convergent parallel*** approach, researchers collect qualitative and quantitative data at the same

time and analyse them separately and then do a comparison of both results (Brannen & Coram, 1992). The sample size for obtaining qualitative data is typically smaller than the sample for gathering quantitative data. This is because the purpose of the collecting the qualitative data is to gain rich and detailed data, albeit from a small number of people (Creswell, 2014).

When the quantitative data is collected first and this is followed by the qualitative data collection, this approach is called ***explanatory sequential***. In explanatory sequential research, researchers tend to collect the quantitative data first then analyse it and confirm the results by collecting qualitative data. The whole purpose of such an approach is to have qualitative data to help provide more details of with which to expand an explain the quantitative data results (Creswell, 2014). The priority is placed on the collection and analysis of quantitative data. Qualitative data is gathered to further support and elaborate the quantitative result (Sieber, 1973). Lastly is the exploratory sequential. The exploratory sequential is a reverse to the explanatory sequential. Researchers start by collecting the qualitative data followed by collecting the quantitative data (Brannen & Coram, 1992).

The mixed method was applied in this research to gain a comprehensive understanding of the research problem and questions. Analysing data qualitatively and quantitatively can deliver stronger evidence and more confidence about the research outcomes. For this study, the explanatory sequential approach was employed. The researcher started to collect the quantitative data first and analysed it and then conducted the qualitative data collection stage to further support the quantitative results.

4.7 Data Collection

According to Kabir, (2016), data collection is considered to be the process of collecting and examining data that allows researchers to address their research questions, design hypotheses, and analyze the outcomes. Data collection begins with defining the type of data required for the research; and this process is followed by selecting the sample needed from a particular population (Anderson, 2010). Moreover, data collection techniques used in research differ from one study to another according to the research needs (Robson, 2002). Typically, decisions about what data collection techniques are needed for the research are made at the early stages of research projects (Robson, 2002).

4.7.1 Qualitative Data Collection Methods

This section outlines the main qualitative data collection methods and provides a justification for those used in the research.

4.7.1.1 Interviews

According to Oishi, (2003), interviews are commonly used for gathering qualitative data; although they can also be used with quantitative research methods. Interviews allow the researcher to gain more knowledge and sometimes to make more observations in the study area (Oishi, (2003). The flexible interaction between the interviewer and respondents while conducting an interview can help to make sure participants understand questions and that their perceptions are accurately represented; however, there might be some barriers for researchers to find participants for the study (Oppenheim, 1992). Interviews can be conducted by phone, online or in a face-to-face meeting (Rogers et al. 2011). According to Rogers et al., (2011), an interview can be categorized into four types: structured, unstructured or semi-structured interviews and focus groups. In terms of structured interviews, the interviewer normally uses closed-ended questions for gathering data from each respondent. On the other hand, unstructured interviews usually refer to a set of open questions allowing researchers to discover information in great detail (Britten, 1995), Semi-structured interviews integrate closed- and open-ended questions; and an interview schedule is created, although the interviewer can ask further questions to seek more information (DiCicco, 2006). Lastly is the focus whereby an interviewer can have a discussion with at least three interviewees about a particular topic (Rogers et al., 2011). In addition, focus group has been defined as a small group of people (normally sit to twelve individuals) gathering to discuss subjects in a study agenda. "The purpose of this discussion is to use the social dynamics of the group, with the help of a moderator/ facilitator, to stimulate participants to reveal underlying opinions, attitudes, and reasons for their behavior" (Kabir, 2016). It is typically used to collect information in relation to peoples` feelings and views of the study that they are involved in (Collis & Hussey, 2003).

In this study, the aim of the semi-structured interviews was to review the factors that were identified in chapter 5. Also. The semi-structured interviews were selected to help identify other factors that were unstated in former studies.

4.7.1.2 Observation

Observation can be classified into two types formal and informal: informal observation is less organized, is relatively complicated and unstructured and requires effort to organize and abstract it; whereas formal observation is more structured (Robson, 2002). Observation can be carried out in a laboratory or in the field (Collins & Hussey, 2003). Further, observation can be non-participant or participant. The aim of non-participant is to record and notice the action and behavior of people with interference of the researcher. The data can be collected suing video or still camera. In contracts, the participant observation refers to the process where the researcher is fully involved in the setting being investigated. Although this technique has been widely in literature, there are some issues associated with it. One problem is that variables in setting cannot be managed. Second problem would be with ethics and technology for recording what individuals say. Lastly, researchers usually fail to notice some activities due to noise and disturbance (Collins & Hussey, 2003).

Table 4.2: The Types of Observational Method, (Source: Kabir, 2016)

Type of Observational Method	Advantages	Disadvantages
Naturalistic Observation	• Particularly good for observing specific subjects. • Provides ecologically valid recordings of natural behaviour. • Spontaneous behaviours are more likely to happen	• Ethics: Where research is undisclosed consent will not be obtained, where consent is not obtained - details may be used which infringe confidentiality
Structured Observation	• Allows control of extraneous variables. • Reliability of results can be tested by repeating the study. • Provides a safe environment to study contentious concepts such as infant attachment.	• The implementation of controls may have an effect on behavior. • Lack of ecological validity. • Observer effect. • Observer bias
Unstructured Observation	• Gives a broad overview of a situation. • Useful where situation/subject matter to be studied is unclear.	• Only really appropriate as a 'first step' to give an overview of a situation / concept / idea
Participant Observation	• Gives an 'insiders' view. • Behaviours are less prone to misinterpretation because researcher was a participant. • Opportunity for researcher to become an 'accepted' part of the environment	• Observer effect. • Possible lack of objectivity on the part of the observer
Non-Participant Observation	• Avoidance of observer effect	• Observer is detached from situation so relies on their perception which may be inaccurate

4.7.1.3 Diaries

Diaries are a data collection method in which users are asked to make records of their daily actions and experiences (Bowling, 2002; Marino et al, 1999). One advantage of diaries is that enables respondents to free their expression and record information related to the research subjects (Burns & Grove, 1987). According to Collins and Hussey, (2003), one of the biggest problems using diaries is finding participants with the time to do this assiduously, and was indeed the reason why this was not considered as an appropriate method for the current study.

4.7.1.4 Expert Review

An expert review refers to methods that allow researchers to gather data from experts who are knowledgeable in the topic of the study. According to Tessmer, (1993), researchers can use this technique in quantitative, qualitative or mixed methods at various phases of the study. In this technique, experts can provide their suggestions or any opinion to improve any area of the study. Moreover, this technique can enable research to gain feedback from people who are expert in the field and have a comprehensive experience rather than novices (Ramirez, 2002).

Table 4.3: Qualitative Data Collection Types: Advantages and Disadvantages

Data Collection Type	Advantages	Disadvantages	Reference
Observation	Researchers have the ability to record data as it happens.	Intrusion of researchers during the discussion	(Creswell, 1994)
	Researchers can be alerted to any unusual aspects	Some private aspects and information cannot be reported by researchers because of confidentiality and privacy	
	Topics that may not be possible to discuss] while interviewing participants, are more easily obtained in observation	Disruption may occur to gain rapport.	
Interview	Very useful when direct observation of participants is not possible	Interviews may have to take place in a designated place rather than a natural setting	
	Historical information can be gained through interview	Responses may be biased	

	Researchers can have control of the questions	Not all people have a similar perspective	
Focus Group	More information can be collected in a short time with less effort	Limitation on the number of questions asked	(Robson, 2002)
	Discussion in focus group help the members to focus on the most significant points of the research subject.	Skillful management needed for the process, otherwise problems of bias, and less sharing of views may occur	
	Flexible and inexpensive	Confidentiality and privacy may be defined as a problem due to the interaction occurring among the members	
	Focus groups foster encouragement for those who are reluctant to participate	Difficulty of result generalization	

4.7.2 Quantitative Data Collection Methods

This section outlines the main quantitative data collection methods and provides a justification for those used in the research.

4.7.2.1 Questionnaire

According to Saunders et al., (2009), the questionnaire is one of the most commonly used tools used for gathering quantitative data; however, it can be also used for gathering qualitative data if it has close-ended questions (Oppenheim, 1992; Engel & Schutt, 2005). According to Bourque and Fielder, (2003), there two different types of the questionnaire: self-administered and interviewer-administered. The questionnaire can be shared with participants online or via hard copies (Rogers et al., 2011). The key advantage of using this technique is that it allows researchers to gather a large amount of data within a short time across a wide geographical area in a cost-effective manner. Although data control can be an issue and analysis can be time-consuming (Oppenheim, 1992), the questionnaire survey was selected as the main method of investigation for the current research. Table 4.4. below outlines the advantages and disadvantages of this method in more detail.

Table 4.4: Questionnaire Pros and Cons

Advantage	Reference	Disadvantage	Reference
Data can be collected more quickly	(Milne, 1999)	Participants may forget the most important aspects	(Milne, 1999)
Data can be gathered from a wide range of participants		Answers might be superficial, especially if the questionnaire is long.	
Data can be analyzed easily, especially when questionnaire is multiple-choice	(Patten, 2016)	If a lot of open-ended questions are used, this can generate a lot of data to analyse, which may be a long process	
A questionnaire can be a good tool to collect critical data, as it can be filled out anonymously		Response rate for questionnaires is relatively low, especially when the researcher is not known	(Patten, 2016)
Questionnaires are cost-effective when mailing or posting to participants		Social desirability. Participants may respond to questions that they believe socially desirable	
With the questionnaire, researchers have the ability to reach certain individuals who can be. difficult to reach.	(Wright, 2005)	Researchers have no control over responses as the participant filling out the questionnaire is not known	(Phellas et al, 2011)
		Questions have to be short and clear as it is hard to ensure there is no misunderstanding]	

4.7.2.2 Survey

Questionnaires are used for surveys, which are the most commonly used method in quantitative data collection (Farooqui, 2006). Surveys can cover both small and large populations, and are divided into three types: factual surveys (where information collected is purely descriptive) attitude surveys (which ask for personal views) and explanatory surveys (Ahamd, 2019). The explanatory survey is the most complex and is designed to develop theories by testing hypotheses (Ahmad, 2019).

4.8 Instrument Development

4.8.1 The Sample Size

It is essential to identify the sample size prior to conducting the study; and sample size is considered important in establishing research findings (Farooqui, 2006). Ideally survey samples should be representative of the wider target population (Sarantakos, 1998). Kahn and Best, (1993) emphasize that a representative sample should be chosen randomly so members

of the target population have an equal chance to participate, the sample should be large enough to meet the study needs, and the sample should not be biased.

- ***Probability Samples***

Probability samples refer to a random selection from a population list, sometimes known as 'sampling frame'. Vehovar et al, (2008) argue that participants in probability samples do not have be equally selected. Probability samples include the random sample, stratified sample, cluster sample and systematic sample. In probability samples, participants also have the choice not to participate (Vehovar et al, 2008).

- ***Non-probability samples***

This type of sample is typically called a convenience sample. It occurs when not all members of the target population can be defined or participants are specially selected for the sample (Vehovar et al, 2008). A non-probability sample requires less time and effort and is therefore not expensive (Vehovar et al, 2008). Typically, non-probability sampling is employed for small scale studies as they are less complex. They can be also used a pilot study prior to the actual study (Robson, 2002).

The non-probability sampling was used for this study. In this approach, the participants answered questionnaire questions based on their willingness and availability (Gravetter and Forzano 2012). Choosing this technique was simpler and quicker compared to probability sampling.

4.9 Reliability and Validity

4.9.1 Reliability

Reliability refers to measuring the consistency (Bollen, 1989) or measuring stability by which same result can be obtained (Nunnally, 1978). It can be said that a scale has achieved a high level of internal reliability if the scale items are consistent and examine the same construct (Huck, 2007; Robinson, 2009). A satisfactory level of reliability that can be achieved on hypotheses testing is 70 or higher. In order to achieve a higher level of reliability, it requires

more time and effort (Nunnally, 1978). However, Nunnally, (1978) argues that in the important settings that require a very important decision, a level of 90 is needed. Correlation coefficient is another expression of reliability and stability (Kahn & Best, 1993). According to Benson and Schell, (1997), the reliability coefficient refers to the ratio of the obtained variance in an assessment.

4.9.2 Validity

Validity refers to well the gathered data fully covered the real investigated research project (Ghauri & Gronhaug, 2005). It can be described as "measuring what is intended to be measured" (Field, 2005**).** The types of validity have been presented differently in the literature. For instance, according to Taherdoost, (2016), validity has multiple types including face validity, content validity, construct validity and criterion validity. Figure 4.4 presents the validity types along with their subtypes. Furthermore, Bollen, (1989) divided validity into: statistical conclusion validity, internal validity, construct validity and external validity. In a mixed approach, validity demonstrates accurate and consistent outcomes throughout the data collection types used in the research (Creswell & Plano Clark, 2011).

- ***Statistical Conclusion Validity***

Statistical conclusion validity refers to the extent to which there is a relationship between two variables. Statistical conclusion validity is about the relationship that is examined in research. It also refers to whether a researcher can assume covariation specified alpha level and the variances gained (Cook & Campbell, 1979).

- ***Internal validity***

Internal validity refers to whether the relationship between the variables is causal; and whether there an existence of confounding factors in the study? There are many issues associated with internal validity. Some of these issues are maturation, selection, testing, and demoralisation (Cook & Campbell, 1979).

- ***Construct validity***

If the relationship between the variables found to be causal then where the main causes and effects are constructed in the relationship. “Construct validity refers to how well you translated or transformed a concept, idea, or behaviour – that is a construct – into a functioning and operating reality, the operationalisation” (Trochim, 2006).

- ***External validity***

In order to understand the external validity, the concept of ‘validity’ should be articulated first. According to Trochim & Donnelly, (2006), “Validity refers to the approximate truth or usefulness of an inference.” These inferences cloud be valid in some research projects while not in another even if both studies apply the same method and design (Shadish, Cook & Campbell 2002).

External validity refers to the generality among the variables. External validity can be assessed only if the researcher understands the interaction between the main variables and moderator variables (Lynch, 1999).

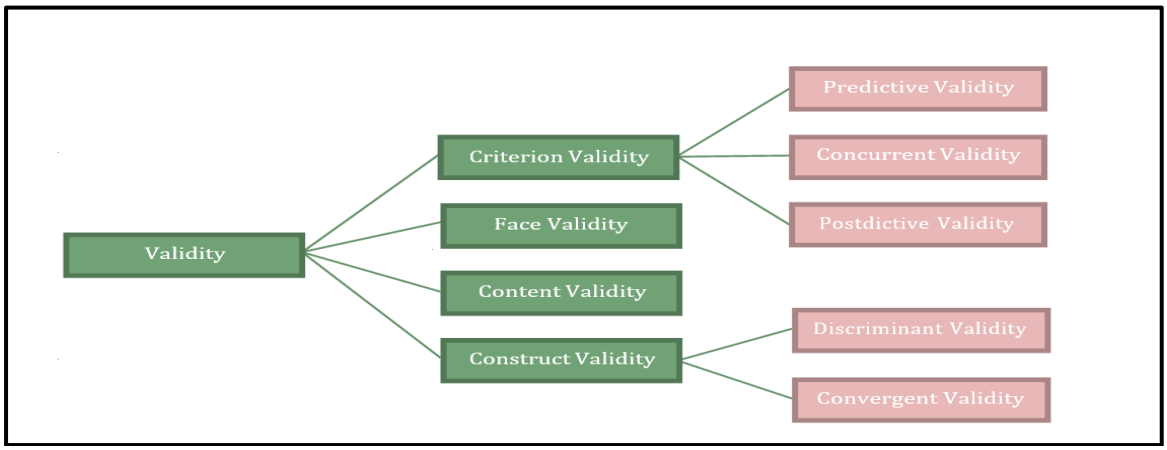

Figure 4.3: Types and Subtypes of Validity (Source: Taherdoost, 2016)

For this study, several steps were taken to ascertain the validity and the quality of the outcomes. In terms the qualitative part of this research, participants were selected based on the experience they had with cloud computing and working in the target domain. In some of the domains, the researcher was directed by IT heads of the department to interview specific individuals as they were the only ones who could answer the types of questions asked in terms of cloud computing

adoption and the factors that might have an influence on the adoption. This step was conducted to ensure that the right information and answers could be gained from the right people.

For the quantitative phase, a paper-based questionnaire was used to obtain information from the participants. The researcher used this data collection approach as it was deemed more effective in ensuring that the correct type of information from the right data source would be collected. Also, it was expected that the manual data collection would provide some advantages to the researcher in regards of visiting the target domain and meeting with IT heads and experts. Prior to the final distribution of the questionnaire, the questionnaire was reviewed in order to check the validity of the wording and terminology clarification. The questionnaire was developed based on previous studies conducted in a related topic to this research. In addition, the outcome of the pilot study ensured and confirms that the content is valid and can obtain the needed info to address the research question.

4.10 Ethical considerations

Historically, it has been argued that the first ethical guidelines on human participant research were issued in 1947 (Chadyuk, 2010). The word ‘ethical` means how people should react and judge actions (good and right vs. Bad and wrong) (Kitchener, 1999). Ethics assess behaviour based on guidelines or principles. In terms of research, ethics aims to provide guidelines to researchers to review and assess their research and develop methods to ascertain that research is ethical (Keith-Spiegel and Koocher, 1985). Risks at all levels should be evaluated by the researcher; and that includes the risks that may be faced by participants either physically or psychologically (Rogelberg, 2008). Furthermore, by conducting a study that follows ethical guidelines researchers can ensure that their data can be utilized by policy makers.

Internet research should be conducted ethically just like any other aspect of academic research. It is entirely the researcher’s responsibility to ensure data confidentiality and privacy during the stage of interaction with participants and data collection (Nosek et al, 2002). Data should be encrypted with strong passwords after being collected so that no one has the ability to read or trace them (Pittenger, 2003). Research ethics should be considered at every stage of the project and not only in the beginning.

This research follows the ethical guidelines of the University of Liverpool. This research has adopted multiple questionnaires. It was requested by the ethics teams in the University of

Liverpool that both applications should be combined into one application and have a single code (8339). Therefore, the applications were combined and ethical approval was then obtained and confirmed.

4.11 Chapter Summary

This chapter has reviewed the research philosophy and methodology and justified the selection of research paradigm, design, approaches and methods. Research types have also been in detail, and the differences between them has been clarified. All the steps taken while conducting the research have been clearly illustrated in the research design section. The research approach, mixed methods and qualitative and quantitative data collection methods used in the current study have been depicted. The chapter also covered the sample selection and sampling methods used for obtaining participants. In addition, the reliability and validity of the research constructs variables and hypotheses have been presented. Finally, this chapter sheds light on the ethical concerns of the study and how ethical standards were adhered to during the data collection process and beyond.

Chapter 5: Quantitative Data Analysis

5.1 Introduction

This chapter explains the analysis and outcomes obtained while conducting the quantitative data analysis. This chapter is divided into several sections. Section one explains the preliminary evaluation of the data which includes the missing data and participant profile. The second section highlights the reliability methods used in detail and all the other tests used prior to testing the hypotheses. Moreover, measurements and structural equation modelling used for assessing the model are explained in detail. Finally, this chapter discusses the assessment and outcomes of the proposed hypotheses for this research. In this study, the data were analysed using SPSS and SAMRTPLS tools.

5.2 Participant Profile

5.2.1 Descriptive statistics

Descriptive statistics are used to arrange, display and evaluate analysis. Typically, the data is presented in charts, tables and graphs (Fisher and Marshall, 2009). In terms of this study, descriptive analysis is used to present respondents' qualifications, education and expertise. These factors were selected to assess and obtain a descriptive profile of respondents. This was the first section to be filled in the questionnaire.

Table 5.1: Respondents' Level of Education

Variable		Frequency	Percentage
Education	Diploma	84	20.58
	Bachelor	283	69.36
	Master	28	6.86
	PhD	13	3.18

Outcomes relating to the level of education variable show that 84 respondents (20.85%) held a diploma, 69.36% held a bachelor degree (283 respondents. This number indicates that the

majority of respondents held bachelor level qualifications. Moreover, 6.86% possessed a Master degree (28 respondents); and finally, only 13 respondents (3.18%) held doctorates.

Table 5.2: Respondents' Study Field

Study Field	CS	123	30.14
	Engineering	83	20.34
	IS	43	10.53
	IT	137	33.57
	Management	22	5.39

The item about respondents' study field revealed that 123 staff (30.14%) had studied Computer Science, while 83 of them (20.34%) were engineers. The IS and IT fields showed percentages of 10.53% (43 respondents) and 33.57% (137 respondents) respectively. However, only about 5.39% (22 respondents) had studied Management.

Table 5.3: Role of Respondents

Role of Respondents	Consultant	8	1.96
	DBA	4	0.98
	ITM	180	44.11
	Network	60	14.7
	Engineer	53	12.99
	Programmer	22	5.39
	System Analyst	26	6.37
	Technician	53	12.99

The role of respondents indicates that the largest group that participated in the survey (180 respondents) were ITM making 44.11% while the smallest group were just four database administrators (0.98%). There were also just eight consultants (1.96%). Networkers, engineers, programmers, system analysts, and technicians represented 14.7%, 12.99%, 5.39%, 6.37%, and 12.99% respectively.

Table 5.4: Respondents' Experience

Experience	Less than 1 year	55	13.48
	1-5 years	108	26.47
	6-10 years	83	20.34
	More than10 years	162	39.7

In terms of the experience that the participants had acquired, the statistics show that **55** participants had less than a year's experience (13.48%) while **108** had between **1-5** years of experience (26.47%). **83** of them had 6 **to 10** years` experience (20.34%); whereas **162** had **more than 10** years of experience (39.7%).

5.3 Preliminary Evaluation

In this stage, numeric values obtained through the questionnaire were manually inserted into an Excel sheet as the questionnaire has been distributed as a hard copy. SPSS was chosen as the tool to be used to analyse these data. Due to the researcher's lack of experience with SPSS, similar Excel sheets were generated for training purposes prior to the final data entry. This was to ensure reliability and data integrity. When sufficient training has been obtained, the data was then transferred to SPSS for the actual analysis. The next stage was to check the data distribution and missing data through a process of screening and cleaning.

5.3.1 Missing Data

Missing data occurs by participants either purposely or mistakenly omitting it. Non-response can occur in survey when participants complete part of the survey and leave the rest (Graham, 2012). It is important to ensure the error rate due to missing data is zero prior to the analysis process. According to Downey and King, (1998), In the case of facing when faced with missing data int the collected sample, a researcher has various options. These include: ignoring the missing data, omitting the person entirely from the study, omitting the person from the particular section that has the missing data or finding a way to replace the missing data with an estimate (Downey & King, 1998). Replacing the missing data with an estimate is arguably the best approach, as it will not result in a zero value or incomplete scale sections (Madlow, Olkin

& Rubin, 1983; Roth & Switzer, 1995). The rate of considering to the error rate acceptable is 5% of the whole number of the questionnaire distributed (Hair et al, 2010).

In the first questionnaire for this study, 500 samples were distributed and 408 were used for analysis. About 13 samples had missing data in some sections about fit and viability adoption. 13 samples are considered to be less than 5%, and were dealt with by estimation as suggested by (Madlow, Olkin, & Rubin, 1983; Roth & Switzer, 1995). In case of questionnaires two and three, there were 3 missing data samples. 2 of them were omitted entirely and the other one was estimated. The third sample was included because it had a single question missing data. The relatively small rate of missing data was due to two reasons. One was that the sample size needed and collected was relatively small so it could be managed and checked easily. Secondly, the researcher checked all the survey items prior to leaving the data collection sites. There were about three individuals who had unintentionally left some responses blank. The researcher had to ask them to double check and fill out the missing data. However, when analysing the data, there were still three missing data samples. The researcher estimated the answer for one of them as recommended by Madlow, Olkin and Rubin, (1983) and Roth and Switzer, (1995).

5.3.2 Questionnaires and Pilot Study

In the context of this study, various tests were applied to examine the reliability and validity of the questionnaires, such as validity of content, pilot study and pre-testing. In order to examine the validity of content, a number of senior researchers and experts, including the research supervisors, examined the items in each section to verify that they accurately and comprehensively described the factor being tested. The questionnaires were modified in line with the feedback provided. A pre-test was conducted whereby experts in the field provided feedback on the clarity and wording of the questionnaires to enhance their validity. Finally, a pilot study was carried out with a small number of IT specialists to check the appropriateness of the questionnaire items and to eliminate any redundancy or misunderstanding. Four of these specialists were Arabic speakers, and the rest were English speakers. The questionnaires were confirmed to be ready for final distribution to participants.

As previously stated, the items in these questionnaires were based on questionnaires used in previous studies which were shown to have reliable outcomes, as this indicated their robustness and appropriateness for application in this study. None of these studies had

however investigated the factors affecting cloud computing adoption in the region of Saudi Arabia nor the adoption performance and the cloud type model.

In the first questionnaire, 16 factors were examined to assess the fitness, viability and the adoption of cloud computing using 84 close-ended questions. The questionnaire design was based on previous studies of cloud computing adoption in the literature. The questionnaire contains two sections to assess the respondent's perceptions of the two dimensions shown in the proposed model, Fit and Viability. The first of these sections uses the DOI construct scale to assess how cloud computing technology matches the tasks of implementing e-government services. The second section asks respondents to give their views on the extent to which their organisation is ready for cloud computing and contains three measures: economic feasibility, organizational factors and technological readiness. All items are based on a Likert scale of 5, where 1 = strongly disagree and 5 = strongly agree.

The second questionnaire was used to assess the adoption performance of cloud computing targeting IT employees using 57 close–ended questions. The performance of cloud adoption was measured based on variables of the factors found in the first stage of the survey (questionnaire one). As with the first questionnaire, all items were measured with a Likert scale of 5, where 1 = strongly agree and 5 = strongly disagree. The third stage was aimed at investigating] the best cloud model considered appropriate for public organizations. In this questionnaire, 64 questions were used to examine the IT heads' perception of the best cloud model for their organizations. All items were based on a 7-point Likert scale, where 1 = strongly disagree and 7 = strongly agree.

5.3.3 Sample Size

Selecting a sampling is an essential part of obtaining an accurate result. There are various types of sampling random sampling, systematic sampling, stratified sampling, snowball sampling, judgemental sampling and natural sampling (Collis and Hussey, 2013). Moreover, according to Cohen et al. (2011), these methods can be divided into random sampling and non-random sampling. In random sampling, each member of the population is given an equal chance to participate and the sample size must be large. However, a non-random sample does not need a random selection. Snowball sampling is a type of non-random sampling (Babbie, 2013).

For this research, snowball sampling was applied. The snowball method is used when it is hard to reach the population in a given context; and allows the researcher to reach participants through another person who has an access to them (Collis & Hussey, 2013). In this research, the target population was IT employees in public organizations in Saudi Arabia. They were all reached through their IT heads in their organizations. Selecting this method was also quicker compared to the other aforementioned techniques which require more time and longer procedures.

A specific size sample is needed to ensure it is representative of the target population. This study applies the Structural Equation Modelling (SEM) using SMARTPLS software; and it has been suggested that when applying SEM, sample sizes of 200 would be typical (Kline, 2011). However, researchers have no consensus over the precise sample size that needs to be used in research (Sivo et al., 2006). The sample size selected for this study was based on the table designed by Krejcie and Morgan, (1970). According to this table, the number of IT employees in the target population needed to be calculated in order to obtain the sample needed. According to Saudi Statistics Authority, there are 10,000 IT employees assigned to different departments in Saudi Arabia. This sample size required is therefore 370 in Krejcie's and Morgan's table. In this research, the final sample of respondents for the first questionnaire was 408 which indicates a satisfactory level which meets the requirement.

Table 5.5: Satisfactory sample sizes from differently sized universes

Universe	Sample	Universe	Sample	Universe	Sample	Universe	Sample
10	*10*	100	*80*	1,250	*294*	6,000	*361*
15	*14*	200	*132*	1,500	*306*	7,500	*366*
20	*19*	300	*169*	2,000	*322*	10,000	*370*
30	*28*	400	*196*	2,500	*333*	15,000	*375*
40	*36*	500	*217*	3,000	*341*	20,000	*377*
50	*40*	600	*234*	3,500	*346*	30,000	*379*
60	*44*	700	*248*	4,000	*351*	40,000	*380*
70	*59*	800	*260*	4,500	*354*	50,000	*381*
80	*66*	900	*269*	5,000	*357*	75,000	*382*
90	*73*	1,000	*278*	5,500	*359*	1,000,000	*384*

Source: adapted from Krejcie, R. and Morgan, D. (1970)

***Sample size** = 370*

5.4 Assessment of Measurement Model

There are various ways of measuring reliability in research: Test-Retest, Alternate-Forms, Spilt-half and Internal Consistency (Hair, 2010). In this research, the commonly-used Internal Consistency Test was used to examine the reliability of the variables' measurements. In an internal consistency test, the consistency of constructs is evaluated through the factors. According to Cortina, (1993), Cronbach's alpha is the most widely used test to examine internal consistency and establish reliability. In terms of the minimum rate accepted to measure reliability, there is no agreed minimally acceptable rate; and Boett and Wrigt, (2015) suggest that the reliability of the population is more important than the reliability of the sample and that where the focus should be. However, Sekaran, (2003) and Hair, (2010) suggest that Cronbach Alpha value should be higher than 0.5. Moreover, Cronbach Alpha is consistent when the minimum value equals 0.6 (Moh Najid, 1999).

As stated, Cronbach Alpha was used in order to assess the internal consistency of the constructs. In Table 5.6 below, all items are shown along with their codes used in the model and the Cronbach alpha values. All items (Adoption, Asset Specificity, Compatibility, Complexity, Fit, IT Infrastructure, Cloud Knowledge, IT Policy, ROI, Relative Advantage, IT Skills, Top Management Support, Uncertainty, Viability,

Security, Task, and Trialability) have a higher Cronbach Alpha value than the minimum recommended rate of 0.5 (Sekaran, 2003; Hair, 2010). In fact, all items are above the rate of 0. 6 which shows that these items' internal consistency and reliability are good enough to be included in the analysis.

The results also show that most of the items have a reliability of 0.8 which indicates these items have a very good reliability and internal consistency. The others are mostly between 0.75 and 0.8 which also shows a very good consistency for these items, bearing in mind that some of these variables' items, such as ITSKILL2 and SEC 4, were deleted due to their low item loadings of under 0.5. Such items would have recorded higher internal consistency although their current level of consistency was still higher than 0.6.

Table 5.6: Cronbach Alpha Measurement Analysis

Items	Item Code	Cronbach's Alpha
Adoption	ADP1, ADP2,ADP3	0.785
Asset Specificity	ASSET 1, ASSET2,ASSET3	0.841
Compatibility	COMPT1, COMPT2,COMPT3	0.788
Complexity	Complx1, Complx2, Complx3, Complx4	0.77
Fit	FIT1,FIT2,FIT3,FIT4,FIT5	0.845
IT Infrastructure	ITINFR1,ITINFR2,ITINFR3,ITINFR4	0.803
Cloud Knowledge	KNWL1,KNWL2,KNWL3,KNWL4	0.875
IT Policy	ITPOLICY1,ITPOLICY2,ITPOLICY3	0.774
ROI	ROI1,ROI2,ROI3,ROI4	0.8
Relative Advantage	ADV1, ADV2,ADV3,ADV4	0.877
IT Skills	ITSKILL1,ITSKILL3,ITSKILL4	0.804
Top Management Support	TMS1,TMS2,TMS3,TMS4,TMS5	0.794
Uncertainty	UNCERT1,UNCERT2,UNCERT3	0.764
Viability	VIABILITY 1 , VIABILITY 2	0.676

Security	SCE1,SEC2,SEC3,SE5	0.786
Task	TASK1, TASK2,TASK3	0.811
Trialability	TRL1,TRL2,TRL3	0.637

5.5 Structural Equation Modelling (SEM)

For this research, structural equation modelling was used in order to assess and verify the research model. It was also used for examining the relationships between the independent and dependant variables. The strength of the research model was also assessed using structural equation modelling. SEM is used to assess the direct and indirect effects of a relationship and it consists of a measurement and a structural model (Fan et al, 2016). The measurement model examines the composite variables (Holye 1995; Kline, 2010) while the structural model examines the dependencies of the hypotheses (Holye 1995; Kline, 2010). Therefore, this research uses the two proposed methods (measurement and structural models). SMART Partial Least Square (PLS) was used to analyze the data through SEM. PLS has been used widely in various disciplines (Duxbury & Higgins, 1991; Hulland & Kleinmuntz, 1994; Smith & Barclay, 1987). PLS enables researchers to gain insights into the reliability and validity of their data before drawing the final conclusions about the research outcomes. Furthermore, PLS can allow identifying the relationship between measures and constructs. Path coefficient and model adequacy can all be determined using PLS (Hulland, 1999). Hence, this research uses the SMARTPLS for the data analysis.

5.6 Analysis of the Measurement Model

Three different indicators were used in order to assess the construct measurement in this research including items loadings, Cronbach's alpha (explained above), and composite reliability.

According to the guidelines of Comrey and Lee, (2013) and Toth-kiraly et al. (2017) items above 0.70 are excellent, very good between 0.63 and 0.70, good between 0.55 and 0.62, fair if loadings are between 0.44 and 0.33, and if between 0.33 and 0.32, it is poor. The minimum value of each item should exceed a value of 0.5 (Hair, 2010).

According to the outcomes (shown in Table 5.7), all items are above the minimum value of 0.5 suggested by (Hair, 2010). Variables such as Asset Specificity, Compatibility, Fit, IT Infrastructure, Cloud Knowledge, ROI, Relative Advantage, IT Skills, Uncertainty, Viability, and Task showed an excellent reliability according to the guidelines of Comrey and Lee, (2013) whereas the other items (Complexity, IT Policy, Top Management Support and Trialability) had some item loadings which could be considered to be 'very good' according to Comrey and Lee, (2013); and only one item loading (in trialability) showed a 'fair' reliability.

Table 5.7: Item loadings

Variables	Item Loading
Adoption	0.923
	0.886
	0.65
Asset Specificity	0.862
	0.919
	0.826
Compatibility	0.817
	0.79
	0.87
Complexity	0.565
	0.7
	0.76
	0.88
Fit	0.796
	0.77
	0.825
	0.729
	0.8
IT Infrastructure	0.855
	0.727
	0.787
	0.789
Cloud Knowledge	0.832
	0.883
	0.817
	0.867
IT Policy	0.632
	0.777
	0.955
ROI	0.724
	0.83
	0.848
	0.816
Relative Advantage	0.922
	0.813

	0.793
	0.886
	0.704
	0.845
IT Skills	0.935
	0.831
	0.818
	0.597
	0.571
Top Management Support	0.74
	0.75
	0.733
Uncertainty	0.772
	0.878
Viability	0.86
	0.729
	0.799
	0.812
Security	0.759
	0.802
	0.927
Task	0.822
	0.761
	0.528
Trialability	0.868

5.6.1 Composite Reliability

Composite reliability was also used to assess the constructs measurement to ensure the internal consistency. According to Saeed et al. (2017), values between 0, 60 and 0.70 are acceptable when using the composite reliability measurement. Values between 0.70 and 0.90 achieve a satisfactory level (Nunnally and Bernstein, 1994).

Table 5.8 shows the composite reliability for all items. The outcomes indicate that the composite reliability values for the entire construct are above 0.70 which indicates a satisfactory level according to the guideline suggested by Nunnally and Bernstein (1994) and Saeed et al. (2017).

Table 5.8: Items Composite Reliability

Items	Composite Reliability
Adoption	0.865
Asset Specificity	0.903
Compatibility	0.831
Complexity	0.823
Fit	0.889
IT Infrastructure	0.869
Cloud Knowledge	0.912
IT Policy	0.838
ROI	0.881
Relative Advantage	0.916
IT Skills	0.871
Top Management	0.84
Uncertainty	0.894
Viability	0.861
Security	0.858
Task	0.888
Trialability	0.77

5.7 Validity of Model Measurement

This section considers the convergent and discriminate validity of the variables and displays a correlations matrix for the constructs.

5.7.1 Convergent validity

Convergent validity occurs when two measures of same items have a correlation; and it can be identified via finding the coefficient of the validity correlation (Engellant et al, 2016). Convergent validity seeks to demonstrate whether there is a correlation between the measurement and the variables. If the instrument is valid, it should show a correlation (University of York, 2008). Convergent validity aims to provide more evidence for construct validity (Chin and Grace, 2014).

For this research, convergent validity was assessed via using the Average Variance Extracted (AVE) for all items. AVE refers to the amount of variance in variables, and can be explained by the latent construct (Farrell et al, 2009). AVE can be calculated through squaring the loading for each indicator in each item and then computing the mean (Hair et al, 2019). Typically, the acceptable rate of AVE should be 0.50 or above (Gu et al, 2019; Hair, 2010). In this study, the AVE values were calculated and outcomes have been presented in Table 5.9. The findings show that all items are above the minimum value of 0.50 proposed by Hair, (2010) and Gu et al. (2019). Although variables, like compatibility, complexity, top management support and trialability achieved just over the minimum 0.50, overall findings have met the AVE requirement. This indicates that each one of the items shares half of its variance.

Table 5.9: Convergent Validity Using AVE

Items	Average Variance Extracted (AVE)
Adoption	0.686
Asset Specificity	0.756
Compatibility	0.562
Complexity	0.543
Fit	0.616
IT Infrastructure	0.625
Cloud Knowledge	0.723
IT Policy	0.639
ROI	0.711
Relative Advantage	0.731
IT Skills	0.695
Top Management Support	0.518
Uncertainty	0.809
Viability	0.755
Security	0.602
Task	0.726
Trialability	0.537

5.7.2 Discriminate validity

Discriminate validity refers to the difference from one construct another empirically (Hamid et al, 2017). Discriminate validity examines the difference in degree among the overlapping items (Hair et al, 2014). Cross-loading is most usable indicator to assess discriminate validity; and in the cross-loadings, the factor indicators on the examined item have to be greater than the other constructs (Hair, 2011). Discriminate validity can be also assessed through comparing the AVE square root value with the items' correlations (Hair 2010). According to Fornell and Lacker, (1981) and Hulland, (1999), discriminate validity refers to the extent to which a construct is different from the other items in the structural model.

In this research, discriminate validity was examined through comparing the square value of AVE with the item correlations and analyzing the average variance obtained (Akter et al, 2011; Aibinu et al, 2011). According to Fornell-Lacker's criterion (1981), the square root of AVE should be greater than its correlation with the other items and should share more variance with its measures than the other items. The square root of AVE should be more than any two construct correlations (Chin, 1998).

Table 5.10 shows the correlation matrix for the constructs. The table brings evidence that the square root value in each construct is greater than its correlation with the other items. Overall, the results show a satisfactory level and confirm the discriminate validity of the constructs.

Table 5.10: Correlation Matrix for Constructs

	Adoption	Assets	Compat.	Complex.	Fit	CKW	IT Policy	ROI	Rel.Adv	IT Skills	TMS	Uncer.	Viability	Security	Task	Trialab.
Adoption	**0.828**															
Assets	0.491	**0.87**														
Compatibility	0.09	0.267	**0.75**													
Complexity	-0.016	-0.1	0.007	**0.737**												
Fit	0.533	0.582	0.092	-0.069	**0.785**											
IT Infrastructure	0.56	0.663	0.1	-0.071	0.714											
Cloud Knowledge	0.277	0.585	0.15	-0.101	0.325	**0.85**										
IT Policy	0.071	-0.001	-0.03	-0.032	0.043	0.005	**0.799**									
ROI	0.355	0.5	0.129	-0.039	0.49	0.325	0.043	**0.843**								
Relative Advantage	0.215	0.266	0.029	0.003	0.319	0.087	-0.003	0.202	**0.855**							
IT Skills	0.039	0.06	0.04	-0.018	0.023	0.112	0.004	0.054	-0.001	**0.833**						
Top Management Support	0.437	0.567	0.099	-0.04	0.544	0.383	0.014	0.677	0.2	0	**0.72**					
Uncertainty	0.002	0.018	-0.028	-0.032	0.012	-0.033	0.008	0.009	0.046	0.015	0.005	**0.899**				
Viability	0.284	0.471	0.078	-0.033	0.435	0.283	0.058	0.828	0.207	0.104	0.532	-0.014	**0.869**			
Security	-0.036	0.023	0.069	0.05	0.073	0.022	-0.052	0.01	0.036	0.011	0.012	0.036	0.029	**0.776**		
Task	0.134	0.26	0.004	-0.082	0.354	0.208	0.034	0.53	0.175	0.034	0.439	-0.043	0.619	0.073	**0.852**	
Trialability	0.273	0.435	0.1	-0.02	0.351	0.277	-0.042	0.205	0.133	0.005	0.474	0.017	0.127	0.042	0.188	**0.733**

5.8 Structural Model Analysis

When item loadings, Cronbach's alpha and composite reliability have been examined and confirmed, structural model analysis should be conducted. A structural model can be examined through assessing the variance on the latent variables and path coefficient (Rahman et al, 2013). In this phase, the model hypotheses are verified along with the relationships among the constructs. This process also assesses and depicts the path coefficient of the hypotheses. The significance among the variables is assessed and shown in Table 5.12 as well. Table 5.11 illustrates all hypothesises this research aimed to examine. This stage is divided into two sections; section one outlines the results obtained through the examination of the proposed model and hypotheses while section two draws a conclusion about the relationship found among the variables.

Table 5.11 Structural Model Hypotheses Path

Item	Hypothesis	Hypothesized Relationship
Fit	H1 (+)	Fit ⟶ ADP
Task	H1a (+)	Task ⟶ Fit
Relative advantage	H1b (+)	Relative advantage ⟶ Fit
Compatibility	H1c (+)	Compatibility ⟶ Fit
Complexity	H1d (-)	Complexity ⟶ Fit
Trialability	H1e (+)	Trialability ⟶ Fit
Security	H1f (-)	Security ⟶ Fit
Viability	H2 (+)	Viability ⟶ ADP
Return on Investment (ROI)	H2a (+)	ROI ⟶ Viability
Asset Specificity	H2b(+)	Asset Spe. ⟶ Viability
Uncertainty	H2c(-)	Uncertainty ⟶ Viability
Top management support	H2d(+)	TMS ⟶ Viability
Cloud Knowledge	H2e(+)	CNWL ⟶ Viability
IT Infrastructure	H2f(+)	IT Infr. ⟶ Viability
IT Skills	H2g(+)	IT Skills ⟶ Viability
IT Policies	H2h(+)	IT Policies ⟶ Viability

5.9 Goodness of Fit of SEM (GoF)

The GoF was proposed by Tenenhaus et al, (2004) and calculates both the measurement and the performance of the structural model. GoF is used to evaluate the path of a PLS model (Tenenhaus et al, (2004). It measures how accurate the proposed model is. GoF can be calculated through the mean of average communality and the R squared average (Tenenhaus et al, (2004). There are two ways to examine the goodness of the model: calculating the mean

of inference statistics or by using indicates of fit. The PLS model depends on bootstrapping, which is used to define the potential of gaining a discrepancy between the correlation and the empirical (Henseler et al., 2016). GoF is explained as computing the mean of AVE and R squared to examine the fitness of the model and proving its power (Rahman et al, 2013). The minimum cut off value is 0.36 for a model to be considered powerful (Akter et al, 2011).

Applying the equation proposed by Akter et al. (2011), the result of GoF is shown below:

$$GoF = \sqrt{\overline{R^{\wedge}}} \times \overline{AVE}$$

$$GoF = \sqrt{0.409} \times 0.660$$

$$GoF = 0.639 \times 0.812$$

$$GoF = \mathbf{0.518}$$

As shown in the equation the $\mathrm{GoF} = 0.518$ for the model, which is greater than the cut off value suggested by Akter et al. (2011) which indicates that the model is powerful and has a good fitness.

5.10 Verification of Latent Variables

After approving the fitness of the model, an assessment of the relationship among the variables is required, which were varied and based on path co-efficient values, also known as beta (β) values and critical ratio or T-test values (Hair, 2010; Rahman et al, 2013).

According to Dewey and Lu, (1959), a path co-efficient is partial regression which examines the direct effect of one variable on another and allows co-efficient separation into elements of direct and indirect influence. Typically, the purpose of examining the hypotheses is to find out the indirect variables that significantly influence the direct variables (Hair, 2010). According to Fisher, (1930) the P value is defined as an index that assesses the significance of variables against a null hypothesis. He defines the cut off value for the P value as 0.05. The relationship in hypotheses is considered to be significant when $P < 0.05$ and its value in critical ratio (CR) is higher than 1.96 (Tabachnick & Fidell, 2007). Moreover, critical ratio occurs when an estimate is divided by its standard error (Hox and Behger, 1998). A T- Test enables researchers

to find out the potentiality of getting sample outcomes in case the null hypothesis was true. When the P-value is less than 5% the hypothesis is rejected; and an observation can be considered significant if CR higher than or equal to 1.96 (Hair, 2010). The lower the P value is, the less likely the hypothesis is significant. P value measures the variance between the null hypothesis and what is being observed (Biau et al, 2010).

Table 5.12 illustrates the summary of the path result along with the corresponding CR values and T-test values. The path for hypotheses H1, H2, H1a, H1b, H1c, H1e, H2a, H2b, H2d and H2g are statistically significant and have a positive impact. However, hypotheses H1d, H1f, H2c, H2e, H2f and H2h are rejected. Although the top management support was statistically supported, its effect on the viability was negative.

The outcomes also show that hypothesis H1a revealed a strong effect on the fitness of cloud computing for implementing cloud computing in Saudi public organizations. This means that in order for an organisation to adopt cloud computing, task requirements have to be identified. Moreover, the DOI factors, such as relative advantage, compatibility and trialability had an effect on the fitness of cloud computing to be adopted into the Saudi public environment as they had a path coefficient of 0.236, 0.056, and 0.264 respectively. The other two factors of DOI (security and complexity) had no effect on the fitness of cloud computing. This means that organizations could potentially take decisions about adopting cloud computing without considering these two factors. It is quite unusual that security did not appear to have an impact on such technology adoption. However, the reason why such an outcome occurred will be discussed in the next chapter.

In terms of viability, the path hypothesis between viability and adoption showed that organization viability had a positive impact on the adoption of cloud computing overall. This was observed from the significant impact of viability factors: ROI, TOM, Asset Specificity, and IT Skills.

Table 5.12: The Hypothesis Path Result

Hypothesis	Relation	Path Coefficient	T Statistics	Supported
H1	Fit → Adoption	0.505	15.419	Yes
H2	Viability -> Adoption	0.065	2.17	Yes
H1a	Task -> Fit	0.257	7.931	Yes

H1b	Relative Advantage -> Fit	0.236	5.635	Yes
H1c	Compatibility -> Fit	0.056	0.827	Yes
H1d	Complexity -> Fit	-0.045	0.809	No
H1e	Trialability -> Fit	0.264	5.791	Yes
H1f	Security -> Fit	0.033	0.662	No
H2a	ROI -> Viability	0.833	20.725	Yes
H2b	Assets Specify -> Viability	0.111	3.07	Yes
H2c	Uncertainty -> Viability	-0.024	0.804	No
H2d	Top Management Support -> Viability	-0.101	1.932	Yes
H2e	Cloud Knowledge -> Viability	-0.032	1.112	No
H2f	IT Infrastructure -> Viability	0.026	0.465	No
H2g	IT Skills -> Viability	0.054	1.56	Yes
H2h	IT Policy -> Viability	0.022	0.602	No

According to Byrne, (2010), squared correlations R^ is *"the proportion of variance that is explained by the predictors of the variable in question".* R^ can be examined as possible if = 0.26, moderate if = 0.13 and weak if = 0.02 (Choen, 1988; Rahman et al, 2013). Table 5.13 depicts R^ values for the dependent variables (Adoption 0.28), (Fit 0.269) and (Viability 0.7). All values show a greater value than the cut off suggested by Choen, (1988) and Rahman et al, (2013) which means that the model obtains a satisfactory level. Moreover, the value achieved by adoption is 0.28 which means that 28% of the variance to adopt cloud computing into the public organizations is significantly explained by adoption; while 26% is explained by the fitness and 67% of cloud computing adoption is explained by the viability.

Table 5.13: Squared Correlations R^ Value

Variables	R Square
Adoption	0.288
Fit	0.269
Viability	0.67

5.11 Common Method Bias (CMB)

When measuring perception, opinion and behaviour, respondents' answers can be different according to their situation and context. If the answers vary, this is known as common method variance (Richardson et al, 2009). In common bias, if the total variance is less than 50%, it means that CMB does not affect the data. If measures are affected by CMB, the intercorrelations among the constructs can be inflated or deflated (Williams & Brown, 1994). For this study, the total variance is 10.311 which is less than 50% (see Table 5.14), which shows a satisfactory level (Podsakoff & MacKenzie, 2003).

Table 5.14: Common Method Bias

Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.093	10.311	10.311	3.093	10.311	10.311
2	2.774	9.247	19.559			
3	2.706	9.021	28.579			
4	2.433	8.111	36.690			
5	2.171	7.237	43.927			
6	2.081	6.937	50.864			
7	1.984	6.614	57.478			
8	1.886	6.287	63.765			
9	1.027	3.425	67.189			
10	0.991	3.302	70.491			
11	0.915	3.049	73.540			
12	0.814	2.712	76.252			
13	0.739	2.464	78.716			
14	0.691	2.304	81.020			
15	0.600	1.999	83.019			
16	0.552	1.840	84.859			
17	0.536	1.788	86.647			

18	0.486	1.618	88.266			
19	0.471	1.568	89.834			
20	0.392	1.305	91.139			
21	0.374	1.246	92.385			
22	0.331	1.105	93.490			
23	0.317	1.058	94.548			
24	0.308	1.026	95.573			
25	0.287	0.957	96.530			
26	0.258	0.859	97.389			
27	0.223	0.745	98.133			
28	0.213	0.709	98.843			
29	0.202	0.672	99.515			
30	0.145	0.485	100.000			

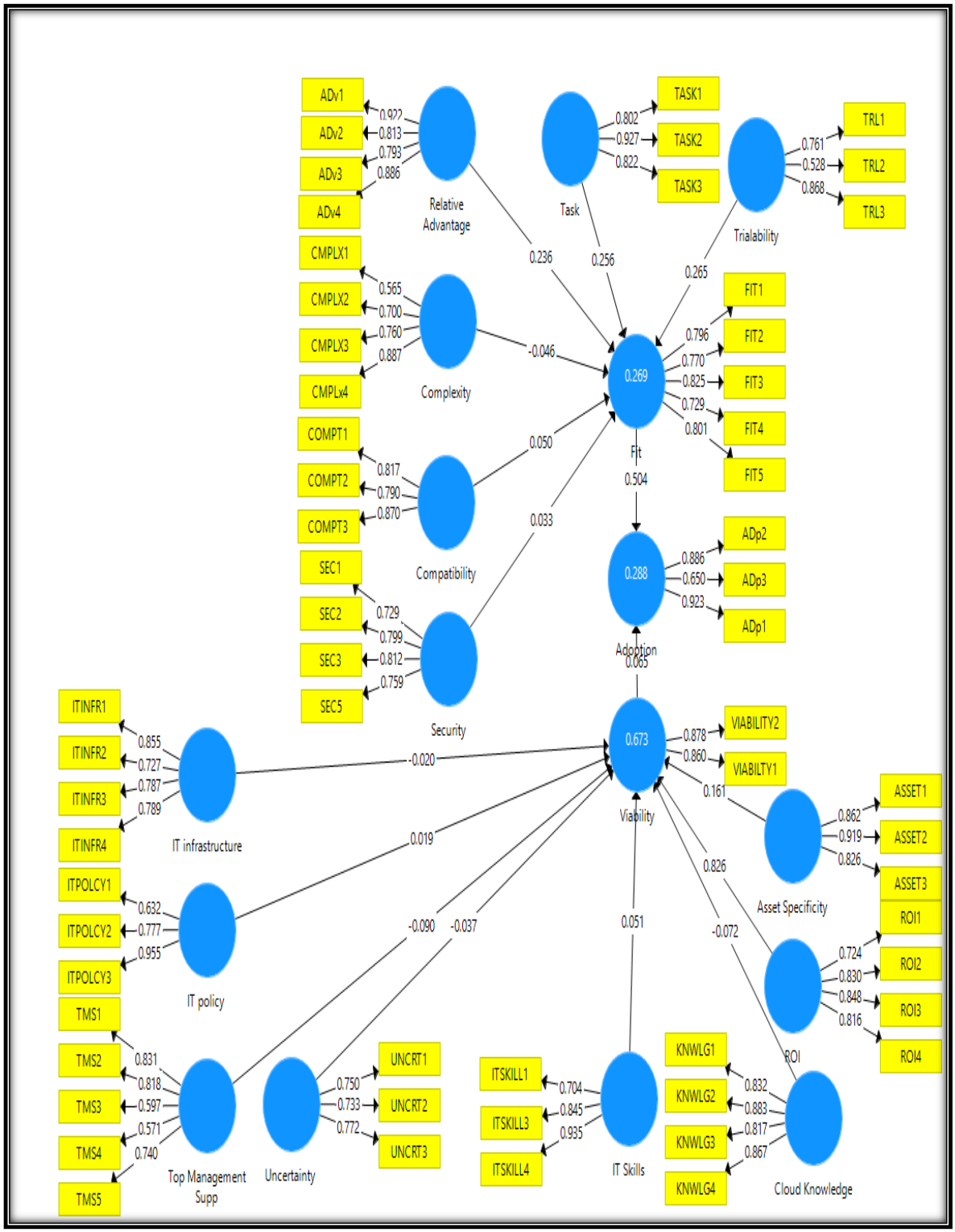

Figure 5.1: The Path Diagram of the Proposed Model

5.12 Assessment of Hypotheses

This section analyses the proposed hypotheses along with their relationship in detail, using the path coefficient.

H1: *The fit of cloud computing to e-government task requirements positively affects Saudi public sectors` decisions to adopt the technology.*

The outcomes for the above hypothesis show a positive direct influence between the adoption of cloud computing and Fit. The obtained critical radio CR for Fit was 0.505 and its t-test value was 15.419. This indicates that Fit can significantly affect the adoption of cloud computing in Saudi public organizations. It can be summarized that Fit has a positive influence on the adoption of cloud computing.

H2: *The viability of cloud computing positively affects the Saudi public sector`s intention to adopt the technology.*

Organization viability was also found to be having a direct influence on the adoption of cloud computing. The outcomes showed that the CR for viability was 0.065 while its t-test value was 2.17, therefore the outcome supported the proposed hypothesis.

H1a: *The E-government-related task requirements positively affect the fitness of cloud computing for implementing e-government services.*

Saudi e-government-related task was found to have a positive impact on cloud adoption. This means cloud computing can be adopted into public organizations if its tasks suit the government-related requirements. The outcomes showed that CR obtained by related-task was 0.257 and the T-test value was 7.931. Consequently, the result supported the hypothesis.

H1b: *Relative advantage positively affects the cloud computing fitness for public organizations` computing needs for e-government services implementation.*

The relationship between relative advantage and Fit was found to be positively significant. The results showed that the critical ratio of relative advantage was 0.236 and its t-test value was 5.635. This indicates that the adoption of cloud computing is positively influenced by relative advantage, as a result of which the hypothesis was accepted.

H1c: *Compatibility positively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation.*

Cloud computing compatibility was found to positively affect the adoption of cloud computing. According to the outcomes, compatibility equals 0.005 and was higher than 1.96, as recommended by Tabachnick and Fidell, (2007). Hence, the hypothesis is supported.

H1d: *Complexity negatively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation.*

Cloud computing complexity was found to be positively affecting the cloud computing adoption. This means the complexity has no influence on the adoption of cloud computing. The outcome showed that the CR obtained by complexity was -0.045 and its t-test value was 0.809. Although the effect of complexity was negative, it failed to support the hypothesis.

H1e: *Trialability positively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation.*

The trialability of cloud computing was found to significantly influence the adoption of cloud computing. The result showed that the CR of trialability was 0.264 while its t-test value was 5.791. This indicates that trialability has a significant role in the adoption of cloud computing and as a result the hypothesis was accepted.

H1f: *Security negatively affects the cloud computing fitness for public organizations` computing needs for e-government services implementation.*

The relationship between security and fit was found to have a positive impact on the adoption of cloud computing. Unexpectedly, this means that security had no effect on the adoption of cloud computing. The outcomes showed that the CR of security was 0.033 and its t-test value was 0.662. While the effect of security was positive on the adoption of cloud computing, the result did not support the hypothesis which was consequently rejected.

H2a: *The viability of cloud computing to e-government implementation is positivity affected by return on investment (ROI).*

In this study, return on investment (ROI) was found to have a positive impact on the adoption of cloud computing. The result showed that ROI had a value of 0.833 in terms of CR and 20.725 in t-test value. The result indicates that the hypothesis is supported.

H2b: *The viability of cloud computing for e-government implementation is positivity affected by asset specificity.*

Organizational asset specificity was also found to have a positive impact on the adoption of cloud computing. This means that the organization has to be viable in terms the asset specificity

of its hardware and software to adopt cloud computing. The CR of asset specificity obtained was 0.111 and the t-test value was (3.07). This result indicates that the hypothesis H2b was supported.

H2c: *The viability of cloud computing for e-government implementation is negatively affected by uncertainty.*

According to the outcomes, uncertainty positively affected cloud computing adoption. The result showed that CR obtained by uncertainty was -0.024 and the t-test value was 0.804. Therefore, the hypothesis H2c was rejected.

H2d: *Top management support positively affects the viability of cloud computing for implementing e-government.*

Top management support was found to have a strong positive impact on the adoption of cloud computing. The outcomes showed that the CR for TMS was -0.101 and t-test was 1.932. Although the effect of top management support was found to be negative, the hypothesis H2d still considered to be supported.

H2e: *Cloud Knowledge positively affects the viability of cloud computing for e-government implementation.*

Cloud knowledge was found to negatively affect the adoption of cloud computing. The result showed that CR was -0.032 and t-test value was 1,112. As a result, this hypothesis was rejected.

H2f: *The perceived viability of cloud computing for offering e-government services is positively affected by IT Infrastructure.*

Although the interaction between IT Infrastructure and viability was found to be positive, the H2f failed to meet the proposed hypothesis. This means that IT Infrastructure does not significantly influence adopting cloud computing. The outcome showed that the CR value of IT Infrastructure was 0.026 while its t-test value was 0.465. Therefore, the hypothesis H2f was rejected.

H2g: *The perceived viability of cloud computing for offering e-government services is positively affected by IT Skills.*

In this study, the IT skill of employees were found to be having a strong effect on the adoption of cloud computing. This implies that an organization should ensure that its employees are

well-trained prior to the adoption of cloud computing. The CR and t-test value for IT Skills were 0.054 and 0.465 respectively. The hypothesis was therefore supported.

H2h: *The perceived viability of cloud computing for offering e-government services is positively affected by IT Policies.*

IT policies were found to not affect the adoption of cloud computing. The value for CR was 0.022 and t-test was 0.602. Hence, the hypothesis was rejected as the result did not support the hypothesis. Table 5.15 provides a summary for all the proposed hypotheses.

Table 5.15: Summary of Hypotheses

Hypotheses	Outcome
H1: The fit of cloud computing to e-government task requirements positively affects Saudi public sectors` decisions to adopt the technology.	Supported
H2: The viability of cloud computing positively affects the Saudi public sector`s intention to adopt the technology.	Supported
H1a: The E-government-related task requirements positively affect the fitness of cloud computing for implementing e-government services	Supported
H1b: Relative advantage positively affects the cloud computing fitness for public organizations` computing needs for e-government services implementation	Supported
H1c: Compatibility positively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation.	Supported
H1d: Complexity negatively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation	Rejected
H1e: Trialability positively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation	Supported
H1f: Security negatively affects the cloud computing fitness for public organizations` computing needs for e-government services implementation	Rejected

H2a: The viability of cloud computing to e-government implementation is positivity affected by return on investment (ROI).	Supported
H2b: The viability of cloud computing for e-government implementation is positivity affected by asset specificity.	Supported
H2c: The viability of cloud computing for e-government implementation is negatively affected by uncertainty.	Rejected
H2d: Top management support positively affects the viability of cloud computing for implementing e-government.	Supported
H2e: Cloud Knowledge positively affects the viability of cloud computing for e-government implementation.	Rejected
H2f: The perceived viability of cloud computing for offering e-government services is positively affected by IT Infrastructure	Rejected
H2g: The perceived viability of cloud computing for offering e-government services is positively affected by IT Skills	Supported
H2h: The perceived viability of cloud computing for offering e-government services is positively affected by IT Policies.	Rejected

5.13 Cloud Performance and Model

As noted in the introduction, a total of three questionnaires were issued in this quantitative phase of the research. Due to the numerous questions proposed to participants, it was considered inappropriate to include all the questions in a single questionnaire. It is recommended in the literature that the number of questions should not be huge, as this would discourage participation and possibly result in participants not concentrating properly on each question (Sharma, 2022). Also, although all three questionnaires addressed the research aim and questions, the various phenomena to be investigated, i.e., Fitness, Viability, Adoption,

Adoption Performance, and selection of cloud model also made the use of separate questionnaires preferable for ease of analysis.

As a result, the second questionnaire was used to answer the following research question:

Do the cloud computing factors identified in Question One influence the performance of cloud computing adoption in Saudi Arabia?

The aim of this question was to assess cloud computing fitness and viability in public organizations in Saudi Arabia. This questionnaire distributed to employees working in Najran University's IT department in order to address this question. Najran University has been using public cloud since 2012 and is planning to migrate to the Cloud in the near future. The selection of this organisation was based on the fact that it is both already using the Cloud and has the intention to migrate fully to the Cloud. This makes this organization a suitable choice to be assessed as the outcome will show both the fitness of cloud computing technology and the viability of the organization for accepting the Cloud. To measure the performance, the FVM was applied (Tjan,2001; Laing and Wei, 2004).

In this context, Fit measures to which extent cloud computing is consistent with Najran University environment whereas viability measures to which extent Najran University is ready to accept the Cloud. Fit was measured by using the DOI factors utilized for addressing RQ1. Viability was assessed on three dimensions: i.e., the technological, organizational and economic, also using the same factors used to assess viability in RQ1 as well. In the proposed matrix, (shown in Figure 5.2), 4 different components were proposed: 'Good target', 'Organisational restructuring', 'Look for another technology', and 'Forget it'. This matrix can help Najran University to predict the best strategy toward cloud computing adoption.

To further elaborate the matrix components; if Najran University for example has a high score for fit but a low score for viability, it means that the characteristics of cloud computing fit Najran University well but Najran University still not ready to accept it. Therefore, the best solution for them in this case is to conduct some organizational restructuring before making a decision about adoption. Moreover, in the event of having a high score for viability but a low score for fit, Najran University needs to look for another technology that can fulfil their task requirements. Cloud computing can only be a good fit and viable for Najran University if there is a high score for both Fitness and Viability. Following the formula used by Laing and Wei, (2004), the following two-dimensional matrix was used.

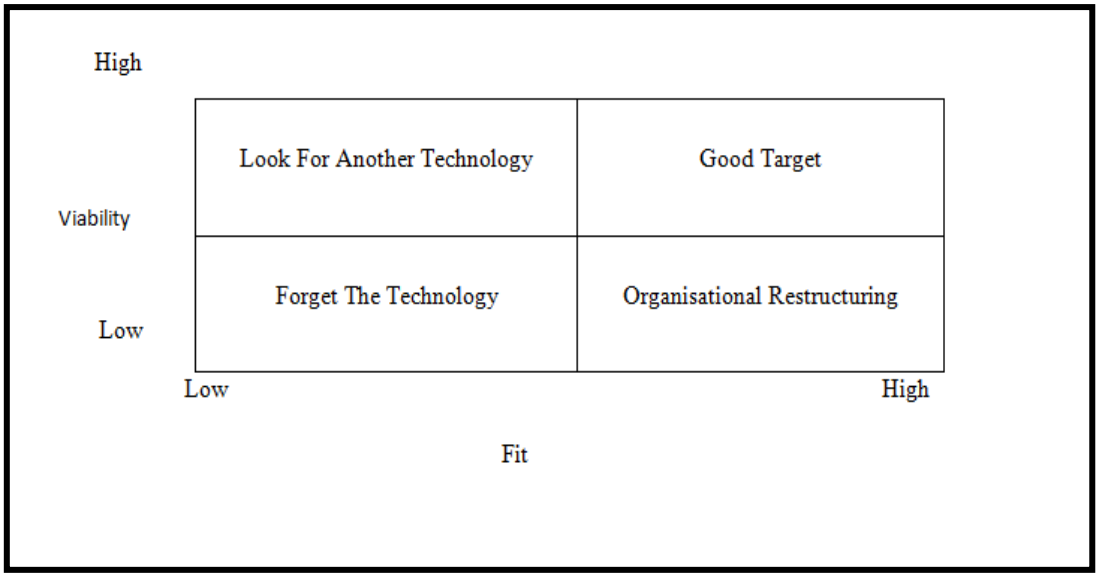

Figure 5.2: Two-Dimensional Matrix Components

Table 5.16 presents the fit constructs together with their measurements and results. Following the guidelines of Laing and Wei, (2004), the mean was calculated for each construct and the outcomes indicated that cloud computing fits the needs of Najran University very well. The total score of Task was **(4.5)** which indicates that adopting cloud computing had a positive impact on the performance of Najran University tasks. The rate of relative advantage was also high **(4.35),** which show that Najran University has a positive attitude towards the relative advantages given by cloud computing and its capabilities. In terms of complexity, participants mostly agree that cloud computing is clear and understandable for them to use which scored a total of (**3.88**).

The results also show that cloud computing is compatible and can be tested. The total scores of compatibilities and trialability are (**3.67**) and (**4.5**) respectively. Lastly, the score for security was (**3.81**) which indicates that (**1.19**) of participants prefer believe that cloud computing is not secure enough for the organization. The number is relatively low compared to 3.81. Overall, the outcomes show that cloud computing fits the needs of Najran University very well.

In regards to viability, Table 5.17 shows the viability constructs together with their measurements and results. The overall outcomes show also that Najran University has a very high viability for accepting cloud computing. The outcomes show that Najran University has a very good support from its upper management when it comes to new technology adoption. The results also revealed that top management in Najran University is aware of the benefits provided by cloud computing and can support it. This was clear by the high score of (**4.60**) received by Top Management Support.

Moreover, the results show that Najran University has the right IT infrastructure, assets specificity, and knowledgeable IT staff, and that respondents believe that benefits provided by the cloud computing overweigh the cost. This was clear by the scores received for IT infrastructure (**4.32**), Asset Specificity (**3.6**), Cloud knowledge (**4.17**), IT skills (**4.13), and** ROI (**3.72**). Furthermore, the result shows that IT employees in Najran University have a low uncertainty at (**2.6**) and IT policy (**2.85**) which indicates a very good attitude towards cloud adoption and having a good policy set in place. Lastly, the total score received by performance adoption was (**3.9**) which indicates that Najran University has a very high intention to adopt cloud computing. Overall, the result shows that Najran University is viable to adopt cloud computing.

Table 5.16: Fit Construct Measurement

Construct		Items	Mean	Construct	Items	Mean
FIT	Task	Citizens are provided effective services through the current e-government system used in the organization.	4.56	Compatibility	Cloud computing matches the nature of the organization's performance	3.95
					Cloud computing can be integrated with current systems easily	3.9
		Cloud computing improves the organization internal operations' performance.	4.55		Cloud computing fits well with the existing systems being used	4.05
		Organizations can easily and effectively share and exchange information through cloud computing	4.3		Cloud Computing does not need several technical changes.	28
	Score		**4.5**		Score	**3.67**
	Relative Advantage	Costs can be lowered when providing e-services **via** cloud computing	4.25	Trialability	Cloud computing services can be tested before the decision of using them	4.45
		Cloud computing facilitates e-government services implementation easily for organizations	4.5		It is important to do proper testing for cloud computing services before the taking a decision to adopt them	4.7
		Cloud Computing offers **use of** the up-to-date version of the technology	4.55		It is important to try cloud services long enough to see whether they fit the work or not	4.4
		Cloud Computing enhances work quality of the organization	4.1			
	Score		**4.35**		Score	**4.5**
	Complexity	Cloud Computing service are easy to be obtain for the organization to do the work	3.7	Security	Cloud computing offers enough security controls.	3.75
		Cloud computing services are clear and understandable.	3.95		Cloud computing services security can protect the organization's data.	3.95
		Cloud computing services are easy to work with for staff	3.95		Data privacy and confidentiality of organization can be maintained by cloud providers	3.85

		In general, cloud services are easy	3.95		Data centres and servers of cloud providers are secure enough	3.75
					In general, cloud computing is more secure than traditional computing systems	3.75
Total score of Fit	Score		**3.88**	Score	**3.81**	

Table 5.17: Viability Construct Measurement

Construct		Items	Mean	Construct	Items	Mean
Viability	Top Management Support	Top management is interested to use cloud computing to operate the organization's work	3.8	Asset Specificity	Our organization need special hardware and software to use cloud computing .	3.55
		Top management gets involved and offers enough leadership in the process of information systems	4.2		Staff with special experience need to be hired to adopt cloud computing.	3.7
		Top management supports adopting new technologies to offer e-services	4.35		In order to process organizational data, cloud services providers would have to make significant investments in equipment and software tailored to organization's needs.	3.55
		Top management is aware of advantages provided by cloud computing technology	4			
		Top management supports e-services implementation to use cloud computing	3.95			
	Score		**4.06**		Score	**3.6**
	Cloud knowledge	The underlying structure of cloud computing is well understood by IT staff	4.3	Uncertainty	In our organization, if cloud computing is adopted, it might not run well and make issues for IT operations.	2.45
		The advantages of using cloud computing are well understood by IT staff	4.35		In our organization, if Cloud computing is adopted, its servers may not run well and may not support our IT operations efficiently.	2.45
		Cloud computing models (SaaS, PaaS and IaaS) and types (Public, Private, Community and Hybrid) are well understood by IT staff	3.9		The pay-as-use model of payment is not clear and it is difficult to know cost and benefits.	3.15
		In general, IT staff have enough knowledge about cloud computing	4.15			
	Score		**4.17**		Score	**2.6**
	ROI	Cloud Computing lowers the investment in new infrastructure	4	IT infrastructure	Our organization has currently a good internet connection speed	4.8
		The deployment process of cloud computing involves a negligible amount of time and effort.	3.6		The organization is mature in using the Internet and related technology.	4.5

		Hiring expensive IT expertise can be eliminated if cloud computing is adopted in-house.	3.75		The organization needs improvement in regards to its computational system capabilities	4
		Computing benefits are more than the costs of its adoption.	3.8		The organization needs cloud-computing services to meet its IT needs.	3.95
		Staff can use cloud computing to work better with no need of more training.	3.45			
	Score		**3.72**		Score	**4.32**
Construct		**Items**	**Mean**	**Construct**	**Items**	**Mean**
Viability	IT Skills	Within this organization, managers at all levels are well-educated in IT.	3.9	IT Policies	There is a shortage of security rules, policies and privacy laws.	2.5
		Our organization has high levels of IT-related skills and technical knowledge.	4.5		Our organization might lose data control if it uses cloud services provided by a supplier hosting data outside the country	3.5
		The IS department is aware of the business process well enough to understand the required applications.	4.15			
		IS staff are able to develop the cloud computing system	4		In our organization, there is no legal protection for the use of cloud computing	2.25
	Score		**4.13**		Score	**2.85**
	Performance of Adoption	It is suggested to use cloud computing perspectives in the organization.	4.05	**Total Score**	**3.9**	
		The organization will adopt cloud computing in the near future.	3.65			
		The organization is planning to assess and adopt cloud computing.	4			

Table 5.18: Outcome of Najran University Cloud Fitness and Viability

Look for Another Technology	Good Target **(Najran University)**
Forget the Technology	Organisational Restructuring

5.14 Cloud Model Selection

Selecting the right cloud model was the last objective that this research aimed to address. In this section, an outline is given of how the study is sought to address the following research question.

Which cloud model do policy makers believe is the most appropriate for Saudi e-government?

Analysis of the data for questionnaire three adopted the SAW method. The SAW method is employed in many areas where decision-makers aim to choose among different alternatives. In SAW analysis, the policy-maker or the person taking the decision gives weight to the attributes. The total weight of the attributes can be calculated by adding up all the attribute values. The SAW method is accurate as it relies on pre-identified attributes and preference weights (Putra & Punggara, 2018).

A questionnaire was prepared and given to the IT head of Najran University. This questionnaire was specifically targeted only to IT heads, as the nature of the questions asked could only be answered by an individual who had enough expertise about department-rated IT tasks. Two questionnaires were distributed. One was to the IT head and the other was to his assistant to ensure the validity of responses as had been recommended in literature (Von, 2022). Both questionnaires were returned with a complete answer and no missing data were found. However, the outcome of this question was based on the responses of the IT head`s assistant. This was because the IT head said that he has been in the department for just under a year, so the researcher decided to use the IT head`s assistant's responses, as he has been in the department for more than seven years.

Table 5.19 presents the questionnaire outcomes rated by the IT head's assistant. While Table 5.20 shows the factors' weight, based on how important they are to Najran University. The calculation of SAW was conducted based on the following formulae:

$$r_{ij} = \frac{x_{ij}}{Max(x_{ij})} \qquad r_{ij} = \frac{Min(x_{ij})}{x_{ij}}$$

Part of the SAW analysis involves calculating the preference value, which can be arrived at through the following formula (Nurmalini & Rahim, 2017):

$$V_i = \sum_{j=1}^{n} w_j r_{ij}$$

Table 5.19: Construct Rate Given by IT Head's Assistant

Cloud Model	Relative Adv.	Trialability	ROI	Asset	Task	IT skills	TMS
Pub-SaaS	5	7	4	5	2	5	4
Pub-IaaS	1	7	2	5	6	6	4
Pbu-PaaS	5	6	4	6	6	6	7
Pri-SaaS	5	6	4	6	6	6	6
Pri-IaaS	4	5	4	4	6	6	4
Pri-PaaS	6	6	4	6	5	6	7
Hyb-SaaS	3	5	5	6	6	6	4
Hyb-IaaS	1	1	6	6	6	6	4
Hyb-PaaS	1	1	6	6	6	6	4

Table 5.20: Factor Weight

Factor	100%
Relative Adv.	100
Trialability	100
ROI	100
Asset	100
Task	100
IT Skill	100
TMS	100

In order to make all criteria comparable, a normalization needs to be conducted. In beneficial criteria, the performance value in each individual cell is divided with the maximum value. For non-Benefield value, the minimum value was computed as follows:

(1)

R1,1= $\frac{5}{Max\ (5,1,5,5,4,6,3,1,1)} = \frac{5}{6} = 0.833$

R2,1= $\frac{1}{\max(5,1,5,5,4,6,3,1,1)} = \frac{1}{6} = 0.166$

R3,1= $\frac{5}{\max(5,1,5,5,4,6,3,1,1)} = \frac{5}{6} = 0.833$

R4,1 = $\frac{5}{\max(5,1,5,5,4,6,3,1,1)} = \frac{5}{6} = 0.833$

R5,1 = $\frac{4}{\max(5,1,5,5,4,6,3,1,1)} = \frac{4}{6}$ = 0.666

R6,1 = $\frac{6}{\max(5,1,5,5,4,6,3,1,1)} \frac{6}{6}$ = 1

R7,1 = $\frac{3}{\max(5,1,5,5,4,6,3,1,1)} \frac{3}{6}$ = 0.5

R8,1 = $\frac{1}{\max(5,1,5,5,4,6,3,1,1)} \frac{1}{6}$ = 0.166

R9,1 = $\frac{1}{\max(5,1,5,5,4,6,3,1,1)} \frac{1}{6}$ = 0.166

(2)

R1,2= $\frac{7}{Max\ (7,7,6,6,5,6,5,1,1)} = \frac{7}{7}$ = 1

R2,2= $\frac{7}{Max\ (7,7,6,6,5,6,5,1,1)} = \frac{7}{7}$ = 1

R3,2= $\frac{6}{Max\ (7,7,6,6,5,6,5,1,1)} = \frac{6}{7}$ = 0.857

R4,2 = $\frac{6}{Max\ (7,7,6,6,5,6,5,1,1)} \frac{6}{7}$ = 0.857

R5,2 = $\frac{5}{Max\ (7,7,6,6,5,6,5,1,1)} \frac{5}{7}$ = 0.714

R6,2 = $\frac{6}{Max\ (7,7,6,6,5,6,5,1,1)} \frac{6}{7}$ = 0.857

R7,2 = $\frac{5}{Max\ (7,7,6,6,5,6,5,1,1)} \frac{5}{7}$ = 0.714

R8,2 = $\frac{1}{Max\ (7,7,6,6,5,6,5,1,1)} \frac{1}{7}$ = 0.142

R9,2 = $\frac{1}{Max\ (7,7,6,6,5,6,5,1,1)} \frac{1}{7}$ = 0.142

(3)

R1,3= $\frac{\min(4,2,4,4,4,4,5,6,6)}{4} \frac{2}{4}$ = 0.5

R2,3= $\frac{\min(4,2,4,4,4,4,5,6,6)}{2} \frac{2}{2}$ = 1

R3,3 = $\frac{\min(4,2,4,4,4,4,5,6,6)}{4} \frac{2}{4}$= 0.5

R4,3 = $\frac{\min(4,2,4,4,4,4,5,6,6)}{4} \frac{2}{4}$= 0.5

R5,3 = $\frac{\min(4,2,4,4,4,4,5,6,6)}{4} \frac{2}{4}$= 0.5

R6,3 = $\frac{\min(4,2,4,4,4,4,5,6,6)}{4} \frac{2}{4}$= 0.5

R7,3 = $\frac{\min(4,2,4,4,4,4,5,6,6)}{5} \frac{2}{5}$= 0.4

R8,3 = $\frac{\min(4,2,4,4,4,4,5,6,6)}{6} \frac{2}{6}$= 0.333

R9,3 = $\frac{\min(4,2,4,4,4,4,5,6,6)}{6} \frac{2}{6}$= 0.333

(4)

R1,4 = $\frac{5}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{5}{6}$ = 0.833

R2,4 = $\frac{5}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{5}{6}$ = 0.833

R3,4 = $\frac{6}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{6}{6}$=1

R4,4 = $\frac{4}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{4}{6}$= 0.666

R5,4 = $\frac{6}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{6}{6}$=1

R6,4 = $\frac{6}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{6}{6}$=1

R7,4 = $\frac{6}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{6}{6}$=1

R8,4 = $\frac{6}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{6}{6}$=1

R9,4 = $\frac{6}{Max\ (5,5,6,6,4,6,6,6,6)} \frac{6}{6}$=1

(5)

R1,5 = $\frac{2}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{2}{6}$ = 0.333

R2,5 = $\frac{6}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{6}{6}$ = 1

R3,5= $\frac{6}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{6}{6}$ = 1

R4,5= $\frac{6}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{6}{6}$ = 1

R5,5= $\frac{6}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{6}{6}$ = 1

R6,5= $\frac{5}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{5}{6}$= 0.833

R7,5= $\frac{6}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{6}{6}$ = 1

R8,5= $\frac{6}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{6}{6}$ = 1

R9,5= $\frac{6}{Max\ (2,6,6,6,6,5,6,6,6)}\frac{6}{6}$ = 1

(6)

R1,6= $\frac{5}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{5}{6}$= 0.833

R2,6= $\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

R3,6= $\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

R4,6= $\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

R5,6= $\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

R6,6 =$\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

R7,6= $\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

R8,6= $\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

R9,6= $\frac{6}{Max\ (5,6,6,6,6,6,6,6,6)}\frac{6}{6}$= 1

(7)

R1,7= $\frac{4}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{4}{7}$ = 0.571

R2,7= $\frac{4}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{4}{7}$ = 0.571

R3, 7 = $\frac{7}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{7}{7}$ = 1

R4,7= $\frac{6}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{6}{7}$ = 0.857

R5,7 = $\frac{4}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{4}{7}$ = 0.571

R6, 7 = $\frac{7}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{7}{7}$ = 1

R7,7 = $\frac{4}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{4}{7}$ = 0.571

R8,7 = $\frac{4}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{4}{7}$ = 0.571

R9,7= $\frac{4}{\max(4,4,7,6,4,7,4,4,4)}$= $\frac{4}{7}$ = 0.571

A normalized decision matrix was consequently obtained (See Table 5.21). The next step was to assign the weightage to the criteria. The sum of the weightage is 100% which accordingly can be multiplied for each construct.

Table 5.21: A Normalized Decision Matrix

Weightage	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Cloud Model	Relative Adv.	Trialability	ROI	Asset	Task	IT skills	TMS
Pub-SaaS	0.833	1	0.5	0.833	0.333	0.833	0.571
Pub-IaaS	0.166	1	1	0.833	1	1	0.571
Pbu-PaaS	0.833	0.857	0.5	1	1	1	0.5
Pri-SaaS	0.833	0.857	0.5	1	1	1	1
Pri-IaaS	0.666	0.714	0.5	0.666	1	1	0.571
Pri-PaaS	1	0.857	0.5	1	0.833	1	0.5
Hyb-SaaS	0.5	0.714	0.4	1	1	1	0.571
Hyb-IaaS	0.166	0.142	0.333	1	1	1	0.571
Hyb-PaaS	0.166	0.142	0.333	1	1	1	0.571

Using the formula, each construct was multiplied by each of its weights in Table 5.20 then the mean was calculated. The results indicated that private Software as a Service was the most suitable cloud model for Najran University, as shown in the table below.

Table 5.22: Final Result of Najran University Model Selection

Weightage	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**Best cloud Model**
Cloud Model	Relative Adv.	Traiability	ROI	Asset	Task	IT skills	TMS	
Pub-SaaS	0.833	1	0.5	0.833	0.333	0.833	0.571	4.903
Pub-IaaS	0.166	1	1	0.833	1	1	0.571	5.57
Pbu-PaaS	0.833	0.857	0.5	1	1	1	0.5	4.69
Pri-SaaS	0.833	0.857	0.5	1	1	1	1	6.19
Pri-IaaS	0.666	0.714	0.5	0.666	1	1	0.571	5.117
Pri-PaaS	1	0.857	0.5	1	0.833	1	0.5	5.69
sHyb-SaaS	0.5	0.714	0.4	1		1	0.571	5.185

Hyb-IaaS	0.166	0.142	0.333	1	1	1	0.571	4.212
Hyb-PaaS	0.166	0.142	0.333	1	1	1	0.571	4.212

5.15 Chapter Summary

This chapter has discussed the quantitative data analysis in detail. The chapter has been divided into several sections. Firstly, the participants' profile and missing data were explained in this chapter. The second section outlined the tests used to verify the construct reliability. Furthermore, the third section explains the outcomes obtained for each of the research hypotheses. The final section presents the cloud computing performance outcomes together with the results of the selection of a suitable cloud model for Najran University. While the results of the questionnaires provided in this chapter answered the research questions and achieved the research objectives, it was felt that interviewing experts in each of the targeted government organisations would provide more insight to the factors affecting cloud computing adoption and the type of cloud model to utilize in the selected Saudi organizations. The results of this qualitative phase of the research are explored in the following chapter.

Chapter 6: Qualitative Data Analysis and Findings

6.1 Introduction

As previously stated, this research has applied a mixed approach using qualitative and quantitative methods. This chapter explains the methods used for conducting the qualitative phase within the public organizations in Saudi Arabia. This chapter focuses on the interview data analysis especially the opinions of the interviewees regarding the intention to migrate towards cloud computing, the significant factors influencing cloud computing adoption and which cloud model might meet the organization's requirements. The purpose of these interviews was to examine to which extent the organizations intended to migrate to the cloud, and to assess the significance of the factors elicited from the literature and research theories. Finally, the purpose was to assess the best cloud model for adoption into these organizations from the perspective of the interviewed experts. Further, the aim of conducting interview was to review the factors identified in chapter 5 and explores other factors that might have an effect on cloud computing adoption.

6.2 Interview Data Collection

The research aimed to have a variety of responses obtained from different people positioned in various sectors encompassing small and large organizations. This was to ensure that that the research had covered several types of different cloud computing users who possessed different knowledge and levels and represented a wide range of cloud computing users operating within small and large domains. The interviews were carried out face-to-face with different experts in the field of cloud computing in each target group. This interview aimed to target only IT heads or experts due to the nature of questions which could only be addressed by people with knowledge of the research issues as well as the organizations. The interviews were expected to return rich data in order to address the research questions.

6.2.1 The Questions for the Interviews

The interviewees were asked questions related to the intention of having cloud computing adopted into their site and how far this process was going to be taken. Another aspect that the interviews covered was identifying the factors that may have influenced the adoption of cloud

computing based on the interviewees' experiences and points of view. The design of the interview schedule (see Appendix C) was also informed by the theoretical model that was designed for the study. Hence, questions were devised about factors that were adopted from the DOI theory (Relative Advantage, Compatibility, Complexity and Trialability as well as Security) and the Fit-Viability Model (Technological Readiness, Organisational Readiness and Economic Dimension. Finally, the interviewees were given questions related to the other research questions regarding the cloud model type that might suit their work needs when migrating to the cloud. Table 6.1 below shows the interview questions in relation to their purpose.

Table 6.1: Interview Questions: Context, Factors and Purpose

List of Interview Questions			
Context	**Factor**	**Questions**	**Purpose**
General	**Cloud Computing Adoption Intention**	1. Do you intend to adopt cloud computing in your organization? If so, what type of cloud and why? 2. Are you ready to overcome cloud computing migration challenges?	• To understand the intention of government organizations to adopt cloud computing. • To understand the readiness of government organizations to migrate to the cloud.
DOI Factors	**Relative Advantage** **Compatibility** **Complexity** **Trialability** **Security**	1. Do you think relative advantage is important factor and would affect your decision of adopting cloud computing in your organization, can you freely explain please? 2. Do you think compatibility is an important factor and would it affect your decision to adopt cloud computing in your organization, can you explain please? 3. Do you think complexity is an important factor and would it affect your decision to adopt cloud computing in your organization? Can you explain please? 4. Do you think trialability is an important factor and would it affect your decision to adopt cloud computing in your organization? Can you explain please? 5. Do you think security is an important factor and would it affect your decision to adopt cloud computing in your organization? Can you explain please? 6. How will these factors positivity or negatively affect your organisation**?** Please explain?	• To study whether these factors are important or not. • To find out how important the factors are

Organizational	**Top Management Support** **Cloud Knowledge**	1. Do you think top management support is important and would it affect your decision to adopting cloud computing in your organization? Can you explain please? 2. Do you think cloud knowledge is important and would it affect your decision to adopt cloud computing in your organization? Can you explain please? 3. How will these factors positivity or negatively affect your organisation? Please explain?	• To study whether the factors are important or not. • To find out how important the factors are
Economic	**ROI** **Uncertainty** **Asset Specificity**	1. Do you think adopting cloud computing can lower the investment in new infrastructure? 2. Do you think ROI is important? Would affect your decision to adopt cloud computing in your organization? Can you say more about it please? 3. How will it positivity or negatively affect your organisation? Please explain? 4. Does your organization need special hardware and software to use cloud computing? 5. If cloud computing is adopted, do you think it will run well?	
Technological	**IT Infrastructure** **IT Policy** **IT Skills**	1. Do you think IT infrastructure, policy and skills are important? Would they affect your decision to adopt cloud computing for your organization? Can you explain this please? 2. How will it positivity or negatively affect your organisation? Please explain? 3. Does your organization have a good internet connection? 4. Are your IT staff aware of cloud computing and are they able to develop cloud computing? 5. Do you have legal protection in the use of cloud computing?	

Cloud Model	**IaaS** **PaaS** **SaaS**	1. What cloud type is currently being used in your organization? 2. What cloud computing service best suits your organizational needs? Please explain? 3. What cloud computing services are your IT staff familiar with? 4. Does your organization have all the resources to implement IaaS, PaaS, SaaS? Please explain?	• To find out which cloud model suits organizational needs

Furthermore, these interviews provided an insight into the intentions of the selected organizations towards the adoption of cloud computing. They also shed light on the most critical factors that affected the adoption of cloud computing. Finally, the interviews focused attention on which cloud model types were considered suitable from the point of view of cloud experts. Table 6.2 shows the participants' profiles along with the ministries they worked for.

6.2.2 Sample size

Some scholars believe that in order to achieve the saturation level of data collection in qualitative approach, a researcher needs 12-16 interviews conducted to comprehensively cover the research aspects (Coenen et al, 2012; Francis et al, 2010). However, according to Baker and Edwards, (2012) there is no specific number of interviews to reach a data saturation level. It depends on the nature of the study. Dworkin, (2012). also conducted an analysis on sample size in qualitative studies and concluded that "While some experts in qualitative research avoid the topic of 'how many interviews are enough', there is indeed variability in what is suggested as a minimum. An extremely large number of articles, book chapters, and books recommend guidance and suggest anywhere from 5 to 50 participants as adequate."

Mathers et al, 1998) have a different view in sample selection stating that in interviews the researcher cannot identify the number and the type of interviewees in advance. These authors suggest that, although researchers should strive to get a sample that is as representative as possible, quality is more important than quantity. Therefore, this research focused on quality by selecting the right people, whose specialisms were related to cloud computing.

A single interview was conducted with each one of the 12 IT experts in the selected organizations. Only one interview was needed with each individual, as all the information needed could be obtained through one interview. Also, it would have been difficult to ask these busy experts to be interviewed several times. The 12 experts were selected based on their experience related to dealing and handling cloud computing and the on-premise data centre. They were also selected because they are policy-makers and have an effect on any organisational decisions about migrating to the cloud. All 12 experts are IT heads and assistants working for the selected organizations.

In three of the target groups, the researcher asked for more respondents to participate and obtain more data as the target is quite wide. This would have helped in gaining more insight into cloud

migration intention, influencing factors and cloud models from different individuals. Another reason was that the researcher found that all these three people were experts in cloud computing and could contribute extensively to addressing the questions raised. Regarding the other organisations approached, the researcher requested more participants but according to the IT experts in those organisations there was a shortage of knowledgeable people in the field of cloud computing and they were the only people who could respond knowledgeably to the type of questions prepared by the researcher. Therefore, this research was able to only recruit a total of twelve IT cloud experts.

Table 6.2: Interviewee profiles

Government Agency	Position of Interviewee	Sector Type	Sector Ministry	Interview Code
MOH	IT Expert (Head)	Health	Health	Ali
MOH	IT Expert (assistant)	Health	Health	Nasser
MOH	IT Expert (assistant)	Health	Health	Saleh
NU	IT Expert (Head)	Najran University	Education	Hamad
GATZA	IT Expert (Head)	*Zakat** and Tax	Authority for *Zakat* and Tax and Custom	Mohammed
NM	IT Expert (Head)	Najran Municipality	Municipal and Rural Affairs	Yasser
NU	IT Expert (assistant)	Najran University	Education	Taraq
NU	IT Expert (assistant)	Najran University	Education	Mana
NU	IT Expert (assistant)	Najran University	Education	Youesf
NM	IT Expert (assistant)	Najran Municipality	Municipal and Rural Affairs	Badar
NM	IT Expert (assistant)	Najran Municipality	Municipal and Rural Affairs	Salem
NM	IT Expert (assistant)	Najran Municipality	Municipal and Rural Affairs	Mahdi

*** *Zakat* is an annual payment on certain kinds of property, used for charitable and religious purposes**

6.2.3 Semi-Structured and Face -to- Face Method

In Chapter 4, it was stated that qualitative data can be collected in various ways, including interviews, focus groups, observation, diaries and open-ended questionnaires. Interviews were identified as the most commonly-used instrument for collecting qualitative data (Croker, 2009). Interview data can be obtained through individual interviews, group interviews, face-to-face, telephone or video links or web interviews (Mathers et al, 1998). Moreover, the semi-structure method consists of a list of open-ended questions according to the research subject that a researcher aims to cover. The nature of the open-ended questions allows the researcher and interviewee to discuss in details all relevant issues to address the research problem. One of the noticeable advantages of the semi-structured interview is that it enables the researcher to freely discuss and extract information from participants; more especially if interviewees have difficulty in understanding the questions being asked (Mathers et al, 1998). Moreover, face-to-face interviews are arguably an optimum way of collecting rich data as they can be easier for creating rapport with the interviewee and are not subject to the same level of technical difficulties (Croker, 2009). Semi-structure methods are best when the research is an exploratory or needs a large amount of data to be collected (Mathers et al, 1998). Therefore, this research has adopted face-to-face semi-structured interviews for this phase of the study.

6.3 Interview translation

The interview questions were divided into two different versions including Arabic and English. There were twelve interviews from different regions (Four of them were non-native speakers, , therefore, the English version was proposed. The researcher commenced by giving the interviewee an overview of the research and obtaining permission to record the interview. Some of the interviewee refused the recording due to privacy issues so, the researcher used the alternative which was to take notes. All the interviewees were notified of the data privacy and confidentiality and informed that their responses and names would remain anonymous and would be shown as code when analysing the results or if needed for publication.

6.3.1 Transcription

According to the IRC Research Toolkit, (2007), transcription is a manner of writing words that have been spoken during the interview. In terms of this research, the researcher transcribed all the participants' audio data obtained during the interviews. A draft was made for analysis. All

irrelevant parts, such as pauses, laugher, disturbance etc, were omitted. This was to ensure consistency and using clean data that focused on the areas that the interviews intended to cover. Also, to ensure the validity and reliability of data, the researcher listened to the audio recordings more than once to check all the data were suitable and correctly transcribed in accordance with the participants' responses. In terms of the notes taken, the researcher had to connect all the notes together and write them up in an understandable manner that could be utilized while conducting the analysis.

6.4 Data Analysis

Data analysis is the process of testing and classifying data to address the research objectives. There are various types of qualitative analytical process which can be applied to numerous analysis approaches, such as grounded theory, content analysis, and thematic analysis (Crabtree and Miller, 1999). According to Vaismoradi et al., (2016) data in qualitative approach can be analysed as either content or thematic analysis. Further, the process of breaking down, recognizing, and revealing data is known as thematic analysis (Braun and Clarke,2006). Both content analysis and thematic analysis are used in qualitative analytical process. However, thematic analysis is the most common and suitable method used for data analysis (Vaismoradi et al., 2016). Moreover, thematic analysis has more flexibility in data interpretation (Braun and Clarke, 2006).

For this study, thematic analysis was employed to analyse the data gathered from interviews. The data were classified into specific topics which addressed the research objectives and the subjective themes that emerged from the interview transcripts. The transcription of recordings and typing up of the field notes began as soon as was possible after data collection, as recommended by Mack et al. (2005) The interview recordings were therefore processed as soon as they were downloaded and the field notes typed up once the researcher had expanded them into full sentences (Mack et al., 2005). Participants' responses were reviewed and coded, and the final themes were drawn through these codes and responses. The themes that structured the analysis are shown in Figure 6.1 below.

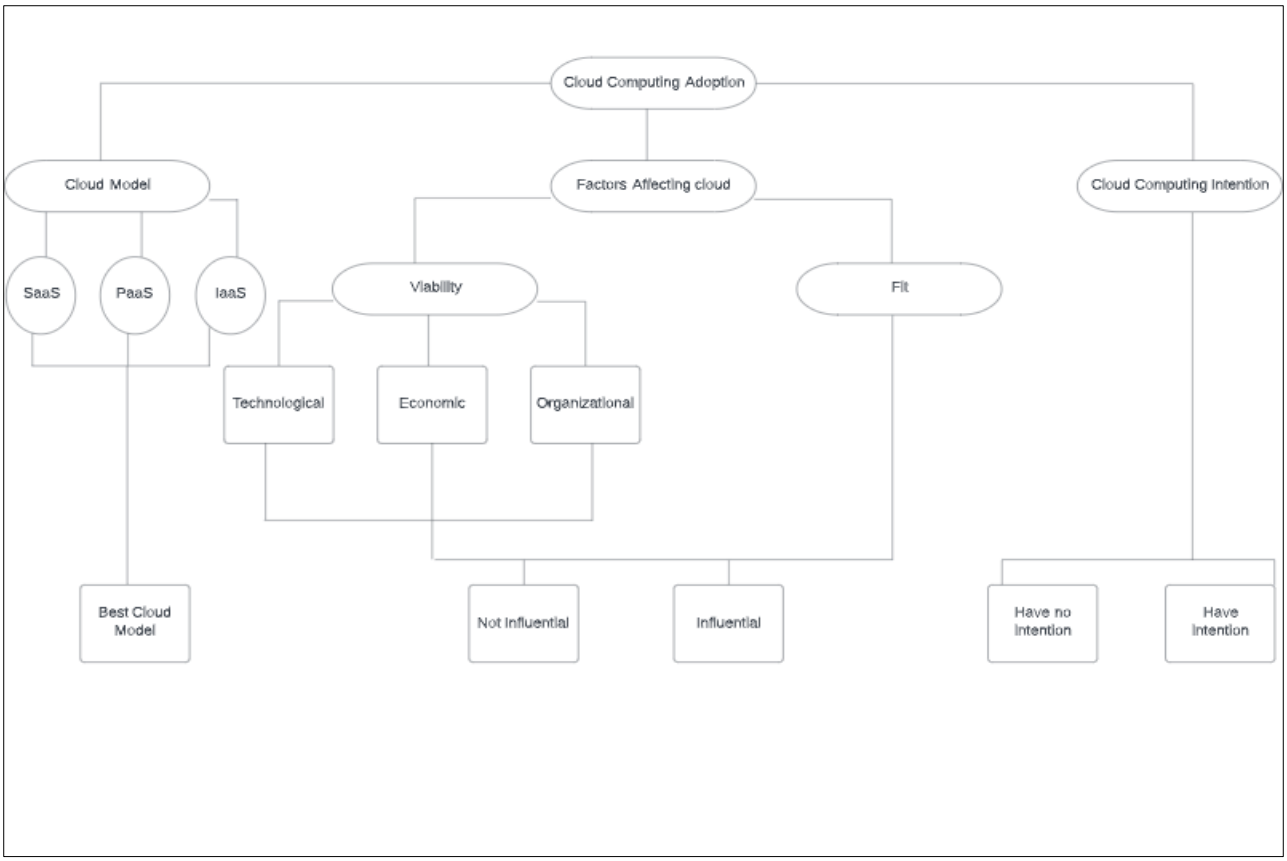

Figure 6.1: Data structure

The final themes were therefore identified through various steps including collecting interview data, analysing the data, drawing data coding structure, generating the themes, reviewing the themes and finally displaying the themes (see section and Figure 6.2)

6.5 The Intention to Adopt Cloud Computing

Through reviewing the outcomes of the interview, it was noticeable that most of the participants interviewed were keen to migrate to the cloud to better improve their services and performance. One of the participants voiced a strong intention for the migration by stating the following:

"We are ready to move right now. For our infrastructure everything is ready and our people also know about it and they are happy to move to the Cloud today or tomorrow." **(Ali)**

Also, the same participant provided the following statement when interviewed about the intention of adopting cloud computing:

"We already have a plan to migrate [fully] *to the cloud. Right now,-we have STC Cloud. Some services are working in STC Cloud and some MOH applications and ERP applications.*

Applications are already working in the STC cloud and we have on premise cloud. We have around two clusters, 52 imposed around 1500 VMS, so we are already familiar with the cloud environment. We have a hyper V environment right now and we're planning a phase of creating a hyper V as well as the VMware environment." **(Ali)**

This organization (MOH) already plans to move completely to the cloud with a local provider. This point was emphasized by a participant stating:

"We aim to completely migrate everything from the MOH data centre to the Cloud [In order] to have the flexible and ease of connection …and we don't want the headache of maintaining the data centre contract supports and all these things." **(Nasser)**

Another participant from the same organization also confirmed the plan to adopt the Cloud:

" Yeah, yeah, they are planning to do. They are planning to go on the Cloud, all the ministries will. They need to migrate and go for the Cloud." **(Saleh)**

Moreover, a third interviewee was also asked the same question about the intention to move towards the cloud and his response was:

"We do have a public cloud already but it is hosted by a third party, in STC I guess but it is not managed by us as the MOH. Like Sahaty is a program for the ministry but it has been hosted by another party." **(Saleh)**

His response was translated by the researcher into English since he is an Arabic speaker. Clearly, this organization has a strong motivation to adopt the Cloud. It is also clear that this organization is familiar with cloud computing and has adopted the public cloud already, which can in turn provide improvements in regards to the services provided and the performance overall.

Furthermore, exploiting cloud advantages seems to be top priorities for two more organizations as is evidenced by the following statements:

"Yes, I think the organization is aiming to go for the hybrid solution in a way that our infrastructure can be hosted into the provider data centres." **(Hamad)**

"Of course, we have intention to adopt cloud computing." **(Mana)**

"Yes, we have the intention to go for the cloud" **(Taraq)**

"Yes, in the beginning for planning to adopt the cloud partially." **(Yousef***)*

"Yes, we have intention to go for cloud computing." **(Bader)**

*"We are currently in the process of adopting cloud computing." (***Salem)**

"In our plan, we have made the process of going for the cloud." **(Mahdi)**

"I think we are planning to go for the Cloud." **(Yasser)**

Responses to the above interviewees were taken into notes and were written up in full by the researcher. However, one of the organizations surprisingly has no intention to move to the Cloud at all. The interviewee stated:

"…and there are a few reasons for that: we are a critical entity, and we need to secure our entity. And also, for data localization purposes; process and accessibility need to be local. Moreover, [there is the issue of] *cost and we have all* ***our*** *technology hosted in place and lastly is data privacy."* **(Mohammed)**

According to the interviewee, this entity has apparently no intention towards adopting the public Cloud due to utilizing their own data centre (private cloud). Their applications and services are all hosted in their data centres. This organization deals with sensitive data related to citizens and the government as well, therefore all data are strictly confidential and must be secure.

Overall, the Cloud has been adopted in all organizations interviewed. Some have stated that they have been using it for more than 5 years:

"Yes, we are using public cloud and 365 email. The organization has been using it since 2012." **(Hamad)**

*"*The Cloud *has been offering a lot to us, we have been using the private cloud since 2012, it is not a new approach for us."* **(Saleh)**

The above statements declaring that public cloud is used in almost all entities, shows clear evidence of the wide cloud knowledge held be the interviewees and that these organizations have an insight about cloud computing generally. However, some these organizations ascertained the need for training the IT staff working in the organizations:

"We have a lack of knowledgeable staff" **(Nasser)**

When the interviewees were asked about what the solution could be the responses were as follows:

"It would be training in interworking and overall." **(Yasser)**

"There are two types of training they need including annual and normal training." **(Hamad)**

*"Yes, I think staff need proper training.***" (Mohammed)**

"Definitely, as cloud computing needs to be developed continuously. Besides the field of cloud computing changes rapidly in terms of networking, security and virtualization." **(Ali)**

"They're maybe giving training in the future; but yes, right now there is lack of training… They ***need*** *to arrange classes about cloud computing."* **(Nasser)**

"We have some training but we need an official training from work. For example, if you're going for a VMware, you should be having to think on the VMware itself, not from the vender company." **(Ali)**

"Everyone needs training. For example, operation then training network team need training. the storage team, they do need some training and security also needs some training. However, there is a lack of training for us. For example, I have been controlling cloud in STC for 5 years. So, I am the only the one responsible for assigning VM storage. Also, providing the IPS, developing security policy - the only guy controlling the whole environment." **(Ali)**

Based on the above statements in regards to the training of IT staff, it is obvious that some of the organizations require current IT staff to improve their competencies in cloud computing, as a successful migration to the Cloud needs competent and well-trained employees. Also, as stated by one of the participants, cloud computing is an evolving paradigm that needs continuous training, also the statement stated by the other in relation the continuous and annual training, all show that proper training is regarded as essential to ensure the success and continuity of cloud computing for an organization to prosper.

6.6 The Factors Affecting the Adoption of Cloud Computing

The researcher intended to investigate the factors affecting cloud computing adoption based on the three dimensions identified as central to viability i.e., technological readiness, organisational readiness and the economic factors as well as DOI factors.

6.6.1 DOI Factors

"Yes, task, relative advantage and compatibility are important factors to cloud computing adoption." **(Ali)**

Yes, task, relative advantage, compatibility, complexity and traiability are critical factors when migrating to cloud computing." **(Nasser)**

"I think complexity and traiability are significant when considering cloud computing" **(Saleh)**

"*of course, relative advantage, compatibility, complexity, trabaility and task are important***"** **(Hamad)**

"Yeah, traiability , compatibility, task and relative advantage are important factors to cloud computing". **(Yasser)**

"Indeed, that task, relative advantage, compatibility, complexity and traiability have influence on cloud computing." **(Mohammed)**

"Relative advantage, complexity, and Security are important." **(Badar)**

"Factors such as relative advantage, compatibility, complexity, traiability and security are important." **(Salem)**

"I believe that relative advantage, compatibility, testing the technology and security are very important." **(Mahdi***)*

"No doubt that relative advantage, compatibility, complexity, traiability and security are critical factors." **(Taraq***)*

"Yes, I think that that relative advantage, compatibility, complexity, traiability and security are important." **(Mana***)*

"Of course, security, relative advantage, compatibility, complexity, and traiability are important." **(Yousef***)*

It seems that all experts agree that DOI factors have a direct effect on the cloud computing adoption. When comparing this result with the results found on the survey, it is found that complexity is considered as a significant factor in the qualitative part whereas it has no direct effect on the adoption of cloud computing in the quantitative part.

6.6.2 Technological Readiness

This section focuses on the interviewees' perceptions of the readiness of the technological aspects of their organizations. It ascertains whether the interviewees thought they were ready to accept the Cloud in terms of their IT infrastructure, IT policy, internet connections and cloud skills overall. An investigation to this dimension would reflect to an outcome of understanding the important factors as well as the likelihood that an organization has towards adopting the cloud.

Interviewees' responses about technological readiness were as follows:

*"Yes, MOH is ready to migrate to the cloud***."** **(Ali)**

"Yes, sure, it [the Cloud] *suits MOH needs."* **(Nasser)**

"Till now we don`t have any issue regarding the Cloud. We have been working with STC for 4-5 years and it is okay, no issues." **(Nasser)**

"Yeah. [the Internet connection] *is good."* **(Saleh)**

"Sure, that IT infrastructure is one of the most critical factors." **(Yousef)**

"Yes, IT skills and IT infrastructure are important." **(Mana)**

"Not enough four members, they need required according to the requirement they see." **(Saleh)**

"The need to hire as well as to train the staff. Both." **(Ali)**

"Currently, IT infrastructure is definitely important." **(Badar)**

"Yes, sure it is very important to have a ready infrastructure that can host the cloud in terms of servers, high resources, network, policy etc." **(Ali)**

"I would say that IT infrastructure is important." **(Salem)**

"I think that IT infrastructure is one of the most critical factors once an organisation *aims to migrate to the Cloud."* **(Mohammed)**

"Of course, IT infrastructure is important factors prior the adoption of cloud computing." **(Mahdi)**

"There are a few factors that I think are critical, including IT Infrastructure." **(Hamad)**

"IT infrastructure is important and the provider is STC/ZAIN." **(Yasser)**

"We are also developing policy… and we will develop one for the servers whatever is required from our side will and secure environment." **(Ali)**

"I thought migrating to cloud computing they need the infrastructure." **(Saleh)**

"For sure, it is important the that the IT policy of the organization meets the security levels required for cloud computing and for allocating the resources." **(Nasser)**

"There are a few factors that I think are critical IT skills." **(Hamad)**

It seems that the experts agree that it is important to have a proper infrastructure prior to adopting the cloud. Acquiring cloud computing technology requires huge bandwidth and good internet connectivity, especially if the organization is large and has to communicate extensively with various stakeholders. Therefore, it is important to assess this factor as well. The results indicate that all the organizations have their own local providers and, according to the above statements, these organizations are ready to migrate to the cloud in terms of the technological aspects.

However, one of the interviewees from the Ministry of Health stated that they have only four members who can deal with all aspects of cloud computing in the current phase of dealing with the cloud. Also, according to their intention towards adopting cloud, they are planning to move completely to the cloud in the near future. This indicates that IT skill have no influence on the adoption of cloud computing as this large organization which offers many services to various levels of stakeholders could migrate to the Cloud with only four experienced members. In contrast, the experts felt that it was very important to ensure IT policy was in place prior to initiating the migration process towards cloud computing.

6.6.3 Organizational Readiness

This section focuses on what the interviewees reported about the readiness of their organizations prior to full cloud adoption. The factors include top management support and cloud knowledge overall. Responses towards these two determinates were as follows:

"Yeah, management is ready to go for migration to the Cloud." **(Saleh**)

"Right now, only three guys are working with the Cloud, myself and two other colleagues." **(Ali**)

"With this in employees with my colleagues, there are already familiar with the cloud environment as they are working 6/4 to five years with St Cloud Anonymous cloud. Okay, they are familiar with the environment. If you move at the cloud also no issues for us." **(Nasser**)

"Yeah of course." **(Saleh**) [Referring to the importance of Top Management Support]

"They know about cloud computing." **(Ali**) [Referring to employee knowledge of the Cloud]

"It [good knowledge of the Cloud] *is a necessary factor in terms of all-round maintenance, upgrading and adding new resources."* **(Ali**)

"Yes, definitely they're good." **(Nasser**) [Referring to employee knowledge of the Cloud]

"I think that Top Management Support is one of the most critical [factors] when aiming to migrate to the Cloud." **(Mohammed)**

"Yes, top management support is one of the most critical factors." **(Taraq)**

"There are a few factors that I think are critical including Top Management Support" **(Hamad)**

"In deed that top management support is critical." **(Badar)**

"I think Top Management Support is important" **(Mana)**

"Yes, Top Management Support is important." **(Mahdi)**

"I think Top Management Support is important" **(Salem)**

"I think Top Management Support is important" **(Yasser)**

According to the aforementioned statements, it can be concluded that top management support is significant to the adoption of cloud computing. It means that if an organization wants to adopt the Cloud, they need to make sure that there is a sufficient support provided from the upper management. This part is essential as top management support has been identified as one of the enablers towards adopting a successful cloud computing system in literature (see Chapter three). Also, as previously stated when analysing the intention of adopting cloud computing, there was evidence that the current employees have enough knowledge about the cloud regardless of the number of staff assigned to working on the Cloud. It can be argued at a certain point that widespread cloud knowledge among staff in an organisation is not a very significant factor for the adoption of Cloud as seen in some organizations that they are ready to move with a small number of IT staff who have a deep knowledge in cloud. One such is MOH which aims to migrate completely with only 3-4 experts.

6.6.4 Economic Dimension

In this part, the aim is to show the results of qualitative data analysis about whether prior to adopting cloud computing, the organization can have a return on investment and can benefit from the cloud rather than consuming time and budget on the existing infrastructure. In order to assess the return on investment, interviewees were asked about the cost and benefits that can be gained from moving to the Cloud and whether this migration was essential towards saving budgets and lowering costs. The interviewees' responses were as follows:

"100% it will lower the cost. At the moment we are paying for the infrastructure and support and the licences. it will reduce to 50% whatever we are spending for the Cloud, for example, if we spend a 100 Riyals per month, with cloud computing you will only spend 50 Riyals" **(Ali)**

"Yeah, it's costly as you need to renew the supports. Yeah, support for the hardware and software; and we need to monitor all the hardware licences and everything. It's a huge end for the storage." **Referring to having a data centre in place. (Ali)**

"Also cost would be the most critical factor to think of when migrating to the Cloud. Also, provider flexibility and ease of management."

"The Cloud saves cost" **(Hamad)**

"Yes, I think that ROI is important factor." **(Mana)(Badar)(Salem)(Taraq)(Mahdi)**

It can be seen that most of the responses demonstrate a positive attitude in relation to the idea that cloud computing would definitely lower costs and improve their Return on Investment. Among the interviewees, there were two who did not state that cost would affect adoption. Reasons for this this may reflect the fact that one of them stated that their organisation was not considering the Cloud at all. According to the given result the return of investment has an influence on adopting the Cloud. Also, return to the statement of the interviewee whose organisation is not considering the Cloud:

"No, and there are a few reasons for that we are a critical entity, and we need to secure our entity. And also, for the data localization purposes. Process and accessibility need to be local. Moreover, [there is the issue of] cost and we have all our technology hosted in place and lastly is data privacy." **(Mohammed)**

It is noticeable that the interviewee has mentioned the cost in relation to having all their technology already hosted in situ. This demonstrates the importance of return of investment for any technology. In other words, if cloud computing was to bring more financial saving to this organization, they may have thought of migrating. However, they believe that they already have what they need and no further expenditure is needed.

"We can trust them because it is a local company and we cannot go for the outside. We cannot go outside the kingdom we need to be secure." **(Ali)**

"They should have to. First of all, this should have to know. Data is secure or not." **(Saleh)**

"Yeah, security is very critical." **(Nasser)**

"It is a very critical factor." **(Ali)**

"I think that is Security is one of the most critical factors which affect migration to the Cloud." **(Mohammed)**

"There are a few factors that I think are critical, including Security." **(Hamed)**

"I think security." Referring to the importance of security**. (Saleh)**

Security has been shown to have a very significant impact on the adoption of cloud computing. In other words, these organizations have no intention towards moving to the cloud if it was not a suitable choice in terms of maintaining a secure environment. This also indicates that security has a significant influence on the decision to adopt cloud computing. It is worth mentioning that a senior expert working in the MOH emphasized that security could not be an issue anymore as their Cloud providers were local and they could trust them with sensitive data. These providers such as STC, MOBILY, and ZAIN can be trusted as they are considered to be local and data sensitivity is no longer an issue, according to the MOH interviewee.

6.6.5 Other Factors Found Influencing Cloud Adoption

There were other factors found to be affecting cloud computing adoption according to the IT experts interviewed in this study. These factors included trust, accessibility, ease of interaction, and service quality (shown in Figure 5.2).

"Trust is also another factor that affect cloud computing adoption." **(Ali)**

"There are factors that have an influence on cloud computing adoption, like accessibility" **(Mohammed)**

"Yes ease of interaction is another factor that influence cloud adoption." **(Hamad)**

"I think service quality is affecting cloud adoption." **(Yasser)**

6.7 Cloud Model

This section outlines the findings about which cloud type model were considered to be suited to the organizations' needs. The interviewees were asked about which cloud type model including Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) they thought was preferable. They have stated the following:

*"We need a software-defined data centre, All the services will be available in software, not hardware on the STC or the MOBILY or from any vendor. Software as a Service. "***(Ali)**

"Yeah, then again, we will be responsible for the infrastructure, the hardware. I think they [the provider] *will provide the space and cooling if you go for the colocation. For example, if you go for the colocation, the providers will provide you only the space in the cooling and the connectivity and we as the MOH we will responsible for the hardware."* **(Ali)**

"Yeah, they need, it is compulsory, Software as a Service is needed and also Infrastructure as a Service as had and for the platform as a service maybe it is not needed." **(Nasser)**

"It depends on the service, if we go with the colocation, we will be able to manage all the services including the hardware and security and everything. Also, in case of applications that are used for public awareness, these can be stored with the vendor but with the sensitive data, they can reside in the data centres, such as medical records for patients." **(Saleh)**

The Ministry of Health's three cloud computing experts therefore responded that both Software as a Service (SaaS) and Infrastructure as a Service (IaaS) were needed. According to these interviewees, Platform as a Service was not needed at this stage.

Another interviewee from GATZA stated:

"We host public applications" **(Mohammed)**

The indication here is that this organization uses a software as a Service (SaaS) and due to the fact that they have their own apps and services hosted on their own data centres, no Platform as a Service (PaaS), or Infrastructure as a Service (IaaS) are needed.

The interviewee from the NU organization stated:

"Currently, Software as a Service and in the future, Infrastructure as a Service." **(Hamad)**

This organization has adopted Software as a Service since 2012. It has been used for the communication purposes between students and the university. This service is also used for student emails. In the future and since their objective is to adopt a hybrid cloud, they aim to use the services of Infrastructure as a Service (IaaS).

The interviewee from NM stated:

"Yes, we use a private Cloud and we use DNS for the public" **(Yasser)**

This current use of the service model is Software as a Service (SaaS) in this organization. Currently they have their own data centres and they are planning to migrate to the Cloud in the near future. Table 6.2 shows the cloud model types which the experts said suited their organisations.

Table 6.3: Organizations and Cloud Model Types

Organization	Cloud Type
MOH	(SaaS)(IaaS)
NU	(SaaS)(IaaS)
GATZA	(SaaS)
NM	(SaaS)

6.8 The Final Result Map

According to Mell and Grance (2011), cloud services that needs to be adopted by any country refers to a serving model or framework for enabling convenient, and efficient data processing that ease and use less recourses to manage the data processing in any organizations. *Cloud adoption* is the main theme used in this qualitative analysis. This theme explores the overall concept of cloud adoption, including what it means to individuals and organizations, the benefits and drawbacks of cloud adoption, and the factors that influence adoption decisions. There are three main themes that are directly connected to cloud adoption as follows:

Firstly, *intention to adopt Cloud computing.* The finding revealed that that MOH, NU, NM have an intension to adopt cloud computing soon. These organizations are motivated to adopt cloud computing for several reasons, including cost reduction, scalability, fewer resources needed and agility (Alshamaila et al. 2013). On the other hand, ZATZA has absolutely no intension to adopt cloud computing because of the sensitive data related to citizens that they held. Thus, they choose to use local data centres instead. Organizations may choose not to adopt cloud computing due to concerns around data security, regulatory compliance, and vendor lock-in. For example, in Taiwan's public sector it was found that certain organizations were cautious about adopting cloud technology due to concerns about the security of their data, lack of IT skills, the potential for regulatory compliance issues, and the possibility of being locked in with a particular vendor (Bittman, 2021; Yang, Kuo, and Huang, 2022).

Secondly, *the factors influencing the adoption*. the factors developed into two sub-themes, i.e. fitness and viability. In fit theme, the study found that several factors, such as task, relative advantage, compatibility, complexity, trialability, security, trust, accessibility, ease of interaction, and service quality supported cloud computing adoption. On the other hand, in viability theme, top management support, IT policy, ROI, and IT infrastructure, significantly influenced the adoption of cloud computing. Interestingly, the study found that IT skill and cloud knowledge did not directly influence cloud computing adoption. This suggests that factors other than technical expertise may be more critical in determining whether organizations choose to adopt cloud computing (Fichman, Dos Santos, & Zheng, 2014).

Thirdly, the *Cloud Models* theme demonstrates the different types of cloud models, including Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) that were considered by participants. According to Amazon Web Services (2022), there are several types of cloud models to choose from, including Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS), each with its own benefits and

drawbacks. Finally, regarding the most appropriate cloud model, the results showed that SaaS was considered suitable for all ministries including MOH, NU, NM, and ZATZA. Moreover, the results showed that IaaS was also considered optimal to be used in MOH and NU.

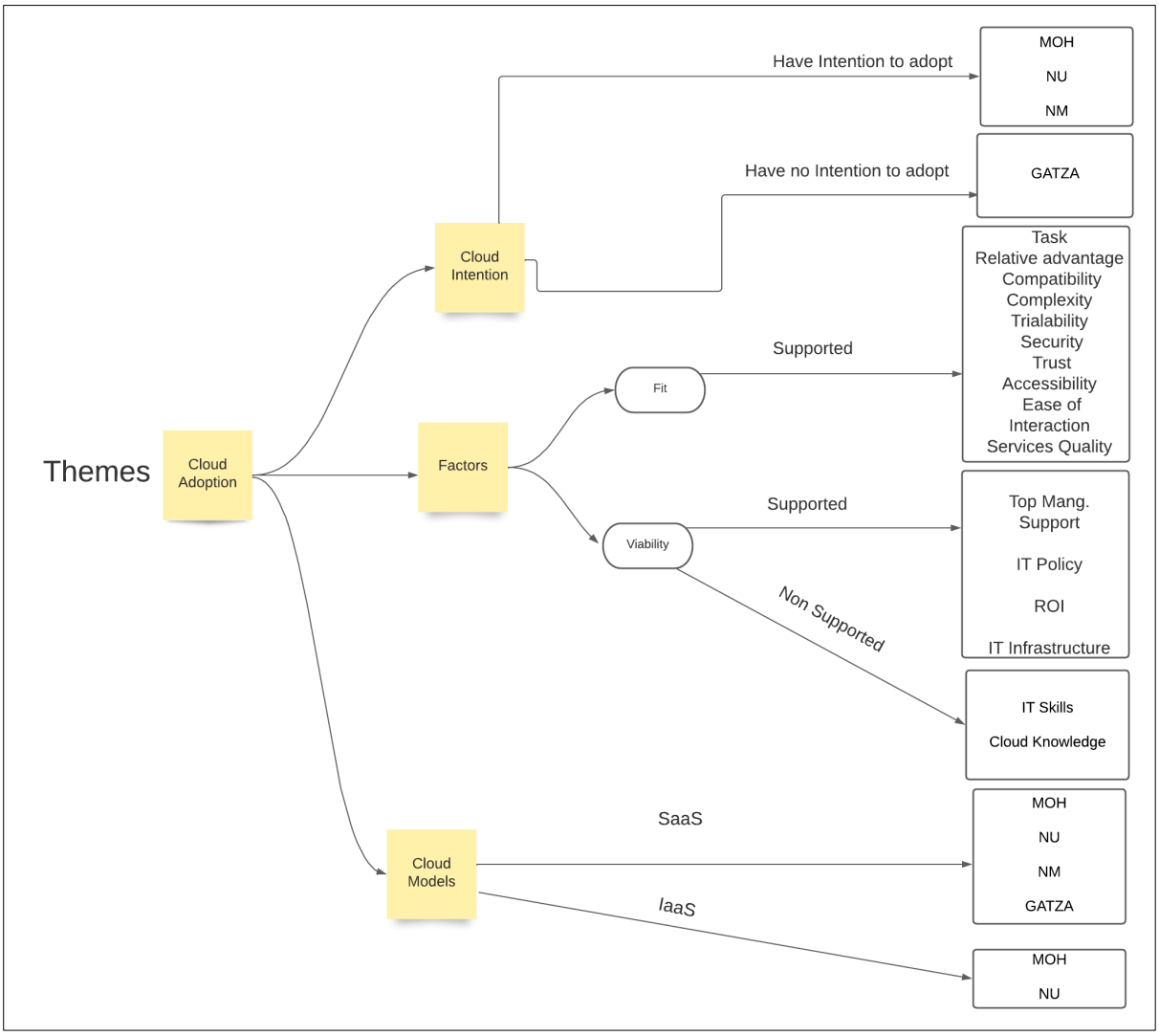

Figure 6.2: Final result map

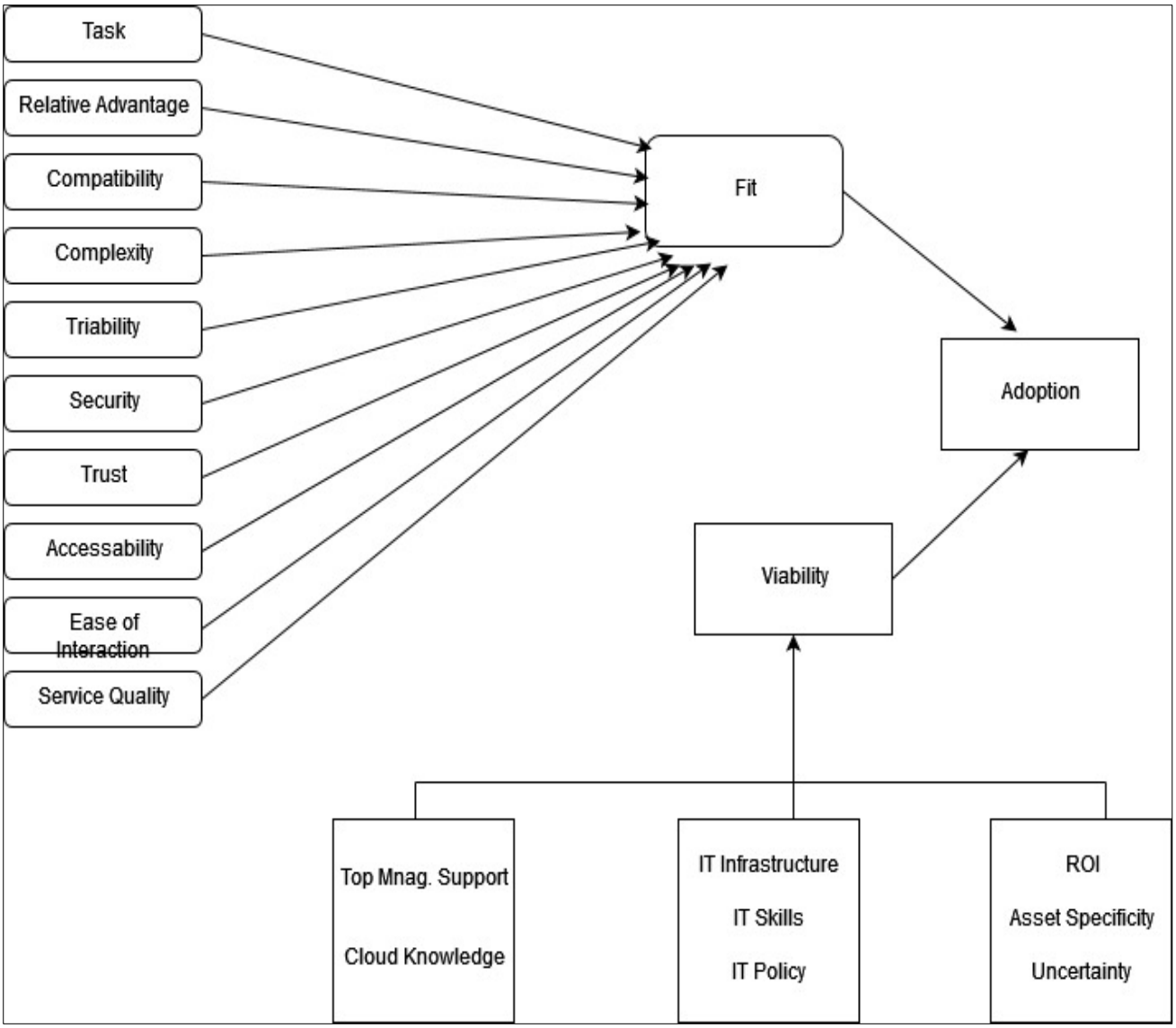

Figure 6.3: Framework Based on Qualitative Findings

6.9 Chapter Summary

This chapter has presented the analysis of qualitative data from interviews conducted with six IT experts from four different Saudi Public organizations. The intentions regarding adopting cloud computing by these organizations was discussed. These discussions included the organisations' plans, decisions, and overall awareness of cloud computing in each entity. According to the outcomes of this chapter, it was indicated that three of these originations already had their own plans about migrating to the Cloud in place. In fact, one of them, the Ministry of Health, was keen to adopt and was on the brink of migrating to the Cloud at the time of interview. However, the results also showed that one of these organizations, The Authority for *Zakat* and Tax and Customs (GATZA), had no intention to move towards cloud computing at all for various reasons including the fact that they already had an infrastructure

built in place, which can handle their interactions and provide services to their stakeholders. Also, due to the sensitivity of the data produced by this organization, they preferred data to be stored in their own data centre devices.

Additionally, this chapter has illustrated the most critical factors considered by interviewees to influence adoption of cloud computing in their organisations. These factors were classified into DOI factors and three types including technological, organizational, and economic dimensions. The result showed that DOI factors all have an influence on cloud computing adoption. The outcomes for this part also showed that economic factors were considered by all the interviewees to have a positive influence on the decision to adopt cloud computing. Conversely, IT skills and cloud knowledge were not found to influence the decision to adopt cloud computing. Apart from these two, the other factors were all found to be considered to have a positive influence on the decision to adopt cloud computing. Security also was found to be significantly affecting the decision towards adopting the cloud.

Finally, this chapter covers the type of cloud model considered suitable in each organization. The outcome shows that (SaaS) is used by all of them and two of them (MOH and NU) intend to have (IaaS) in the future.

Chapter 7: Findings and Discussion

7.1 Introduction

This chapter provides a summary and evaluation of the qualitative and quantitative outcomes obtained in the research. It illustrates the results from the questionnaires used in the study in detail, together with an evaluation of the fitness and viability factors. In terms of fitness, DOI factors are explained along with security whereas viability is explained based on three dimensions: technological, economic and organizational factors. The results of the interviews are discussed alongside the quantitative results for each factor as they facilitate understanding the effect of that factor in more depth. The findings are also shown to either confirm others' findings or not, and this builds a picture of how the current study has built on their contributions to the field. This chapter also briefly discusses the answers to the research questions used to address the research problem.

7.2 Fitness and DOI Factors

This section presents a detailed summary of the factors that were found to affect the fitness of cloud computing adoption. These factors are Fit, Task, Relative Advantage, Compatibility, Complexity, Trialability and Security.

7.2.1 Fit

In this research, Fit measures the extent to which cloud computing technology is consistent and fit with the main structure, culture and values of Saudi public organizations (Liang et al, 2007). The outcomes show a positive direct influence between the adoption of cloud computing and Fit. The critical radio (CR) for Fit was 0.505 and its t-test value was 15.419. This indicates that Fit can significantly affect the adoption of cloud computing in Saudi public organizations. It can be summarized that Fit has a positive influence on the adoption of cloud computing. The result means that cloud computing fits Saudi public organizations' structure, culture, values and competence and therefore, supports the hypothesis: *The fit of cloud computing to e-government task requirements positively affects Saudi public sectors` decisions to adopt the technology*. This result is consistent with Mohammed et al, (2017) and Tashkandi and Al-jabri, (2015) who agreed that fit has a positive impact on the adoption of cloud computing adoption.

7.2.2 Task

Task refers to how cloud computing fits Saudi governmental tasks. Saudi e-government-related task requirements were found to have a positive impact on cloud adoption. This means cloud computing can be adopted into public organizations if it suits the government-related task requirements. The outcomes showed that the CR obtained by the Task factor was 0.257 and the t-test value was 7.931. Consequently, the result supported the hypothesis: *The E-government-related task requirements positively affect the fitness of cloud computing for* implementing e-government services. This result is consistent with Yoo and Kim, (2019) whose results also indicated that the related-task has a positive impact on the adoption of cloud computing. However, Yoo and Kim (2019) conducted their study in the private sector with users of cloud computing services at IT companies doing business in Korea and used only quantitative methods. The current study showed that Fit is also important in the Saudi public sector.

7.2.3 Relative Advantage

Relative advantage means perceiving the benefits obtained through adopting cloud computing (Arpaci, 2016). Relative advantage is one of the factors proposed by Rogers, (1995) and mostly has been found to affect cloud computing positively in various contexts. In the current study, the relationship between relative advantage and Fit was found to be positively significant. The results showed that the critical ratio of relative advantage was 0.236 and its t-test value was 5.635. This indicates that the adoption of cloud computing is positively influenced by relative advantage, as a result the hypothesis: *Relative advantage positively affects the cloud computing fitness for public organizations` computing needs for e-government services implementation* was accepted.

This result is consistent with Alkhater et al. (2015) who surveyed managers in IT departments in different sectors such as manufacturing, engineering and energy; Almaiah and Al-Khasawneh (2020) who investigated public universities in Saudi Arabia and Albar and Hoque (2019) who conducted an online survey with managers of 200 sample organizations, about two thirds of which were private. All these studies found that relative advantage had a positive impact on the adoption of cloud computing.

The results of the current study also suggest that current public organizations have perceived the advantages offered by cloud computing. This was also supported by the result found in the qualitative analysis which strongly emphasises that the managers interviewed recognized the benefits provided by cloud computing and therefore planned to adopt it. The anomaly was the manager from GATZA (the authority for customs and excise) who confirmed that his organisation would not be adopting any public cloud computing, as their applications and services were all in their own data centres. GATZA deals with sensitive data and has a duty to Saudi citizens to ensure their data is totally secure.

7.2.4 Compatibility

Compatibility refers to the extent the new system fits into the existing system of an organization (Oliveria et al., 2014; Rhimli, 2013). Organizations are likely to have an intention to adopt a new technology only if it is perceived to be compatible with their business (Thong, 1999; Rogers, 2003). Cloud computing compatibility was found to positively affect the adoption of cloud computing. According to the outcomes, compatibility equals (0,005) and higher than (1.96) as recommended by Tabachnick and Fidell, (2007). Hence, cloud computing compatibility supports the hypothesis: Compatibility positively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation. Compatibility was also found to be a critical aspect of cloud computing adoption by five of the six IT experts interviewed, with only Saleh (MOH) not mentioning it.

The result is in line with previous studies by Alhammadi et al. (2015). This study is now somewhat outdated, as it was conducted seven years ago; and the authors only used a sample of 81 IT experts from the private sector. The authors also say that although they found compatibility was significant, this contradicted earlier studies by Borgman et al, (2013); Low et al (2011) and Oliveira et al (2014) who did not find a significant impact of Compatibility on Cloud adoption. However, like the current study, Gangwar et al (2015) and Alshamaila et al. (2013) did find it to be a significant factor.

7.2.5 Complexity

Cloud computing complexity was found to positively affect cloud computing adoption. This means the complexity has no influence on the adoption of cloud computing. The outcome showed that the CR obtained by complexity was -0.045 and its t-test value was 0.809. Although

the effect of complexity was negative, it failed to support the hypothesis: *Complexity negatively impacts the cloud computing fitness for public organizations` computing needs for e-government services implementation.* The result means that Saudi public organizations have not reached a sufficient degree of understanding of the difficulties associated with cloud computing, and it may be adopted regardless of how difficult it is. One possible reason for this might be a lack of awareness and insufficient training sessions offered in regards to cloud computing and its complexity. Alternatively, the respondents' skill levels might have been high enough to make them perceive cloud computing complexity as not an issue for its implementation.

Some interviewees also seem to suggest that complexity was significant:

"It [good knowledge of the Cloud] is a necessary factor in terms of all-round maintenance, upgrading and adding new resources." (Ali from MOH)

Also, that employees did have a sufficiently high awareness of the Cloud's complexities:

"Yes, definitely they're good." (Nasser from MOH) [Referring to employee knowledge of the Cloud]

However, they also felt more training was required:

"The need to hire as well as to train the staff. Both." (Ali from MOH)

So, it seemed that even within the same organisation, the Ministry of Health, there was some disagreement about whether complexity was an issue.

The result also shows that complexity had no direct influence on the intention to adopt cloud computing for Saudi public organisations. This result is in line with findings by Karim and Rampersad, (2017) who commented that finding that complexity was not a significant factor for adoption of cloud computing by Saudi universities was unexpected.

7.2.6 Trialability

In this context, trialability means that an organization is able to test the cloud solutions prior the adoption (Ezer & Kofi, 2014). The trialability of cloud computing was found to be significantly influencing the adoption of cloud computing. The result showed that the CR of trialability was 0.264 while its t-test value was 5.791. This indicates that trialability has significant role on the adoption of cloud computing and, as a result, the hypothesis: *Trialability positively impacts the cloud computing fitness for public organizations` computing needs for*

e-government services implementation was accepted. The results shows that trialability can have a positive effect on the decision of cloud computing decision makers in public organizations when aiming to adopt cloud computing.

These survey findings were confirmed by the IT experts in that five of them specifically mentioned trialability as being a critical aspect for cloud computing adoption.

Trialability has been found to be significant (e.g., Alshamaila et al., 2013) and not significant (e.g., Hsu & Lin, 2016). The authors of the latter study commented that trialability will not be seen as important if staff is sufficiently experienced.

7.2.7 Security

While many studies have shown that security issues can hinder an organization from adopting cloud computing and it has a very significant influence on the decision of these organizations to adopt the cloud, the results of the survey in the current study showed that security was perceived to have no direct effect on cloud adoption. The relationship between security and fit was found to have a positive impact on the adoption of cloud computing. Unexpectedly, this meant that security showed no significant effect on the adoption of cloud computing. The outcomes showed that the CR of security was 0.033 and its t-test value was 0.662. While the effect of security was positive on the adoption of cloud computing, the result did not support the hypothesis: *Security negatively affects the cloud computing fitness for public organizations` computing needs for e-government services implementation;* and due that, it was rejected.

One possible explanation of this result is that most Saudi government agencies are now hosting their infrastructure and data with local organizations. Having data stored locally with trusted organizations such as STC and MOBILY would no longer make security a barrier to adopting the Cloud for Saudi public organizations. This became clear when one of the IT experts from the MOH stated that security was no longer an issue for as they could trust STC to host their data and IT infrastructure. Another reason is that recent advancements in cloud computing have enabled providers to offer users a more secure environment, so security is not so much of an issue for cloud computing adoption (Pancholi and Patel, 2016; Tang et al., 2016).

This result was consistent with Akar and Mardiyan, (2016), Hammouri and Abu-Shanab, (2020) and Lynn et al, (2020) who all reported that security issues had no significant effect on the adoption of cloud computing. However, other scholars (Al-Rousan & Hashish, 2016; Al-

Sharafi et al., 2017; Sinjilawi et al., 2014) found that security was important for adoption Moreover, Karim and Rampersad (2017) studied cloud adoption in Saudi universities, and found that concerns for the security of data stored in the cloud had the largest negative impact in relation to the adoption of cloud technology. The authors noted that Saudi universities were cautious when adopting new technologies which might account for security fears being a barrier to investing in cloud technology.

The interviews with the IT experts provided an explanation about why the quantitative results did not show security as a significant factor. Many of the experts stressed that security was crucial in adopting cloud computing; as one interviewee commented:

"I think that is security is one of the most critical factors which affect migration to the Cloud." (Mohammed from GATZA)

However, when cloud providers are local (like STC MOBILY and ZAIN), security is no longer seen as an issue. The correlation between security and cloud fitness is recommended for further investigation to assess the explanation used in this study.

7.3 Viability Factors

In this section, viability is assessed based on three components: technological, economic and organizational factors. The technological factors that are used to assess the viability of cloud computing are IT Infrastructure, IT Policy, and IT Skills while the economic factors include Return of Investment (ROI), Asset specificity and Uncertainty. Finally, this section discusses the organisational factors which include Top Management Support and Cloud Knowledge.

In this study, viability assesses the extent to which the organization is ready to accept a new technology (cloud computing) (Liang et al, 2007). Organization viability was also found to be having a direct influence on the adoption of cloud computing. The outcomes showed that the CR for viability was 0.065 while its t-test value was 2.17. Therefore, the outcome supported the proposed hypothesis: *The viability of cloud computing positively affects the Saudi public sector`s intention to adopt the technology*. This indicates that public organizations in Saudi Arabia are ready to adopt cloud computing into their IT environment. Similar results were also confirmed by Karim and Rampersad (2017).

7.3.1 Technological Factors

The technological factors addressed here are: IT Infrastructure, IT Policy, and IT Skills.

7.3.1.1 IT infrastructure

The capacity of the existing IT infrastructure to run a new technology is very important. It has been found in many previous studies that IT infrastructure has a positive impact on the decision on cloud computing (Sugandini et al., 2018; Tan, 2012; Liang et al., 2007). However, the result of this study shows that IT infrastructure has no statistically significant impact on cloud computing. Although the interaction between IT Infrastructure and viability was found to be positive, the proposed hypothesis was not supported. The outcome showed that the CR value of IT Infrastructure was 0.026 while its t-test value was 0.465. The result therefore rejected the hypothesis: *The perceived viability of cloud computing for offering e-government services is positively affected by IT Infrastructure.*

However, it was confirmed in the qualitative section that IT Infrastructure has a positive influence on cloud computing adoption. This was shown by statements like the one from Ali from the Ministry of Health:

"We are ready to move right now. For our infrastructure everything is ready and our people also know about it and they are happy to move to the Cloud today or tomorrow."

Also, from Mohammed from GATZA:

"I think that IT infrastructure is one of the most critical factors once an organisation aims to migrate to the Cloud."

Another IT expert (Hamad from Najran University) said that the organisation's plans to *"go for the hybrid solution"* needed to take in account that their infrastructure could be "*hosted in the provider data centres."*

This is very different from the results of the quantitative analysis. The implication of the survey result is that, since most public organizations are migrating completely to cloud `environments including their IT infrastructure solutions, IT infrastructure seems not to be as important as when it was first being adopted. Another reason may be that some of the public organizations have no intention to move towards the cloud at all and this implies that they already have their IT infrastructure and that they are not considering cloud computing at all.

This study is in line with Salem and Hwang, (2016) who found that IT infrastructure had no direct effect on the adoption of cloud computing. The correlation between IT Infrastructure and viability is recommended to be investigated further in the future to assess the explanation used in this study.

7.3.1.2 IT Skills

IT skills are considered to be important when it comes to implementing a successful cloud computing system. Employees should have sufficient experience in order to effectively handle cloud services. In this study, the IT skills of employees were found to have a strong effect on the adoption of cloud computing. It means that an organization should ensure that its employees are well-trained prior the adoption of cloud computing. It also means that IT skills influence the adoption of cloud computing positively. The CR and t-test value for IT Skills were 0.054 and 0.465 respectively. The hypothesis: *The perceived viability of cloud computing for offering e-government services is positively affected by IT Skills*, was therefore supported.

The results from the interviews with IT experts showed that one expert (Hamad from Najran University) confirmed the results of the survey by saying:

"There are a few factors that I think are critical [for Cloud adoption] -*like IT skills."*

This result is consistent with a study by Lian et al, (2014) which also proposed the significance of IT skills on the adoption of cloud computing. This study was on the intention of Jordanian hospitals to adopt cloud computing, and found that the 223 IT staff questioned identified technological factors like IT Skills as being the most important in the decision to adopt cloud computing.

7.3.1.3 IT Policies

The intention to adopt cloud computing can be affected by IT policies. Several studies have found that IT policies have a positive impact on the adoption of cloud computing. In this study, IT policies were not found to affect the adoption of cloud computing. The value for CR was found 0.022 and t-test was 0.602. Hence, the hypothesis: *The perceived viability of cloud computing for offering e-government services is positively affected by IT Policies*, was rejected as the result did not support it. Once again, the possible clarification is that since public organizations are moving towards local agencies (some are related to the government such as, Sadia and Yesser), IT policy becomes no more an issue for them toward the decision to adopt the cloud. This was also clear in the qualitative section. One expert from the Ministry of Health

spoke about how policies were being developed and that they would *"develop one for the servers - whatever is required"* (Ali). Another (Nasser) said that IT policy had to meet "*the security levels required for cloud computing and for allocating the resources."* Therefore, as long as policies are in place and perceived to be satisfactory, they are taken for granted an not seen as an issue affecting adoption.

This result is in line with Makhlouf (2020) who also found that IT policy has no effect on the adoption of cloud computing.

7.3.2 Economic Factors

In this study, the economic factors were Return on Investment, Asset Specificity and Uncertainty.

7.3.1.1 Return On Investment (ROI)

Return of Investments is measured by the extent to which that the benefit of an organization will be increased and the costs will be lowered after adopting cloud computing (Chang e al, 2012). User intention to adopt a new technology will be increased if the cost is reduced (Smith and Uiu, 2012). In this study, return on investment (ROI) was found to have a positive impact on the adoption of cloud computing. The result showed that ROI had a value of 0.833 in terms of CR and 20.725 in t-test value. The result indicates that the hypothesis: *The viability of cloud computing to e-government implementation is positivity affected by return on investment (ROI),* was supported. This means that the ROI has positive impact on the decision of adopting cloud computing in Saudi Public Organizations.

The interviews provided further insight into the kind of return on investment that was expected by government organisations. One expert from the Ministry of Health (Ali) was confident that investing in cloud computing would reduce expenditure by half.

This result is in line with Tripathi, (2019) whose study also showed that ROI had a positive effect on the adoption of cloud computing.

7.3.1.2 Asset Specificity

Asset specificity is defined as "durable investments that are undertaken in support of particular transactions," the opportunity cost of which investment is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated" (Williamson,

1985 cited in Makhlouf, 2020). It also means that an organization can specify the assets needed prior to adopting cloud computing (Liang et al, 2007). Organizational asset specificity is also found to be having a positive impact on the adoption of cloud computing. It means that the organization has to be viable in terms its asset specificity of hardware and software to adopt cloud computing, and asset specificity can also include personnel that are suitably knowledgeable and any licencing required (Lian et al., 2014).

The outcomes also show that assets specificity have a positive impact on the decision to adopt cloud computing. The CR of asset specificity obtained was 0.111 and the t-test value was 3.07. This result indicates that the hypothesis: *The viability of cloud computing for e-government implementation is positivity affected by asset specificity*, was supported. The result is consistent with Fink, (2013) and Makhlouf (2020), who also found that asset specificity had a direct effect on the adoption of cloud computing.

7.3.1.3 Uncertainty

In this context, uncertainty means to which extent the adopter has an adequate knowledge towards the outcomes that can be obtained out of adopting cloud computing (Knight, 1921). A new system may result in some uncertainties (Jaloen & Lehtonen, 2011). According to the outcomes, uncertainty is positively affects the cloud computing adoption. The result showed that CR obtained by uncertainty was -0.024 and the t-test value was 0.804. Therefore, the hypothesis: *The viability of cloud computing for e-government implementation is negatively affected by uncertainty*, was rejected. The result shows that Saudi public organizations do not consider this factor as a significant indictor on the decision of adopting cloud computing. The results also signify that there a lack of uncertainty in public organizations in Saudi Arabia towards cloud computing.

This might be caused due to the lack awareness and training mentioned previously. Also, it was notified in the qualitative section that there is a lack of knowledge of cloud computing among some public organizations. This point was also supported by Alshamaila and Papagiannidis, (2013) that a lack of knowledge may result in a less accurate prediction of the outcomes of a new technology. Employees should be given more training and communications courses and are prepared in advance of cloud deployment. This result is in line with (Morgan & Conboy, 2013) which also found that uncertainty has a positive impact on the adoption of cloud computing.

7.3.3 Organisational Factors

In the current study, the organisational factors were Top Management Support and Cloud Knowledge.

7.3.3.1 Top Management Support (TMS)

Top management support plays an essential role and has a positive impact on decisions to adopt cloud computing and new innovation overall. Having and ensuring the adequate support from the top managers is important because changes and execution on cloud can be made only through them.

Top management support was found to be having a strong positive impact on the adoption of cloud computing. The outcomes showed that the CR for TMS was -0.101 and t-test was 1.932. Although the effect of top management support was found to be negative, the hypothesis: *Top management support positively affects the viability of cloud computing for implementing e-government,* was still considered to be supported. This result means that current organizations in Saudi Arabia confirmed that they have enough support from upper management towards adopting cloud computing. In fact, this was also stated by almost all IT experts interviewed.

The results from the interviews also show that top management support has a significant impact on the decision of adopting cloud computing. Experts in all four of the organisations they represented agreed that it was a critical factor for the adoptions of cloud computing. This result is consistent with those of Karim and Rampersad, (2017); Alshamaila and Papagiannidis, (2013) and Akar and Mardiyan, (2016) which also reported the significance of TMS on the adoption of cloud computing. A meta-analysis by Amron et al, (2019) showed that top management support was the second most-cited factor as being a key determinant of cloud computing adoption.

7.3.3.2 Cloud Knowledge

Adopting cloud into an organization requires enough knowledge. Personnel working who will be engaging with cloud computing adoption and implantation should be well-prepared and trained (Buyya et al 2011). Cloud knowledge is found to be negatively affecting the adoption of cloud computing.

The result showed that CR was -0.032 and t-test value was 1.112. As a result, the hypothesis: *Cloud Knowledge positively affects the viability of cloud computing for e-government*

implementation, was rejected. The results showed that cloud knowledge has no effect on the adoption of cloud computing. It also showed that IT employees in Saudi Arabia were perceived to have a lack of knowledge in cloud computing.

The result obtained in the quantitative analysis is in line with the result obtained in the qualitative. Experts also confirmed that the number of people dealing with cloud computing is relatively low and more sessions and training is needed for other personnel to cope up with the cloud advancement and to be prepared for the complete migration towards the cloud. This result is consistent with Hassan, (2017) that shows also that cloud computing can be adopted regardless of the employee cloud knowledge. This author was investigating cloud adoption among Malaysian small and medium enterprises and remarked that most of the organisations investigated used free cloud-based services which could explain why minimal knowledge of the Cloud by employees was acceptable (Hassan, 2017).

7.4 Research Questions

The research questions proposed in this research aim to examine the factors affecting the fitness and viability of cloud computing in public organizations in Saudi Arabia and assess the performance of cloud computing adoption. They also aim to recommend the optimal cloud model for decision-makers in Saudi Arabia. The questions presented in this research are sought to find out to which extent cloud fitness is affected based on DOI and security factors and cloud viability is affected based on technological, organizational, and economic factors. It also aims to find out to which extent that cloud adoption is fit and viable in public organizations in Saudi Arabia and to which extent best cloud models can be recommended for public organizations.

In regards to question 1, the answer was found by exploring secondary sources to identify the factors and by confirming them through interviewing cloud computing experts. A summary of how research question 1 was answered is presented below:

Q1: What are the factors that influence the fitness and viability of cloud computing for IT governance in Saudi public organizations?

The aim of this question was to find out the factors that have an influence on the fitness and viability of cloud computing adoption in public organizations in Saudi Arabia. The proposed factors, identified in Chapter 3, were elicited in two stages. In first stage, the relevant factors were determined from a review of previous research studies and were incorporated into the

investigation. The second stage of answering this research question was conducted later when the factors were confirmed by the semi-structure interviews (see Chapter 6). The semi-structured format of the interviews enabled a deeper understanding and verification of the factors that affected cloud fitness and viability from the IT experts' point of view. The factors were confirmed and the results showed that there were 16 factors that had a significant influence on the adoption of cloud computing. All the factors affecting cloud computing adoption were investigated empirically. After the factors had been identified in the Literature Review, the next step was to find the relationships among these the factors in order to answer research question 2.

Q2: Do these factors have a significant relationship with the fitness and viability of cloud computing adoption?

The purpose of this question was to find out the influential factors that affect the fitness and viability in the context of Saudi Arabian public organizations; and to examine the strength of relationships among the factors identified in research question 1 (independent and dependent variables. This was answered by examining the proposed model presented in chapter 5 quantitatively. The first questionnaire was used to answer this question which was conducted with 408 IT employees working across different departments in public organizations in Saudi Arabia. The outcomes confirmed that the proposed model fits well with observed data. The outcomes of this question also show that fit, viability, task, relative advantage, compatibility, trialability, top management support, IT skills, ROI and asset specificity had a direct and significant effect on the adoption of cloud computing while IT policy, IT infrastructure, cloud knowledge, security, complexity and uncertainty had no direct and significant effect on the adoption of cloud computing. Table 7.1 presents the outcomes of the relationships among the factors affecting cloud computing adoption in the Saudi public organisations investigated.

Table 7.1: The Relationships among the Factors and Cloud Computing Adoption

Hypothesis	Relation	Path Coefficient	T Statistics	Impact
H1	Fit → Adoption	0.505	15.419	Positive impact
H2	Viability -> Adoption	0.065	2.17	Positive impact
H1a	Task -> Fit	0.257	7.931	Positive impact
H1b	Relative Advantage -> Fit	0.236	5.635	Positive impact

H1c	Compatibility -> Fit	0.056	0.827	Positive impact
H1d	Complexity -> Fit	-0.045	0.809	Positive impact
H1e	Trialability -> Fit	0.264	5.791	Positive impact
H1f	Security -> Fit	0.033	0.662	Positive impact
H2a	ROI -> Viability	0.833	20.725	Positive impact
H2b	Assets Specify -> Viability	0.111	3.07	Positive impact
H2c	Uncertainty -> Viability	-0.024	0.804	Positive impact
H2d	Top Management Support -> Viability	-0.101	1.932	Positive impact
H2e	Cloud Knowledge -> Viability	-0.032	1.112	Negative impact
H2f	IT Infrastructure -> Viability	0.026	0.465	Negative impact
H2g	IT Skills -> Viability	0.054	1.56	Positive impact
H2h	IT Policy -> Viability	0.022	0.602	Negative impact

Q3: Do the cloud computing factors identified in question one influence the performance of cloud computing adoption in Saudi Arabia?

The purpose of this question was to examine whether cloud computing adoption performance is fit and viable in public organizations in Saudi Arabia. The answer to this question was dependent on the first two research questions being answered and these questions were therefore tackled sequentially. However, obtaining variety of responses from a wide range of organizations and a large sample was desirable in order to have more understanding of the process of cloud adoption. As a result, various methods were attempted to achieve that. This question was conducted in five stages. Four stages of them were rejected and one was confirmed to be used to address this research question as it was the primary objective and it was based on primary data. At first, an online survey is distributed in various IT departments online that aims to examine the performance of cloud computing adoption in different IT departments using random sample approach. However, most of the responses received from IT departments were related mostly to the ministry of education. This was not equivalent to the random approach as the rule is that each sample should have a similar chance of participation to the distributed questionnaire (Babbie, 2013). As a result, these responses were rejected.

Second stage was therefore conducted. Due to the lack of reaching participants during the Covid-19 period, a secondary data is aimed to be utilized temporary based on previous studies. Secondary data is obtained and generated through a source that has already been investigated including books, records, biography, newspaper, statistical data, data archives, internet articles, journal papers, and database etc (Muhammed, 2016). Hence, the researcher conducted an intensive research to find similar studies related to the factors affecting cloud computing as they are the base for addressing this question. Temporarily outcomes after then were proposed. Although the outcomes obtained through the secondary data stage seems to be more realistic and closer to the nature of outcomes that have been published in literature, it was used temporarily and then rejected due to unreliability of the outcomes and also sticking with primarily aim of this research which is achieving primary data.

As a result, the third stage was commenced. Third stage was to seek primary data from different IT departments and have a combination of small and large population. A snowball approach was adopted (Collis and Hussey, 2013) this time as it was hard to reach out the participants. Hence, six IT heads working in different departments were contacted and confirmed their participants to the study. An online survey then, that aims to investigate the cloud adoption performance, was conducted through email. However, only one ministry had responded to this survey which was the Ministry of Education. Although the number of samples obtained was enough to be analysed and comply with the rules of snowball approach, it was also rejected due to suspicious data source and incomplete responses received. Moreover, a follow up letter was sent to the selected targets once again, from the researcher back home university, seeking their participation with accurate response and larger samples but disappointedly again no response was obtained. As a result, the next stage was carried out.

Through searching in literature, Machine Learning methods were recommended as the nature of question 3 and 4 is likely about predication. In this stage, the researcher approached and contacted some experts in Machine Learning filed and explained the research aim and objectives. However, these experts have concluded that Machine Learning tools need a huge data set in order to have comprehensive and accurate outcomes and according to that machine learning was not a suitable choice. Consequently, this stage was rejected as well and final stage started.

In view of all the difficulties encountered with trying to conduct an online survey with a suitable number of IT staff employed in Saudi public organisations, the researcher decided to

approach these organisations in person. Accordingly, a number of paper-based questionnaires were prepared. This was to avoid the uncertainty of data source and suspicious responses. To ensure that, the researcher went personally and met the IT heads, which by their approval and also ethics department recommendation, the questionnaires were distributed among the employees. The sample was thus purposive and collected through the snowball method (see Chapter 6 section 6.3.3) (Collis & Hussey, 2013). In total, 25 questionnaires were distributed, 22 were returned, 2 had missing data and 20 were analyzed to address the research question. The outcome of the question is presented in Chapter 5.

Which cloud model do policy makers believe is the most appropriate for Saudi e-government?

The aim of this research question was to identify the appropriate cloud model for one of the selected samples in research 1 and 2 but due to the same reasons mentioned in (research question 3 justifications) of having more samples from different population, same stages conducted were also applied in this question as both have been distributing together. This questionnaire was targeted only to the IT heads as the nature of questions asked can only be answered by an individual who has enough expertise on the department-rated IT tasks. Two questionnaires were distributed. One was to the IT head and the other was to his assistant to ensure the validity of responses as had been recommended in literature. Both samples were returned with a complete answer and no missing data were found. However, the outcome of this question was based only on the responses provided by the IT head`s assistant. According to the IT head, he had been in the department for just under a year, the researcher then decided to use the IT head`s assistant response as he has been in the department for more seven years. The outcome of the question is presented in Chapter **5** and the outcome of the interviews can be found in Chapter 6.

7.5 Chapter Summary

This chapter has summarized the key outcomes of this study including the relationship of fitness and viability factors with the adoption of cloud computing. The outcomes show that there are 10 factors having a positive influence on the adoption of cloud computing while 6 factors have indirect effect on the adoption of cloud computing. Finally, this chapter concluded by explaining the research questions and how they have been answered in this research. In next chapter, conclusion will be written according to the research finding and future work will be also suggested.

Chapter 8: Conclusion and Future Work

8.1 Conclusion

This study aimed to investigate the factors that affect the adoption of cloud computing in the public organizations in Saudi Arabia. It also aimed to predict the success and failure of fitness and viability of cloud computing adoption and determine the best cloud model for public organizations in Saudi Arabia. Decision makers in Saudi Arabia will benefit from the study in that it provides a proactive perception of the most significant factors that influence the adoption of cloud computing to better adopt a successful cloud computing system. Also, the findings offer a means of understanding whether cloud computing is a suitable choice for the public organizations in question; and this would be another way that policy makers working in public agencies could benefit from this study. Moreover, the decisions regarding selecting the best cloud model that matches organizational needs are important for a successful cloud and e-government implementation. Hence, decision makers can also utilize the approach used in this study to find out the cloud model that best suits their organizational needs.

This research was motivated by the lack of previous studies that empirically investigated the factors affecting cloud computing adoption using a mixed approach which included both qualitative and quantitative analyses. Moreover, the literature review revealed a lack of empirical investigations that applied all the fit and viability factors identified in the current study to examine and predict the success or failure of cloud computing adoption by public organisations. This gap needed to be addressed, as making an accurate decision about cloud adoption is not only affected by the significant factors but also whether cloud adoption is fit and viable to the organization's requirements. This study was also motivated by the lack of studies that identified the best cloud model for public organizations as knowing this can also influence the decision about making a completely successful migration to cloud computing for e-government systems.

This study adopted DOI factors together with FVM factors as the theoretical frameworks, which were incorporated together to develop the proposed model presented in Chapter 3. The research model was empirically tested and validated and the empirical results were presented in Chapter 5. Finally, this study used close-ended questionnaire conducted with 408 IT employees investigating the factors that affected cloud computing adoption; and a second

survey with 21 more IT managers to examine the adoption performance along with the cloud model.

In the first survey, the data collected were analyzed using SEM in two phases including measurement model assessment and structural model evaluation. In terms of measurement model evaluation, items loadings, Cronbach's alpha and composite reliability were used to assess the research measurement utilized in the research; while in the structural model evaluation, the correlations among the factors and hypotheses testing outcomes were all examined and presented in Chapter 5. The outcomes obtained confirmed that the proposed model is powerful and better fit the data collected when conducted the quantitative analysis.

A qualitative data collection was also conducted in 4 different IT public organizations through semi-structured interviews with six cloud computing experts. This was conducted to further investigate the factors that affected cloud computing adoption and to confirm the significance of the factors found to be affecting cloud computing adoption according to the results of the survey. The outcomes of the qualitative data analysis are presented in Chapter 6.

The proposed model can provide a comprehensive perspective of the factors that affect the adoption of cloud computing. The outcomes of this research are believed to be valuable to project managers working in public organizations and policy makers as well as cloud adopters more generally. The outcomes also can be of value to IT leaders by increasing their awareness about the success and failure of cloud performance in their organizations as well as providing a means to identify which cloud model best suits their organizational needs.

8.2 Research Objectives

As stated previously in Chapter 1, the main aim of this research is to conduct an exploratory study that investigates the factors affecting cloud computing adoption in Saudi public organizations. In terms of the research objectives, they were proposed and addressed as follows:

- ***Explore the factors influencing the fitness and viability of cloud computing for IT governance in public sector organizations.***

This study has explored the factors that influence the adoption of cloud computing qualitatively and quantitatively. The findings were verified empirically, and presented in chapters 5 and 6. The outcomes showed that there are ten factors that have an influence on the adoption of cloud

computing while 6 factors have no statistically significant direct effects. The factors that were perceived to influence cloud adoption included: fit, viability, task, relative advantage, compatibility, trialability, top management support, IT skills, ROI and asset specificity; while the indirect impact factors include IT policy, IT infrastructure, cloud knowledge, security, complexity and uncertainty.

- ***Examine the relationship between factors identified in objective 1 and the fitness and viability of cloud adoption.***

Towards achieving this objective, a conceptual model that combined DOI and FVM factors was developed based on previous theories and studies. The model was **tested** quantitatively using SEM with a sample of 408 respondents. The outcomes confirmed that the model fitted well with the data collected. As a result, the model is seen to be valuable in clarifying the adoption of cloud computing.

- ***Examine the effect of cloud computing fitness and viability on the performance of public organizations in Saudi Arabia that have adopted cloud computing.***

In order to achieve this objective, a two-dimensional matrix was used to predict the success and failure of cloud computing adoption in Najran University. The outcomes of the predication show that Najran University has a high fit and viability for adopting cloud computing.

- ***Develop a tool to identify the appropriate cloud model for an organization.***

This objective was achieving through applying the simple adaptive weighting (SAW) method to predict the best cloud model for Najran University based on the IT head assistant's response. The outcomes show that Private Cloud Software as a Service (Pri-SaaS) was the best cloud model for Najran University.

8.3 Research Contribution

Research contribution can be explained in three sections: theoretical, methodological and practical contribution.

8.3.1 Theoretical Contribution

- This study contributes to the knowledge by providing a comprehensive understanding of the factors influencing the adoption of cloud computing adoption in public

organizations in Saudi Arabia. Through an intensive review of the literature, it was found that Saudi Arabia is still in the relatively early stages of implementing cloud computing and e-government systems. Hence, this research develops a conceptual model that aims to investigate the factors that may have an influence on the adoption of cloud computing and may also impact the intention of public organizations to adopt the cloud by using a mixed approach. The proposed model incorporates DOI factors and FVM factors and tests them empirically. To the best of the researcher's knowledge, this is the first model that combines the proposed factors to explore cloud adoption in public organizations in Saudi Arabia.

- While previous studies have covered the factors that impact the adoption of cloud computing, few studies have investigated the factors based on organizational, economic and technological factors especially within public organizations in Saudi Arabia. Also, previous studies lack linking to investigate the factors to measure the cloud adoption as well as the cloud model.
- Moreover, this study can contribute to the knowledge by providing an insight towards measuring the performance of cloud adoption. In this study, a two-dimensional matrix using FVM factors was used to predicate the fitness and viability of the success and failure of cloud computing adoption. Exploring the literature, there was a lack of examining the performance of cloud adoption; this objective therefore was carried out. To the best of knowledge of the researcher, this is first time a two-dimensional fit-viability model has been tested] in the context of cloud computing in Saudi Arabia. The two-dimensional model can be also applied to investigate the public organization environment in a variety of contexts.

8.3.2 Methodological Contribution

- This research has applied a mixed method research methodology to address research objectives. Employing the mixed method has given an insight on how a mixed method can be used to assess the factors affecting cloud computing for e-government systems. Applying mixed approach can also be in favour of managers working for public organizations. The mixed method used in this research can help managers to assess their e-government systems and make wise decision towards adopting cloud computing as well as selecting the right cloud model. In this research, the quantitative approach was multi-stage and did not simply conduct a single survey, like so many other authors, but went on to conduct a smaller survey and then a questionnaire with a single expert.

- This research has also a gap identified in the literature of the field by providing a tool with which policy makers can identify a cloud model that suits their organizational needs. The proposed tool was used by adopting the SAW method. The tool can also be generally applied within the area of public organizations, and can be utilized for public organisations other than Saudi Arabia.

8.3.3 Practical Contribution

- This study is believed to provide a holistic support to the policy makers working in governmental sectors and wishing to adopt cloud computing and e-government systems. The findings of this research will assist policy makers towards a successful transformation to e-government.
- In terms of practical contributions, the outcomes of this research are going to help cloud providers provide and host data for government organisations by offering them services that meet their needs. This study has found that the intention of public organizations to migrate to the cloud is quite high; as a result, cloud service providers can take advantage of this finding by offering their services the government agencies.
- Moreover, this study can provide cloud service providers with a comprehensive understanding of the issues existing within government organizations and concerning the decisions taken by IT managers. For instance, this study has found that IT personnel lack the awareness of cloud computing in some organizations. Such issues may impede some organizations from adopting cloud computing; as a result, an effort towards enhancing awareness of cloud knowledge is also needed from cloud providers. This could be achieved through providing more promotional activities, such as workshops, online classes, seminars and so on.
- Adopting cloud computing offers a number of benefits that can enhance e-government services and provide faster and better services. This is especially important given the current goals of the Saudi government to achieve the objectives laid out in Vision 2030 regarding improvements to e-government]. This study offers the government of Saudi Arabia detailed evidence that can contribute to improving its systems of e-government and the chance of implementing successful cloud computing services. For instance, the outcomes of this study found that some organizations lack skilful IT personnel and cloud knowledge which have contributed to a failure in the transitioning process towards adopting cloud computing and the integration process of systems. With such

outcomes, the government may consider raising the awareness of its IT employees and may also hire consultants prior to any adoption process to make sure that all issues regarding the adoption of cloud computing are met and can be dealt with.

- The integrated model proposed was designed to be used by the Saudi public organizations; however, it can also serve other regions that may have an intention to adopt cloud computing and wish to find out which factors affect cloud computing adoption.

8.4 Lessons Learnt from the Study

One major lesson learnt from the study was how to effectively obtain specific information from a rich literature containing a wealth of detail. Being able to obtain exactly the right information is a skill that I have learnt on this research journey. Also, through the literature review I was able to develop my critical thinking by exploring many previous studies that were related to the factors affecting cloud adoption, which further fostered my understanding of the research problem, helped me to identify the knowledge gaps and select the methodologies which were the most appropriate to conduct the research.

Additionally, developing the research methodology was a major skill that I was able to improve. Conducting a mixed approach, and using interviews and a SAW analysis as well as several questionnaires taught me a lot about conducting research. Using this approach allowed me to acquire a full picture of the research problem, including gaining a perspective from different IT experts, and coming to understand how data can be analyzed qualitatively. Also, analysing quantitative data using the SEM technique required another steep learning curve. The process was relatively challenging in that a number of procedures had to be undertaken and understood such as the SPSS and SMARTPLS tools. Also, SEM requires a minimum of 200 samples for a reliable result, so the process of data collection took more than two months. Despite the long process taken to the collect the data, it was worth waiting to meet the requirements for the SEM.

8.5 Study Limitations

While this study has accomplished its current objectives, it still has some limitations. The target population of the study was Saudi Arabia's public organizations. The outcomes of this research were therefore limited to the public organizations and private organizations including large, medium and small businesses were out of scope.

Although objectives 3 and 4 were met, a larger sample was needed for better results. Although this study used many strategies for acquiring more participants, there was only limited cooperation and support from public organizations. Moreover, given the limited time and resources available to the researcher, the study had to be carried out within a single time period which means that it was not able to capture the changes that occur in a dynamic phenomenon such as cloud adoption.

Since the questionnaires ultimately had to be distributed in person as hard copies, this was one reason why it was difficult to obtain a] larger sample. It is anticipated that [with a larger sample better results will be obtained in the future, especially as Saudi Arabia is making a good progress in implementing the 2030 Vision's policies in adopting modern technologies. The study can be replicated, and results will be definitely interesting and are going to contribute to the body of knowledge. The study's limitations have therefore signposted possible areas that would be worthwhile to investigate and these are described in more detail in the next section.

8.6 Future Work

The study's main aim was to identify and understand the factors that affect cloud computing adoption in public organizations. This opens a door for other researchers to replicate the study with other and more government organizations, and compare this study's outcome with theirs.

The current research model can be utilized globally to address cloud adoption and more factors could be added to the model for further enhancement. For instance, the model could be improved further by investigating the fitness and viability of cloud adoption in relation to the social and cultural factors, as these two are key influencing factors when it comes to cloud adoption. Different theories using same factors might be applied and the results of both studies can be compared.

The number of respondents acquired for this study was 408 for questionnaire 1 and 21 for questionnaires two and three. Future work could usefully be conducted with larger samples taken from a wider range of government organizations. Simply replicating the study with the same organisations at a later date would also be of interest as the current study is cross-sectional and only provides a 'snapshot' of the situation regarding cloud adoption by Saudi government organisations. As aforementioned, the Saudi government has policies in accordance with the Saudi Vision 2030 which supports the adoption of new technologies, and a longitudinal study would reveal how government organisations' adoption of cloud computing is changing in response to these policies.

While this study has used the most recommend methods in the data collection process and analysis using questionnaires and semi-structure interviews and using SEM to analyse the data; future researchers could try other methods, such as case studies, focus groups, observations, and other data collection methods suggested in Chapter 4. It was difficult for the researcher to gain access to government ministries and use any data collection methods other than surveys and a limited number of interviews; as understandably, there were security issues that precluded this. Saudi universities and government ministries might usefully collaborate in research projects on cloud adoption, or the adoption of other new technologies, which would allow other, more sensitive, methods of investigation such as direct or even participant observation.

This study targeted only the IT heads to answer question 4. It would be interesting to answer this question using a wider target population in future research. For instance, other employees having an IT background but working in other departments could be questioned; and other stakeholders having IT experience could also be included. Taking the view of government cloud providers would contribute heavily to the outcomes of future research so it would be of great interest if future studies were to include them.

Further, factors found to be affecting cloud computing in the qualitative stage could be tested empirically. These factors included trust, accessibility, ease of interaction and service quality (see Figure 6.2 in Chapter 6). In other words, a researcher could examine the influence of these factors on cloud computing adoption using the DOI and FVM model and incorporating them. The relationship among these factors could be also tested using SEM.

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1.2 Appendix A

Questionnaire One & Two

Part A: Organization and Participant Information

1. Qualifications:
Diploma or less □ Bachelor □ Master □ Doctorate □
Other _____

2. Study Field:
Computer Science □/ IT □/ Engineering □/ Management □/
Other_____

3. Department: _____

4. Role :
Information Security Manager □ / Information Technology Manager □ / Consultant □ Analyst □ / Technician □ / Other: _____

5. How many years functioning in this organisation?
Less than 1 year □ / 1 – 5 years □ / 6 – 10 years □ / More than 10 years □

6. What is your filed in the organization?
Services □ / Financial □ / Education □ / Other _____

For sections B-D, Please choose the number that you think is right as 1 represent that you strongly disagree and 5 you strongly agree

Par B : Issues of E-Government deployment

	What are the most issues faced in implementing E-Government Services	Strongly disagree				Strongly agree
9	Top management support shortage	1	2	3	4	5
10	IT infrastructure shortage	1	2	3	4	5
11	Funding shortage	1	2	3	4	5
12	Experience Shortage	1	2	3	4	5
13	Increase of cost of consultation	1	2	3	4	5
14	IT skills shortage	1	2	3	4	5

Others:

SECTION C: Cloud Computing Adoption Drivers

	Cloud Computing is aimed to adopted for	Strongly disagree				Strongly agree
15	Lowering cost	1	2	3	4	5
16	Obtaining scalability	1	2	3	4	5
17	Enhancing work efficiencies	1	2	3	4	5
18	Recovering disaster	1	2	3	4	5
19	Enhancing transparency	1	2	3	4	5

Others:

Part D : Factor Affecting Cloud Computing

A- Fitness of cloud Computing

		Strongly disagree				Strongly agree
Task						
20	effective services to citizens is offered by the e-government systems	1	2	3	4	5
21	Work performance is enhanced by the e-government systems	1	2	3	4	5
22	Sharing Information among stakeholders can be obtained through e-government systems	1	2	3	4	5
Relative advantage						
23	Cost will be declined if adopted cloud computing	1	2	3	4	5
24	If cloud computing is adopted, work can be done easier.	1	2	3	4	5
25	Latest systems can be enabled to be used by cloud computing.	1	2	3	4	5
26	Overall quality can be enhanced through using cloud computing	1	2	3	4	5
Complexity						
27	Cloud computing services are easy to use	1	2	3	4	5

28	Cloud computing services are clear and understandable	1	2	3	4	5
29	Cloud computing can be easy to employees to interact with	1	2	3	4	5
30	In general, cloud computing services are not complex	1	2	3	4	5

		Strongly disagree				Strongly agree
Compatibility						
31	Cloud Computing can fit the organization needs	1	2	3	4	5
32	Current systems in the organization can be easily integrated with the cloud.	1	2	3	4	5
33	Current system can be run by the cloud	1	2	3	4	5
34	Overall cloud computing does not need further technical improvement	1	2	3	4	5
Trialability						
35	Cloud computing should be tested first	1	2	3	4	5
36	It is important to test cloud computing before using it	1	2	3	4	5
37	It is important to test cloud services	1	2	3	4	5
Security						
38	Enough security is provided by cloud computing	1	2	3	4	5
39	Security in cloud computing is strong.	1	2	3	4	5
40	Cloud vendor can be trusted on data privacy.	1	2	3	4	5
41	Cloud vendor equipment are secure	1	2	3	4	5
42	In general cloud computing is secure than traditional methods	1	2	3	4	5

		Strongly disagree				Strongly agree
Fit						
43	Cloud computing matches e-government services	1	2	3	4	5

44	Applications used within the organization is suited by cloud computing					
45	Sharing information can done effectively through using cloud computing	1	2	3	4	5
46	Existing applications can be adopted easily through cloud computing	1	2	3	4	5
47	Cloud computing capabilities are matched with the organization external and internal needs	1	2	3	4	5

B- Viability Assessment

		Strongly disagree				Strongly agree
Top Management Support						
48	Upper Management is willing to adopt the cloud	1	2	3	4	5
49	Strong leadership is offered by the top management in the organization	1	2	3	4	5
50	New innovated systems are encouraged by top management support	1	2	3	4	5
51	Top management are aware of the advantages provided by cloud computing	1	2	3	4	5
52	Operating e-services are supported by top management support	1	2	3	4	5
Cloud Knowledge						
53	IT employees are knowledgeable when it comes to underlining structure	1	2	3	4	5

		Strongly disagree				Strongly agree
54	Advantages given by cloud computing are well known by IT staff	1	2	3	4	5
55	IT staff have a good understanding of cloud types and models	1	2	3	4	5
56	In general, IT employees have good understanding of cloud computing	1	2	3	4	5
ROI						
57	Cloud Computing lowers the investment in new infrastructure	1	2	3	4	5
58	Deployment process of cloud computing involves a negligible amount of time and effort.	1	2	3	4	5
59	System maintenance can be lowered through cloud computing	1	2	3	4	5

60	Hiring expensive IT expertise can be eliminated if Cloud computing is adopted in-house.	1	2	3	4	5
61	Computing benefits are more the costs of its adoption..	1	2	3	4	5
62	Staff can use cloud computing to function their work better with no need of more training.	1	2	3	4	5
Asset Specificity						
63	Our organization need a special hardware and software to use cloud computing .	1	2	3	4	5
64	Staff with special experience need to be hired to adopt cloud computing.	1	2	3	4	5
65	In order to process organization data, cloud services providers would have to make significant investments in equipment and software tailored to organization's needs	1	2	3	4	5
		Strongly disagree				Strongly agree
Uncertainty						
66	In our organization, if Cloud computing adopted, it might not run well and make issue with IT operations.	1	2	3	4	5
67	In our organization, if Cloud computing adopted, its servers may not run well and may not support our IT operations efficiently.	1	2	3	4	5
68	The pay-as-use model of payment not clear and is complex to know cost and benefits.	1	2	3	4	5
IT infrastructure						
69	Our organization has currently a good internet connection speed	1	2	3	4	5
70	The organization is mature in using the Internet and related technology..	1	2	3	4	5
71	The organization needs improvement in regards to its computational system capabilities	1	2	3	4	5
72	The organization needs cloud-computing services to meet its IT needs.	1	2	3	4	5
IT Skills						
73	Within this organization, managers at all levels are IT well-educated.	1	2	3	4	5
74	Our organization has high levels of IT-related skills and technical knowledge.	1	2	3	4	5
75	IS department is aware of the business process well enough to understand the required applications.	1	2	3	4	5
76	IS staff is able to make cloud computing system development	1	2	3	4	5

IT Policies						
77	There is a shortage of security rules, policies and privacy laws.	1	2	3	4	5
78	Our Organization might lose data control if it use cloud services provided by a supplier hosting data outside the country	1	2	3	4	5

		Strongly disagree				Strongly agree
79	In our organization, there is no legal protection in the use of Cloud Computing	1	2	3	4	5
Viability						
80	Our organization's capabilities and current resources support cloud computing.	1	2	3	4	5
81	Our organization can efficiently move computing needs to cloud computing.	1	2	3	4	5

C- Cloud Computing Adoption

		Strongly disagree				Strongly agree
82	It is suggested to use cloud computing perspectives in the organization.	1	2	3	4	5
83	The organization will adopt Cloud Computing in the near future.	1	2	3	4	5
84	The organization is planning to assess and adopt cloud computing.	1	2	3	4	5

Thank you for your Time. Your cooperation is highly appreciated.

1.3 Appendix B

Questionnaire (3) Cloud Model and Services (Arabic Version)

Same questions have been applied on Public, Private, and Hybrid clouds to assess (SaaS, PaaS, and IaaS).

اسم المنظمة

النموذج السحابي المسخدم حاليا في المنظمة

(Software as a Service) البرمجيات كخدمة

(platform as a service) منصة كخدمة

(Infrastructure as a service) البنية التحتية كخدمة

لايوجد نموذج سحابي في المنظمة

أخرى (Other (please specify

ما نوع السحابة المستخدمة حاليًا في المنظمة

(Public Cloud) السحابة العامة

(Private Cloud) السحابة خاصة

(Hybrid Cloud) السحابة الهجين

المنظمة لم تتبنى اي من الانواع السابقة بعد

أخرى (Other (please specify

السحابة العامة هي نوع من الحوسبة حيث يقوم مزود الخدمة بتوفير الموارد للجمهور عبر الإنترنت. تختلف الموارد باختلاف المزود ولكنها قد تشمل إمكانيات التخزين أو التطبيقات أو الأجهزة الافتراضية. تسمح السحابة العامة بقابلية التوسع ومشاركة الموارد التي لا يمكن لمؤسسة واحدة تحقيقها

<u>(Software as a service) قياس نموذج البرمجيات كخدمة للسحابة العامة</u>

وهي البرامج و التطبيقات التي يتم الوصول اليها واستخدامها عن طريق شبكة الانترنت ويمكن للعملاء الاستفادة منها عن طريق تاجيرها عند الطلب

يعتبر اعتماد البرمجيات كخدمة أفضل من الأنظمة المستخدمة حاليا في منظمتنا

أعلى قيمة 7	6	5	4	3	2	أقل قيمة 1

يتم اختبارالبرمجيات كخدمة في سياق مؤسستنا قبل الالتزام بالتبني

أعلى قيمة 7	6	5	4	3	2	أقل قيمة 1

يمكن أن يؤدي اعتماد البرمجيات كخدمة في مؤسستنا إلى تقليل التكلفة ويمكن أن يوفر عائدًا مرضيًا على الاستثمار

أعلى قيمة 7	6	5	4	3	2	أقل قيمة 1

تمتلك منظمتنا الموارد المطلوبة لاعتماد البرمجيات كخدمة

أعلى قيمة 7	6	5	4	3	2	أقل قيمة 1

يتم تحديد وتقييم متطلبات الخدمات الإلكترونية واحتياجات الحوسبة لتنفيذ البرمجيات كخدمة في مؤسستنا بوضوح

أعلى قيمة 7	6	5	4	3	2	أقل قيمة 1

يتمتع موظفو تكنولوجيا المعلومات في مؤسستنا بالمهارات والقدرات اللازمة لضمان الاعتماد البرمجيات كخدمة

أعلى قيمة 7	6	5	4	3	2	أقل قيمة 1

الإدارة العليا في مؤسستنا مهتمة لاعتماد البرمجيات كخدمة

أعلى قيمة 7	6	5	4	3	2	أقل قيمة 1

Organization name

What cloud model is being used in the organization now?

(Software as a Service)

(platform as a service)

(Infrastructure as a service)

What cloud type is being used in the organization now?

(Public Cloud)

(Private Cloud)

(Hybrid Cloud)

(Software as a service)

SaaS is considered to be one of the best cloud models that is being used now in the organization.

1 2 3 4 5 6 7

The organization has the ability to test SaaS before adopting it

1 2 3 4 5 6 7

Adopting SaaS into the organization can lower cost and increase the ROI.

1 2 3 4 5 6 7

Our organization has all resources needed to adopt SaaS

1 2 3 4 5 6 7

Our staff in the organization have all training and skills needed to adopt SaaS

1 2 3 4 5 6 7

The Upper malmanagement in our organization is interested in adopting SaaS

1.4 Appendix C

Interview Guide

Preamble: Permission to record copyright waiver

Section 1- Introduction

- What position do you hold within the organization?
- What are your main responsibilities?
- What are your responsibilities regarding cloud computing?
- How long have you been working for the organization?
- How many IT staff dealing with cloud computing in the organization?

Section 2: Intention of Cloud Adoption

- Do you have intention to adopt cloud computing into your organization?
- What type of cloud you intend to adopt and why?
- Are you ready to overcome cloud computing migration challenges?

Section 3: Factors affecting cloud computing

- Based on your experience, what factors do you think that have an influence on cloud computing adoption?
- Do you think (relative advantage, compatibility, complexity, triaibility , and security) are important factors and would affect your decision of adopting cloud computing in your organization, can you freely explain please?
- Do you think (top management support, IT infrastructure, IT skills, IT policy, and ROI) are important factors and would affect your decision of adopting cloud computing in your organization, can you freely explain please?
- How will these factors influence positivity or negatively, please explain?
- Does your organization have a good internet connection?
- Are you IT staff aware of cloud computing and are able to make cloud computing development?
- Do you have legal protection in the use of cloud computing?

Section 4: cloud Model

- What cloud type is currently being used in your organization?
- What cloud computing service is best suits your organization needs? Please explain?
- What cloud computing service that your IT staff is familiar with?

- Does your organization have all resources to implement IaaS, PaaS, SaaS, please explain?
- Do you have trained staff who can deal with IaaS, PaaS, SaaS, please explain?

Finally, is there anything you would like to add?

1.5 Appendix D

Ethical Approval

Faculty of Science and Engineering Research Ethics Committee

19 May 2021

Dear Prof Schaefer

I am pleased to inform you that your application for research ethics approval has been approved. Application details and conditions of approval can be found below. Appendix A contains a list of documents approved by the Committee.

Application Details

Reference:	8339
Project Title:	A Cloud Computing Adoption Model for E-government Implementation in Saudi Arabia.Principal Investigator/Supervisor: Prof Dirk Schaefer
Co-Investigator(s):	Mr Mohammed Al Yami
Lead Student Investigator:	-
Department:	Civil Engineering and Industrial Design
Approval Date:	19/05/2021
Approval Expiry Date:	Five years from the approval date listed above

The application was APPROVED subject to the following conditions:

Conditions of approval

Please note: this approval is subject to the University's research restrictions during the pandemic, as laid out on the research ethics webpages. Therefore, wherever possible, research should be conducted via remote means which avoid the need for face-to-face contact with human participants during the pandemic. The process for requesting an exemption to these restrictions is described on the research ethics webpages.

- All serious adverse events must be reported to the Committee (ethics@liverpool.ac.uk) in accordance with the procedure for reporting adverse events.
- If you wish to extend the duration of the study beyond the research ethics approval expiry date listed above, a new application should be submitted.
- If you wish to make an amendment to the study, please create and submit an amendment form using
- the research ethics system. If the named Principal Investigator or Supervisor changes, or leaves the employment of the University during the course of this approval, the approval will lapse. Therefore it will be necessary to create and submit an amendment form within the research ethics system.
- It is the responsibility of the Principal Investigator/Supervisor to inform all the investigators of the terms of the approval.

Kind regards,

Faculty of Science and Engineering Research Ethics

Committee foseethics@liverpool.ac.uk

FOSE-REC

Appendix - Approved Documents

(Relevant only to amendments involving changes to the study documentation) The final document set reviewed and approved by the committee is listed below:

Document Type	File Name	Date	Version
Questionnaire	Questions3	14/11/2020	1
Advertisement	This will be transalted in Arabic	23/03/2021	1
Questionnaire	Ranking the importance of foactors for each cloud model (002)	24/03/2021	1
Interview Schedule	Interview Schedule	29/04/2021	1
Participant Information Sheet	Information sheet for Que	29/04/2021	1
Participant Consent Form	Question Participant Consent form (Al Yami Mohammed)	29/04/2021	1
Participant Information Sheet	Information sheet interview	29/04/2021	1
Participant Consent Form	Interview consent form.doc (5)	29/04/2021	1
Fieldwork Risk Assessment	Risk Assessment Form2020 (2)	29/04/2021	1