Researching the Acceptance and Use of Cloud Computing for Education and Administration in Saudi Arabian Universities

By

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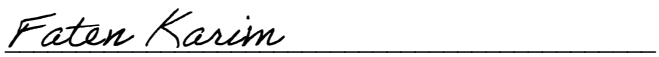
Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.



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Abstract

Cloud computing technology is not widely used in Saudi Arabia at the present time in any capacity. However, as the country attempts to modernise its economy and civil society, attempts are being made to introduce advanced technologies into the education system in order to invigorate and modernise it. Cloud computing would offer significant benefits to Saudi educational institutions wanting to upgrade their IT systems. Connection to the cloud would mean that institutions could access digital resources housed on the internet, reducing the cost of using information technology (IT) since software wouldn't have to be purchased, installed and maintained at the local level. This would not only be cost-effective, but also efficient, and offer access to advanced technologies and enhanced security. For a range of reasons, however, the Saudi Arabian education system has not yet embraced cloud computing. Issues for the Saudis include security and privacy concerns, a lack of trust and negative cultural attitudes, but, most importantly, little experience digital devices in educational settings and a lack of knowledge and technical know-how.

The goal of this research was to identify the factors that could influence the adoption of cloud computing in Saudi Arabian universities for use in administrative, teaching and learning contexts, and to advance the theoretical understanding of this issue by suggesting a conceptual model. The model provided by this study grouped factors into four key categories: technological, organisational, environmental, and cultural, which is reflected in the research questions. The research is based on extended TOE theory (technology, organisation, and environment) and the Hofstede model, which includes cultural factors.

To achieve the aims of the research, an exploratory study consisting of two phases, qualitative (interviews) and quantitative (survey), tested and validated this model empirically. The first phase, a qualitative study, was conducted by undertaking interviews with decision makers, IT staff, and academics at Princess Nourah University. This focus enabled deep analysis in a specific context of hindrances to the adoption of cloud computing, as well as potential solutions to these hindrances. Thematic analysis was applied to these interviews to refine the conceptual model – which had been informed by a literature review – in order to identify further factors that might affect the adoption of cloud computing. In the second phase of the research, an online and paper-based survey was conducted to test the proposed model. The survey's theoretical design was based on the literature review and the aforementioned conceptual model. 421 respondents participated from 24 Saudi Arabian government universities. Structural equation modelling (SEM) was used to analyse the questionnaire. Based on this analysis, the hypotheses of this research were tested and verified.

Data analysis revealed that the factors of relative advantage, compatibility, senior management support, readiness, competitive pressure, regulatory support, high masculinity, and high individualism have a positive impact on the adoption of cloud computing in this particular context. They also showed that security concerns, high uncertainty avoidance, and high power distance have a negative impact on the adoption of cloud computing. Unexpectedly, the results indicate that complexity and language and religion do not affect the adoption process.

The study makes an important theoretical contribution by providing a model for the organisational adoption of cloud computing within universities in the developing country of Saudi Arabia. The majority of existing cloud computing research has focused on developed countries (Greengard, 2010; Hailu, 2012). While there are studies that have focused on technology adoption within developing countries, they have investigated adoption predominantly at the individual level rather than the organisational level (Alzahrani & Goodwin, 2012; Susanto & Goodwin, 2010). Even those few studies that have explored organisational adoption in developing countries, the focus has been on e-government contexts rather than university contexts (Abdalla, 2012; Alhujran, 2009; Alghamdi et al 2011; Altameem, 2007; Choudrie, Umeoji, & Forson, 2012; Seng, Jackson, & Philip, 2010). Therefore, this study has made a vital contribution by providing a model for the organisational adoption of cloud computing that takes into account cultural factors affecting Saudi Arabian universities. This is critical as Saudi Arabia attempts to modernise and transform its educational sector to meet the demands of a connected global economy.

Researching the Acceptance and Use of Cloud Computing for Education and Administration in Saudi Arabian Universities

Chapter 1

Introduction: Data from the cloud

1.1 Background to the research problem

Education in the Kingdom of Saudi Arabia is undergoing important changes in the context of economic and social goals established for the kingdom as its leaders seek to cement its position as an economic and political powerhouse in the Middle East by increasing the skills of its citizens and moving its economy away from its dependence on a single commodity (oil) (VISION 2030, online).

One aim is to improve Saudi universities, as well as teaching pedagogy and methodology throughout the education system by introducing more and better information and communication technologies (ICTs). In fact, arrangements have recently been put in place to replace all print books with digital books by 2020.

One aspect of ICTs that could facilitate the planned changes in the Saudi education system from top to bottom is the adoption of cloud computing.

1.1.1 Cloud computing

Cloud computing is the result of the evolution of computer technologies and their combination with the Internet to produce a

> *Model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.* (Mell & Grance, 2011, p. 2)

By 2007, the term cloud computing came to describe the online saving of data, alongside the purchase or rental of servers and other computer equipment. Its development reflects organisations' shifting demand for these resources (Regalado, 2011). Miller (2009) has described the cloud as a large group of interconnected computers. They can be either personal computers or network servers. Per this conceptualisation, a very wide range of end users can access the applications and the data stored in the cloud. Any authorised user can access applications and files from any computer over the Internet, for example. For the end user, the technology and infrastructure behind the cloud are hidden and it is irrelevant which protocol the cloud services use.

1.1.2 A brief history of cloud computing

Cloud computing means different things to different people. But, largely, it denotes to internet technologists outside resources, or represents the provision of IT services and resources over the internet without the need to understand the complicated operations behind the scenes (Woodford, 2017).

Voas and Zhang (2009) depict the history of computing as seen in Figure 1.1, which shows six stages of development:

1. dumb terminals linked to mainframes
2. personal computers
3. networking computing
4. Internet computing
5. grid computing
6. cloud computing.

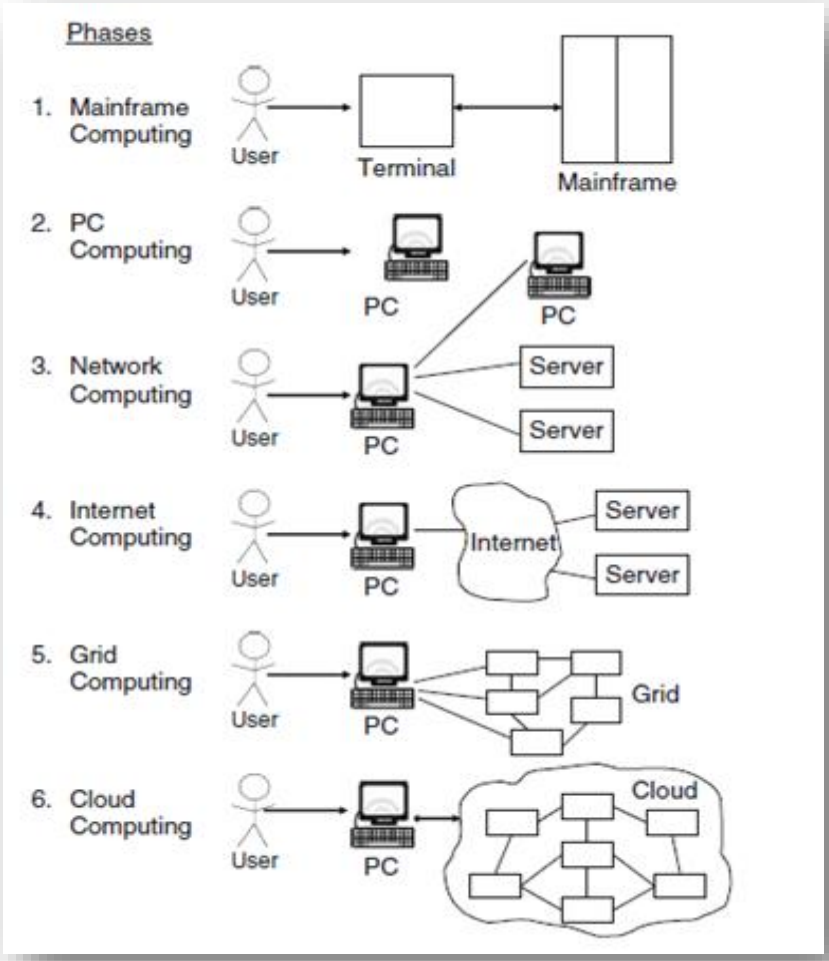

Figure 1.1 Stages of computing patterns (Voas & Zhang, 2009, p. 16)

During stage 1, dumb terminals were commonly utilised to interface with large and powerful mainframe computers. Throughout stage 2, stand-alone personal computers evolved to become sufficiently powerful to meet the plurality of people's requirements. In stage 3, for the pooling of resources and to provide open access to data on each PC, personal computers and servers were interconnected over local area networks. Through stage 4, local area networks were linked to other local area networks, developing the global

network identified as the Internet. This allowed distant applications and data to be accessed and retrieved. In stage 5, grid computing allowed the pooling of storage and resources within a dispersed grid system of computing. During stage 6, cloud computing appeared as a facilitated and accessible method of sharing resources on the Internet (Furht, 2010).

While viewing these six computing stages, it appears cloud computing is merely a version of the stage 1 mainframe computing paradigm. However, several key distinctions exist. Cloud computing provides strong power and capacity, as the number of PCs that connect to the cloud add to its power and capacity, whereas mainframe computing offers a finite computing power that can be easily measured and determined. As well as this, users access a mainframe computer through dumb terminals, whereas in cloud computing powerful PCs can be used to connect to the cloud and also use their local computing power (Furht, 2010).

Cloud computing and traditional networks use the same technology. Virtualization is the main difference between them. Virtualization allows users to have a huge flexible scalability by providing unlimited resources via the cloud where apps, programs and data can be accessed. In traditional networking, all the hardware is fixed within a specific limit, limited usually by the capacity of the computer or the finances of the computer owner. In order to scale up digital activities, more money has to be spent to upgrade the hardware or the software, even if they are not used to the maximum. Moreover, the owner pays for the hardware, installation and maintenance. On the other hand, scaling up with cloud computing means that a computer user can tap into massive resources ready to go according to the user's needs. In addition, the user will pay only for their usage (Salem, 2012).

The development of cloud computing is a boon for countries such as Saudi Arabia, which is developing ICT expertise late compared to countries such as the US, the UK, or Australia. For example, being able to access software from the 'cloud' will lessen the learning curve and workload for individuals who are tasked with supporting teachers and administrators since the software is kept up-to-date where it is located. Saudi technologists will be benefitting from the evolution of computing over the last 40 years.

1.1.3 Benefits and issues of cloud computing

Benefits. The main advantages of cloud computing are to reduce the IT cost. By using cloud computing, organisations do not have to set up an IT infrastructure, and instead are able to rent resources and pay per their service usage (Buyya et al., 2009). Additionally, cloud computing allows companies to dynamically source software and computing infrastructure depending on consumer usage (Mell & Grance, 2011). IT

outsourcing can economise cost and deliver access to technical information. The cost of using IT facilities are significantly reduced by utilising cloud computing (Alsanea, 2015).

Because of these facilities, cloud computing increases productivity, availability, reliability, and flexibility, while also decreasing response times (Marston et al., 2011). Furthermore, cloud computing reduces the consumed energy by decreasing the discharge of carbon (Bose & Luo, 2011) because of the joint arrangement usage of the resources for computing and supplying on demand scalability with pay per usage (Mell & Grance, 2011).

Issues. In spite of the many positive features of cloud computing, there are still some disadvantages. They relate to:

- ***Reliability***. The cloud, like all computer systems, can be unreliable if the users encounter downtime due to issues with the cloud servers that lead to slowdowns or breaks in service (Alsanea, 2015; Yang & Chen, 2010). Cloud computing is completely dependent on the Internet and, as any other service dependent on the Internet, can fail.
- ***Security concerns.*** The top security concerns related to cloud computing, as mentioned in (Rashid, 2016) are:
  - ***Data violation.*** Cloud service providers become a target for breachers because they control great amount of sensitive data such as financial information and intellectual property. It is recommended that organisations protect their data by using multifactor authentication and encryption (Rashid, 2016).
  - ***Ruined authentication.*** Data is normally attacked due to the authentication's weakness, such as weak passwords or failing to change the user access authority when the user leaves the organisation. Using multifactor authentication systems will decrease breach possibilities. Examples of such authentication are one-time passwords combined with phone-based authentication (Rashid, 2016).
  - ***Account theft.*** Cloud computing has become fertile soil for fraud and software exploits. Attackers can spy on transactions and change data. This can also be avoided by using multifactor authentication (Rashid, 2016).
  - ***Losing data forever.*** Another malicious way in which hackers sabotage cloud computing, and ruin reputations, is to delete cloud data permanently. Thus, cloud providers usually protect data and applications by distributing them in different zones and machines while providing data backup.

- ***Lacking understanding.*** Adopting cloud computing without fully recognising the essence of cloud computing will lead to numerous financial, technical and legal risks.
- ***Improper use of the cloud service.*** Cloud services can be captured to serve malicious purposes, such as breaking encryption codes to attack a user's computers and sending spam emails. Providers should be aware of such activities and provide tools for their clients to protect them.
- ***Denial of service (DoS) attacks.*** DoS attack is not new in the computer world, but it has become more popular in cloud computing. A DoS attack can slow systems to a crawl or even cause them to time out, which consumes a large amount of power and increases a customer's bill. Service providers are responsible for protecting their clients from DoS by employing defence strategies (Rashid, 2016) (White, McMillan, Brenton, Featherston & Hubbard,2011).
- ***Privacy.*** Privacy and confidentiality are aspects of security, a serious issue in cloud computing. Organisations that might use the cloud are very wary of locating sensitive data on cloud servers since they do not know the exact location of their data (Kaufman, 2009). It is incumbent on the provider to protect sensitive data with the most sophisticated means possible in terms of organisational procedures and computer processes.
- ***Availability.*** Availability is another issue that hinders the adoption of cloud computing. Failure downtime could happen any time and the clients would be unable to either do their work or fix the problem (Alsanea, 2015; Kaufman, 2009).

1.1.4 Cloud computing in education

The trend to cloud computing is becoming increasingly embedded in institutions' organisational strategies and has also permeated the education sector (Bojanova, Zhang, & Voas, 2013). Just a few years ago the term cloud computing did not exist. Today, it is one of the most important IT trends (CeArley & Claunch, 2012).

Many large industries with extensive IT infrastructures have not been able to benefit from this technology because of quite specific technological, organisational, environmental and cultural limitations. These limitations are examined in this study in the context of Saudi Arabian universities.

Cloud computing is 'a new dawn' for education (Sultan, 2010). Within the education sector, it is leading to different computing models in the provision of services to students, researchers, academics, and managerial staff at universities (Sultan, 2010) by virtualising resources, like software applications and laboratories, enabling them to be provided via the Internet as a substitute for being installed on each local computer (A

Vouk, 2008). Furthermore, the cloud enables access to distance learning programs and e-learning systems (Klug, 2014).

Before the cloud was developed, the institution had to install software on its local computers, protect them from viruses, and keep them up-to-date, which places a large burden on IT staff and imposes significant cost.

Furthermore, universities had to provide sufficient hardware to meet the needs of their students and staff, in addition to maintaining the machines and the physical network running through and between buildings, although all of the devices and some of the programs were only used at certain times during the year, such as examination time, and remained unused for the rest of the year.

By using a cloud service, universities can decrease the cost of installing software for each computer and keeping it updated. Updates become the responsibility of the cloud provider, and the constantly up-to-date cloud applications can be run on any Internet browser or any device with access to the Internet – desktop computer, laptop, Ipad or smart phone. Although universities must pay for the service offered by the cloud provider (who benefits from the economies of scale), the cost is not as great as when universities have to maintain and run an in-house computer network.

Cloud computing not only reduces costs and other inputs, it also provides student access to high tech programs and a collaborative environment where students can work together.

When an organisation adopts a new technology, corresponding changes occur in the organisation which allow it to benefit from that technology, thereby improving the organisation's performance (Damanpour & Schneider, 2006). When using cloud computing, its adoption modifies the nature of the work executed by staff, the IT procedures used, and the organisation's abilities. New procedures emerge to take advantage of the resources available to the organisation internally and externally (Ranganathan & Balaji, 2007), and an organisation's capabilities will increase as the new technology becomes familiar and well used (Chen, 1996).

1.2 The rationale for the research

There is an absence of exploratory research that traces the spread and adoption of cloud computing, particularly due to the rapidity of change cloud computing represents and encourages by offering access to so many resources so cheaply and easily, including data management and storage.

In studies that have been completed and published (for example, Abdalla, 2012; Abdulrab, 2011; Alsanea, 2015; Borgman, Bahli, Heier, & Schewski, 2013; Chang et al., 2013), several factors influencing the

adoption of cloud computing have appeared consistently. These can be categorised as *organisational, technological, environmental,* and *cultural*. A review of the theories and the conclusions in the literature indicated that the most appropriate framework to apply in the current study was the technology-organisation-environment framework (TOE) (Gangwar, Date, & Ramaswamy, 2015; Rosli, Yeow, & Siew, 2012), along with Hofstede theory (Hofstede, Hofstede, & Minkov, 2010) to identify potential factors relating to the adoption of cloud computing. TOE covers technological, organisational, and environmental factors and Hoftstede deals with cultural factors, aligning the cultural factors with other factors to represent a comprehensive model.

Although previous studies (Kendall et al., 2001; Kuan & Chau, 2001; OECD, 2003) have recognised the significance of technological factors, such as perceived benefits, complexity, or compatibility, the effect of environmental, technological and organisational factors is context sensitive, differing according to culture, training, individual skills and abilities, institutional history, accessibility, and leadership. For example, in small and medium enterprises (SME) very common technological factors are the cost and perceived direct benefits and relative advantages of using the technology (Chen, Huang, & Lu, 2005; Ghobakhloo, Arias-Aranda, & Benitez-Amado, 2011; Premkumar & Roberts, 1999).

In cloud computing and IT adoption, relative advantages, cost, complexity and compatibility are the factors most used when judging issues in a technological context (Low, Chen, & Wu, 2011; Mehrtens, Cragg, & Mills, 2001; Premkumar & Roberts, 1999). However, the uptake of technology in an educational setting is not just a technological issue, but also highly personal for the individuals involved, that is, the potential end users. For this research, potential users of cloud computing in the university system were targeted since computer use in the tertiary sector is currently more common and more sophisticated than in the secondary and primary sectors.

Many universities in Saudi Arabia are undertaking trials of cloud computing systems (Ibrahim, Salleh, & Misra, 2015; Tashkandi & Al-Jabri, 2015). However, the concept has not been coherently introduced. No specific criteria or strategies have been employed, and very little research has examined the factors affecting the adoption intention of universities in Saudi Arabia as a developing country (Alsanea, 2015; Tashkandi & Al-Jabri, 2015).

Thus far, the adoption of cloud computing systems in Saudi universities has been based on the systems of foreign countries, and there has been a lack of consideration as to whether this adoption is ideal for the specific requirements of Saudi institutions and culture. Aspects of the technology and technology uptake, of

the organisation, the institutional environment and culture have not been considered. It is anticipated therefore, that the findings of this study will be useful in promoting cloud computing in appropriate ways, especially by identifying aids or obstacles to its adoption. Knowing what motivates potential users will make it possible to more effectively structure the introduction and adoption of cloud computing.

1.2.1 The research questions

Based on the previous research rationale, the study was designed to answer the following questions:

1 *What technological factors influence the decisions related to cloud computing in Saudi Arabian universities?*

2 *What organisational factors influence the decisions related to cloud computing in Saudi Arabian universities?*

3 *What environmental factors influence the decisions related to cloud computing in Saudi Arabian universities?*

4 *What cultural factors influence the decisions related to cloud computing in Saudi Arabian universities?*

1.2.2 Aims and objectives

The main goal of this study was to empirically identify the factors that may impact cloud computing adoption in Saudi universities. To achieve this aim, the specific objectives included:

- to recognise and inspect the factors that may influence the adoption of cloud computing
- to critically evaluate the current literature about the adoption of cloud computing in educational and administrational context.
- to comprehend the main technological, organisational, environmental, and cultural drivers and barriers
- to develop a conceptual model which will deliver benefits to Saudi universities
- to develop a suitable research methodology for the empirical research in universities in the Saudi context to verify and validate the developed model
- to carry out an empirical qualitative and quantitative assessment of the measurement factors to examine statistically the significance of relationships
- to review the conceptual model and frame a group of recommendations intended to address the research gaps in the context of Saudi Arabia.

1.3 Research context

The context of this research is noteworthy. Saudi Arabia is wealthy and a powerful force in the Middle East. However, in many educational, social and cultural features, it is still classed as a 'developing' nation. There is no long tradition of Roman or British law, universal education, Industrial Revolution or Enlightenment, such as have led to the wealth and organisation of the nations referred to as 'developed'. Moves to modernise the kingdom are afoot (Chulov, 2017), however, and improving education is part of the future vision.

1.3.1 The Kingdom of Saudi Arabia

Saudi Arabia in its current form was only founded in 1932 by Abdulaziz Al Saud after three decades of conquests in the tribal region. It is geographically the largest country in the Middle East, covering approximately 2,250,000 square kilometres between the Arabian Gulf and the Red Sea, and makes up four-fifths of the Arabian Peninsula (Figure 1.2). The capital city of Riyadh is sited on a large plateau near the centre of the country, and has a population of 6.5 million. The whole population of the country is 31 million, with males forming 54.3% of the population, and females 45.7%. More than 50% of the population is under the age of 20, and this generation of young people and their education are critical to the future success of the country.

The people of the Arabian Peninsula are not a single unit historically or culturally, with diverse local customs and tribal loyalties. However, the Arabian Peninsula has never been colonised, and the indigenous population has come to share a common history of success in a harsh environment, and for 300 years have been moving toward the current modern state. The overarching influence is the Islamic religion. The geographically widespread population, local cultural differences and religious mores, along with a deep religiosity, but an extremely young population, all affect the ways in which Saudi Arabia is pursuing educational reform.

Figure 1.2 Map of Saudi Arabia (MOHE, 2010)

The climate in Saudi Arabia varies from region to region, but temperatures can be higher than 50 degrees Celsius in several regions in the summer, whilst in the winter, temperatures can be freezing in the northern regions. There is little rainfall, and more than 95% of the country is desert. In the southwest, a series of mountains are parallel to a coastal plain by the side of the Red Sea. In this location only, the weather is affected by the Indian Ocean monsoon, receiving approximately 300mm of rain a year. In the North, Saudi Arabia shares borders with Kuwait, Iraq and Jordan and in the South, Saudi Arabia shares borders with Yemen and Oman. In the East, the neighbouring countries are the United Arab Emirates, Qatar and Bahrain (Figure 1.2) (MOHE, 2010).

Geographically, Saudi Arabia sits atop one of the world's largest oil reserves, and has benefitted economically throughout the 20th century. However, the Saudi government is aware of challenges facing the country. As oil production contracts due to a natural decline in production, per capita income is falling, and the government is looking to diversify the economy. Key to this is improving education in order to prepare the large youth population to participate in a modern workforce more and more reliant on digital tools.

The political context. Saudi Arabia is a monarchy. The King possesses legislative, administrative, and forensic functions and is also the Prime Minister, and as such, controls the Ministers Council, which works as a parliament in the country. The law of Saudi Arabia is based on *sharia* and is related to the teachings of Mohammed. Saudi religious practices originate from Islamic traditions (Al-Zarah, 2008), and are fundamental to public and private life.

The tribes that originally controlled the Arabian Peninsula, and which were united under Abdulaziz Al Saud, are still strong in Saudi Arabia and exert a potent influence on the Saudi Arabian people, and need to be taken into consideration in any future studies and actions (Aldraehim, 2013).

Within the last ten years the government has revived the Shoura Council or Consultative Committee which consists of 150 highly educated and top people appointed by the King, including academics, retired top officers, ex-civil servants and businessmen who participate in taking national decisions. Members of the Shoura Council are selected by the King, and recently women have begun being appointed to the Council (Alsanea, 2015).

Despite these developments, the political and cultural factors in Saudi Arabia have a direct effect on dealing with technology issues, such as security concerns. There is a strict ruling authority that must be convinced and agree before applying any technical solution or advice (Alsanea, 2015)

Cultural context. Elements of religion, political structures, tribal structures, and the influence of modernisation all play a part in creating the Saudi Arabian culture. Saudi Arabia is a centrally significant cultural entity for Muslims internationally. Most Saudis act according to the instructions of Islam, and they are highly affected by the religion. In seeking to modernise Saudi life, the government has established extensive strategic plans relating to technology use, with the goal of being classified as a developed country in the near future (Aldraehim, 2013; Alsanea, 2015).

The information and communication technology (ICT) context. The Saudi government gives very high priority to ICTs due to their fundamental effect in the economies of several countries. Saudi Arabia is the largest marketplace for these technologies in the Middle East. The sector occupies about 55% of the entire ICT in the regional market (SAGIA, 2014). A recent study estimates that Saudi Arabia's ICT spend will increase to reach 43.7 SAR billion by 2020 (Alkhalout, 2016).

ICT adoption is growing quickly, and is witnessing great accomplishments beginning with the establishment of the Directorate of Post, Telegraphs and Telephones in 1926 and ending with establishing a Ministry of Communications and Information Technology (MCIT) in 2003 (MCIT, 2016). Saudi government has initiatives to make a sustainable, knowledge-based economy with the improvements of the services delivery in the country (Alkhalout, 2016). Saudi Arabia represents the 19th largest economy globally and encourages diversity in the mainly oil-based economy (CITC, 2015). The Saudi government has invested heavily in the spreading of technologies across the country by supporting ICT enterprises in the public and private sectors and civil society (CITC, 2015), and this is attracting ICT-enabled service providers, such as data centres to invest in Saudi Arabia. Nevertheless, information technology expansion in Saudi Arabia is a very delicate process and involves dynamics which interact closely with Saudi Arabia's very unique societal, political, cultural, and economic context (Al-Sudairy & Tang, 2000).

As stated by Al-Turki and Tang (1998), most obstacles confronted by organisations interested in adopting information technology are included in some aspect of the following:

- the lack of top management support
- the limitation of IT financial resources
- deficiency of qualified, skilled staff
- the shortage of superior training for personnel.

1.3.2 The existing state of cloud computing in Saudi Arabia

As an enabling technological system, cloud computing is being rapidly introduced into Saudi universities.. The cloud gives organizations, including universities, access to modern computer applications and data storage and retrieval without excessive investment in standalone local systems. However, very little research has been undertaken into the acceptance and use of the technology in Saudi Arabian universities, and this information is critically needed to assist with the successful modernization of the Saudi tertiary system.

According to BMI (2014) (Business Monitor International, a Fitch Group Company), the adoption of cloud computing services in Saudi Arabia should produce rapid growth in that technological area. The government is investing widely in e-government applications to improve facilities provided by the public sector, and making use of cloud computing services. The e-government program (YESSER) mentions in its website (Yesser, 2016) that

> *The government cloud computing initiative provides government agencies with ready services of high efficiency, reliability and security with respect to infrastructure, platform, and software all as a service.*

Government secure network, government service bus and e-correspondence are examples of available cloud based services.

ICT industry experts expect that cloud computing and mobility will be the foundation of the strongest ICT investments in Saudi, mainly on the private cloud model (CITC, 2015). The International Data Corporation (IDC) predicts a sharp increase in cloud services in Saudi equivalent to compound annual growth rate of 57.7% over the period extending through 2017 (IDC, 2014).

The IDC (2014) have pointed out that data security concerns are the drivers behind national enterprises preferring the adoption of the private cloud over the public in order to keep the data under their control and management. Buller (2016) notes that Saudi Arabia would like to have a public cloud locally and under their control, but due to the deficiency of infrastructure and skills, this is currently difficult.

Currently two telecommunication companies have taken the chance to provide cloud services in Saudi Arabia (Alsanea, 2015), but despite this evolution, many challenges still exist, such as resolving data ownership, shortage of cloud regulations and national cloud strategies (Buller, 2016).

As a response to the lack of cloud regulations, the Communication and Information Technology Commission in Saudi Arabia (CITC) has proposed new regulations to support cloud computing developments in Saudi Arabia (CITC, 2016).

1.3.3 Gender in Saudi culture and education

When the Kingdom of Saudi Arabia was established in 1932, it was a poor country, and as a result its educational systems were very limited. At this time, there were only 12 schools, with a total of 700 students (Al Rawaf & Simmons, 1991). However, after 1938 when oil was discovered in significant quantities in Saudi Arabia, the situation changed and the education system was radically improved, although it was still open only to boys (Al Rawaf & Simmons, 1991). By 1950, there were 42,000 students being educated and 365 schools across the country. And by 1959, arrangements had been made so that girls could attend public school.

Currently, primary and secondary education is free for all Saudi citizens, as well as non-Saudi students. However, tertiary education is exclusively for Saudi citizens, and the students who attend are paid allowances by the government (Alamri, 2011).

Universities in Saudi Arabia offer qualifications from diplomas to doctorates. Most universities accept both male and female students, but they are physically separated. The tertiary education system is modelled along lines similar to the educational system of the United States. However, the policies and procedures in Saudi Arabia's educational system have been adapted to take into account the traditions and customs of Islam (MOHE, 2010).

Gender in the education system. The restrictions in the education system are one of the examples that Saudi culture, based in the Islamic tradition (Al-Zarah, 2008), is one of the most gender segregated in the world. Within the workplace and educational settings, women are not permitted to socially intermingle with males, other than their relatives. Traditional attitudes related to the genders have had a dramatic influence on education, especially for Saudi women (Al Rawaf & Simmons, 1991; Alsharari, 2010).

Prior to 1959, in fact, the only available education for females in Saudi Arabia had to be organised in private dwellings or in private institutions in which females could preserve all characteristics of their Muslim identity. In 1959, public state schools were opened for girls, but co-educational schools have never been considered (Kutbi, 2015). Nevertheless, while Saudi Arabia prior to girls' formal education could reasonably be depicted as 'a society of men' due to the predominantly male professional workforce, as well as their domination of the political arena, economic platforms and social sphere, educated Saudi woman are beginning to move into public positions of societal authority and enter positions traditionally reserved for men.

Currently, there are female doctors, university instructors and professors, as well as businesswomen. Today's Saudi women are laboratory scientists, media personalities, and factory workers. Gender segregation, however, has led to a variety of behaviours and compromises that allow Saudi women to be educated and to work without much contact with men outside the family. Face-to-face meetings seldom occur. Instead, males and females utilise phone or videoconference facilities to conduct business meetings, and in much the same way congregate in gender-segregated universities, in which men are only allowed via video link. Furthermore, the progression of women into a myriad of fields is still regulated by Islamic law and traditions within the country (Kutbi, 2015).

Women's tertiary education. In 1961/1962, women began participating in Saudi universities by studying as irregular 'part time' students at King Saud University, which was established in 1957. These females accounted for 5% of the overall enrolment and were not expected to obtain professional employment. In the initial phase (1969-1975) of female enrolment, the major objective was to expand opportunities for female education from primary school to the university level (Al Rawaf & Simmons, 1991). Within this phase was also imbedded the need to improve the quality of the educational institutions and to improve the efficiency of the educational programs. By 1975, females accounted for 14% of the students in Saudi universities (Jamjoom & Kelly, 2013).

Saudi Arabia has continued to provide quality education for females, guaranteeing their continuing education and contribution to the nation. In 2004, about 200 institutions were established for women only (Education, 2013), and the Ministry of Higher Education (MOHE) in Saudi Arabia published a report stating that 48.8% of students in Saudi Arabia were female (Kutbi, 2015). By 2011, Al-Arabia News pointed out that the percentage of female students had grown to 58% at seven universities in Saudi Arabia (Al-Arabia News, 2011).

Princess Nourah Bint Abdulrahman University (PNU). The provision of education for women in a strictly gendered society led in 2008 to the establishment of the Princess Nourah Bint Abdulrahman University (PNU), the largest female university campus globally, currently hosting 60,000 students and 5000 staff (Figure 1.3).

PNU is testament to the substantial investment in the education of women, which had begun in earnest in 1970 when the General Presidency for the Education of Girls established the first college for women. The inauguration of more colleges followed until there are now 102 institutions, ranging from university colleges to intermediary colleges and community colleges. These are distributed over 72 Saudi cities and include approximately 600,000 students (PNU, 2015).

PNU was selected as the focus for the current research because of its size and reputation as an educational institution. Because it is a university for women, and the researcher is a woman, access was permitted, as was contact with the students. Furthermore, as a large institution in which there had been investment, and a trailblazer for women, it was felt that the students' introduction to and adoption of technology would present a useful test case in the use of cloud computing in education.

Figure 1.3 Princess Nourah Bint Abdulrahman University (PNU)

In 2006, under the supervision of the Ministry of Higher Education, a royal order was disseminated for the establishment of the first university for women in Riyadh. This included six colleges already located in Riyadh, in addition to a number of new colleges established for the purpose of women's education and development (PNU, 2015).

With the establishment of PNU, came the General Administration for Information Technology and Communication, commissioned out of a commitment to awareness and utilisation of technical advances in administrative and academic processes, attempting to put PNU at a high rank among local and international educational institutions. The General Administration is the main focus for state-of-the-art information technology at the university, and is effective at keeping abreast of the most recent developments in the field of information technology. The General Administration strives to utilise the latest programs and technologies to facilitate high standards of work among PNU employees (PNU, 2015).

Given the growing prominence of women in Saudi Arabian society and the education system in particular, research is now needed into the adoption of new technologies in the tertiary education sector. PNU is the most notable female only university in Saudi Arabia and therefore provided the ideal context for preliminary data collection in this study.

1.3.4 Reforming the system

According to Ghafour (2009), the Saudi government has started to implement reforms in the country's education system in order to bring the higher education system up to a similar level to advanced countries. As a result, higher education in Saudi Arabia has undergone dramatic changes in recent times.

Education is always a priority of the Saudi government and receives the largest part of the budget at 25% of total spending (Council, 2015). In 2009, the Saudi King gave the equivalent of $2.5 billion USD to create a graduate-level educational organisation, King Abdullah University of Science and Technology, currently the sixth wealthiest university worldwide (Hamod, 2009).

In addition, a new university specialising in distance education, the Saudi Electronic University, was opened in 2011. It offers both undergraduate and graduate degree programs (SEU, 2012). In the last eight years, Saudi Arabia has built 25 universities and 68 technical institutions and trained approximately a half million academic staff (MOHE, 2010).

In addition, MOHE has initiated a National Centre for e-Learning and Distance Learning (NCeDL) which seeks to boost the preparation of electronic based educational material, and to provide an online environment for the academic staff at all universities to access and create online courses through its own learning management system (LMS) called JUSUR. This new system enables the faculty in higher education institutions to utilise the latest technology to respond to current demands for online learning (Albalawi, 2007). Moreover, Albalawi (2007) concluded that overall, faculty had positive attitudes towards this new e-learning platform. They believe that online courses will play an important role in the higher education future in Saudi Arabia. In addition, they think that online learning will progress students' learning, motivate students' interest in learning, and be a useful solution to address the issue of frequent gender separation in the Saudi higher education system.

Cloud computing. Cloud computing is being adopted in the fields of government, business, and education due to its attractive features and wide range of applications. It is an attractive technology in the educational community because it offers many features that educational institutions could utilise to enable their personnel and students to do the work more effectively and efficiently, and the government of Saudi Arabia has been attempting to update its educational systems by adopting the latest and best educational technology practices (M. Alamri, 2011).

However, despite its attractiveness, due to the complexity of managing cloud systems, many academic institutions have faced major difficulties in implementing their use. As well as this, the introduction of the technology has been hampered by the lack of professional studies that have investigated the adoption of cloud computing. In response to this, the Ministry of Higher Education has financed students to do their PhDs in e-learning and cloud computing overseas in countries like the United Kingdom, the USA and Australia in order to improve the chances of a successful introduction of cloud computing into the Saudi Arabian educational system, respecting all the while the unique circumstances and requirements of the country (Abdullah Alshwaier, 2012)

1.4 Methodology and methods

The research techniques used in this study were based in a mixed methodology, which permitted the researcher to commence a widespread review of relevant theory, and pair that review with the adoption of methods for collecting and analysing qualitative and quantitative data. A mixed methods approach allowed the research results to be confirmed, cross-validated, and corroborate findings within the study.

In this study, the research design incorporated exploratory, descriptive and explanatory research methodologies. The two main phases of the study consisted of qualitative research, followed by quantitative. The former consists of exploratory research and the latter incorporates descriptive and explanatory research.

The exploratory stage can be useful when attempting to clarify a particular research dilemma, and was important for the formulation of the conceptual model and hypotheses which developed initially from the literature, and served as a basis for the design of the quantitative research.

The descriptive stage was useful prior to entering the collected data field to have a clear and concise picture of the current situation of cloud computing in Saudi universities. Explanatory research was conducted as it moves beyond description to identify key factors that influence the adoption of cloud computing.

1.5 The organisation of the thesis

The thesis consists of four phases: background theory, focal theory, data theory, and contribution as illustrated in Figure 1.4.

1.5.1 Background theory

In this phase, the researcher makes a comprehensive literature review of the research fields and context, evaluating other thesis contributions and identifying theoretical areas (Phillips & Pugh, 2010). As presented in Figure 1.4, this phase included the following three chapters:

Chapter 1: Data from the cloud. This chapter shows the background of the problem, research goals and objectives. It also examines the study significance. The chapter explains the research context. It provides a general idea of the Kingdom of Saudi Arabia, political context, culture context, ICT context, and finally an overview of women's education in Saudi Arabia.

Chapter 2: Literature review. As part of the literature review, this chapter begins by explaining the concept of cloud computing and its impact on organisations, including educational organisations. Then related studies are investigated, providing an extensive review of research relating to the cloud.

Moreover, the existing literature of technologies adoption is discussed in this chapter. The identification of factors influencing the adoption of cloud computing was the aim of this chapter.

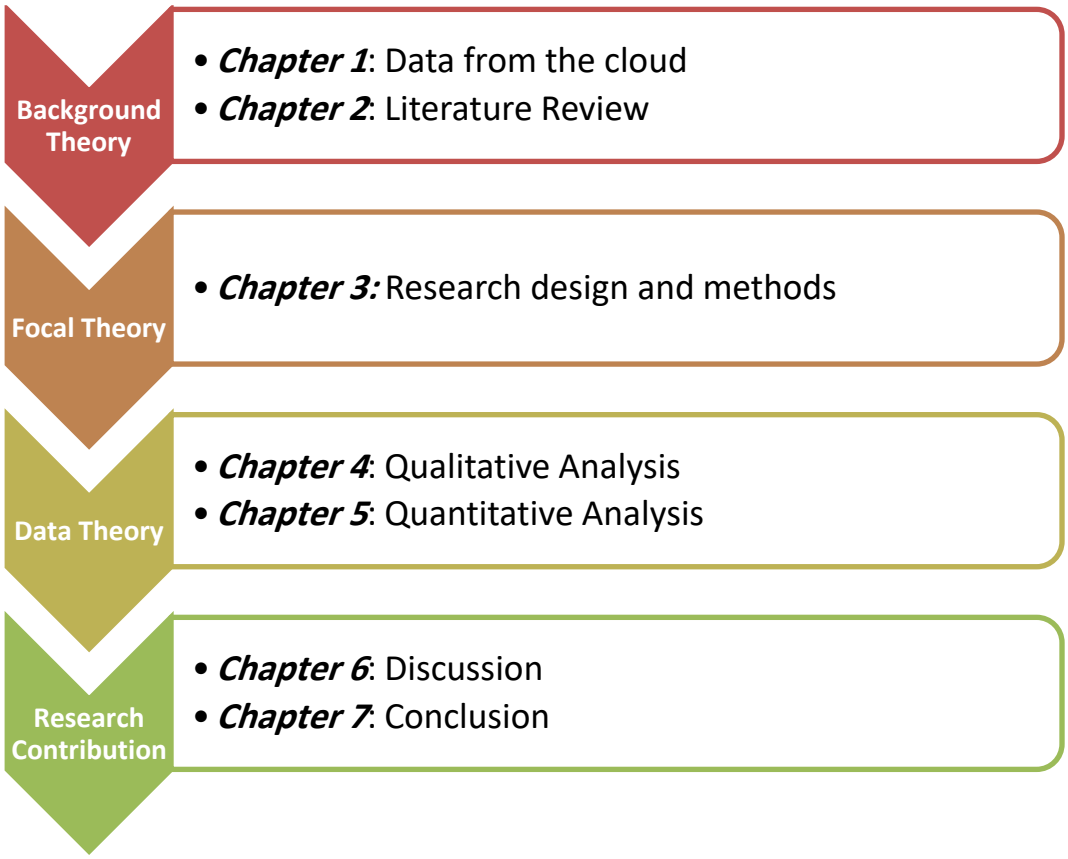

Figure 1.4 Thesis outline

1.5.2 Focal theory

In this phase the research problem was established and the hypotheses created (Phillips & Pugh, 2010).

Chapter 3: Research design and methods. The conceptual model that embraces TOE framework and Hofstede theory was developed in this chapter. This model is to be a comprehensive model for understanding and integrating cloud computing in Saudi universities. The research methodology used for this research is clarified in this chapter. The research design process is outlined, and all the data collection methods (qualitative and quantitative analysis) and analytical procedures and techniques selected are justified and described.

1.5.3 Data theory

In this phase, the researcher justified the relevance and validity of the data. The focus in this phase is data appropriateness (Phillips & Pugh, 2010).

Chapter4: Qualitative findings. This chapter presents the analysis of the qualitative data, which was obtained using interviews. It aims to refine the proposed model and the hypotheses that were developed from the literature. Thematic analysis was used to analyse this qualitative data.

Chapter 5: Quantitative findings. Based on the cloud computing literature in Chapter 2 an initial conceptual model was developed in Chapter 4, then, built on that a survey in order to gather the needed data. This data is analysed and discussed in this chapter.

1.5.4 Research contribution

In this phase, the Research contribution of the research is explained.

Chapter 6: Discussion. The results of the data collection steps have been emphasised in this chapter. The significance of the outcomes is extensively explained, particularly with relation to the research objectives.

Chapter 7: Conclusion. The final outcomes of the study, with research implications, its limitations, and future recommendations are summarised in this chapter.

1.6 Summary

The aim of this chapter is to introduce the research background to the reader. An overview of the research environment and context of the research have been presented. The definition and background of events leading to the process and term of ‘cloud computing’ were explained, along with the associated benefits and issues. Specifically, the adoption of cloud computing in the education sector was reviewed. The logical basis for the research, particularly the aims and objectives of the research question were presented. Additionally,

the research context, describing the existing state of cloud computing in Saudi Arabia, as well as the cultural and educational norms were discussed to cast light on the research topic that will be discussed. The applied theoretical framework and research methods were examined. Furthermore, the significance of this study was discussed, and the limitations noted. Moreover, the outline of the thesis, consisting of the phases background theory, focal theory, data theory, and research contribution was presented. The application of the mentioned outline to the structure of the thesis was illustrated.

The next chapter provides a comprehensive review of cloud computing technology, nature of cloud computing in education in general and particularly in developing countries.

Chapter 2

Literature review

This chapter reviews current knowledge of cloud computing. It examines the role of cloud computing in education in general and then covers the particular relevance of cloud computing for education in Saudi Arabia as a developing country, including the unique characteristics of academic institutions, potential benefits, and the adoption barriers of cloud computing. Finally, this chapter discusses the conceptual model and hypotheses that stemmed from the literature review and forms the basis of the study.

2.1 How cloud computing works

A personal or local computer is generally loaded with only part of the resources employees could use or benefit from using, whereas the cloud provides a variety of resources to achieve any task. Commonly, the user merely requires a device that is fit to run a web browser and is capable of connecting to the cloud. The cloud acquires all the properties and data required by the user (Strickland, 2008). The following sections describe how cloud computing works in terms of cloud architecture, cloud storage and cloud services.

2.1.1 Cloud architecture

A cloud computing system can be conceptualised as consisting of two sides: the front side and the back side, which are linked by way of a network, such as the Internet (Figure 2.1). The user is at the front side, and requires a computer with an application such as a browser to connect to the cloud. The back side is the 'cloud' and it consists of all the other users that are connected to the cloud, and this consists of computers, servers, and data storage systems. On the back side, each application will usually have its own dedicated server. Then a central server is needed to administer the system, monitor and balance traffic to run the cloud optimally. In order to do this, it uses protocols and middleware. Middleware is a special kind of software that allows networked computers to communicate with each other (Strickland, 2008).

As shown in Figure 2.1, users or clients use their own PC or portable devices to connect to the cloud by the Internet. The cloud is accessed by these users as a single application, device, or document. The hardware and the operating system used in the cloud are not visible to the users (Strickland, 2008).

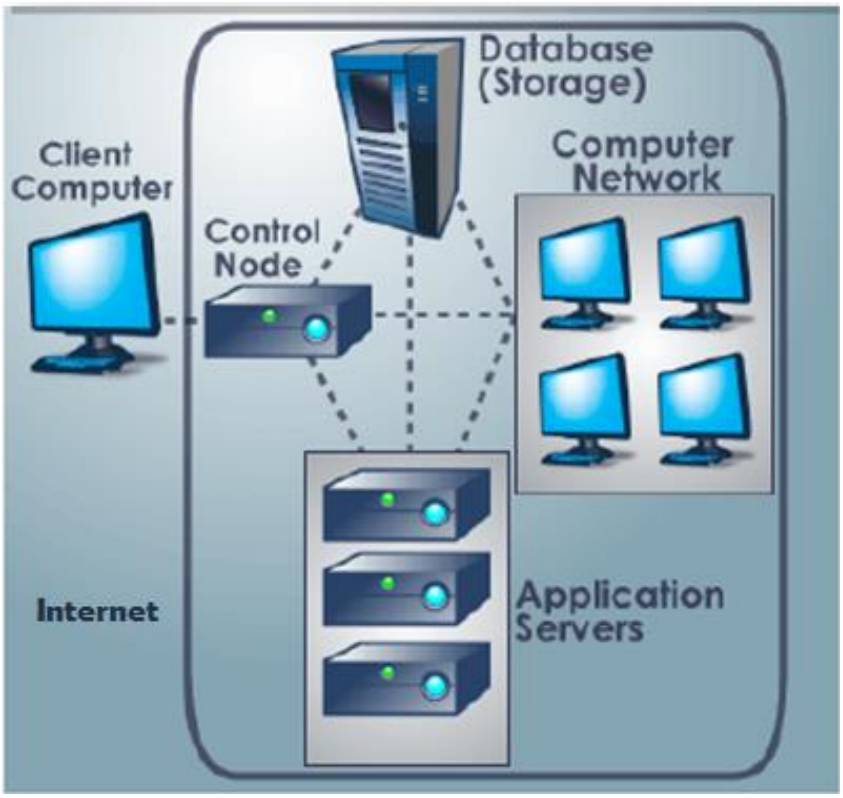

Figure 2.1 A typical cloud computing system (Strickland, 2008, p. 1)

2.1.2 Cloud storage

Data storage is a centrally important resource of cloud computing. In the past, data were usually stored on a single dedicated server, while with storage in the cloud, the data are located on a third-party server or servers. When data are stored, the user sees a virtual server. This makes it appear that the data are stored in a place with a specific name (Miller, 2009). However, the data could be stored on any of the computers used in creating the cloud. In this case, the location of the data may change over time, as the storage space is dynamically managed in the cloud. Therefore, the user sees a 'static' location for their data, but the location is virtual. Despite this, users can access and manage their data in this virtual storage space as if it were stored on their own computer, so long as they are connected to the Internet (Miller, 2009).

2.1.3 Cloud services

'Cloud service' describes any service or application offered through cloud computing. With the right middleware, the applications of cloud computing are many and varied; the user can have access to all the applications a computer can run, such as spreadsheets and web browsers, as well as customised computer programs designed for a specific company or context (Armbrust et al., 2010; Miller, 2009).

The application for a cloud service is hosted in the cloud, and then a user runs the application through the Internet using a web browser. A browser, such as Google *Chrome* or Mozilla *Firefox*, opens the application in the browser. This web-based application operates and behaves like a normal application stored on the PC.

However, the application and the working documents remain on the host's cloud servers, and not on the end user's computer (Miller, 2009).

2.1.4 Cloud computing deployment models

Cloud computing deployment models are categorised by The National Institute of Standards and Technology as shown in Figure 2.2 (Mell & Grance, 2011).

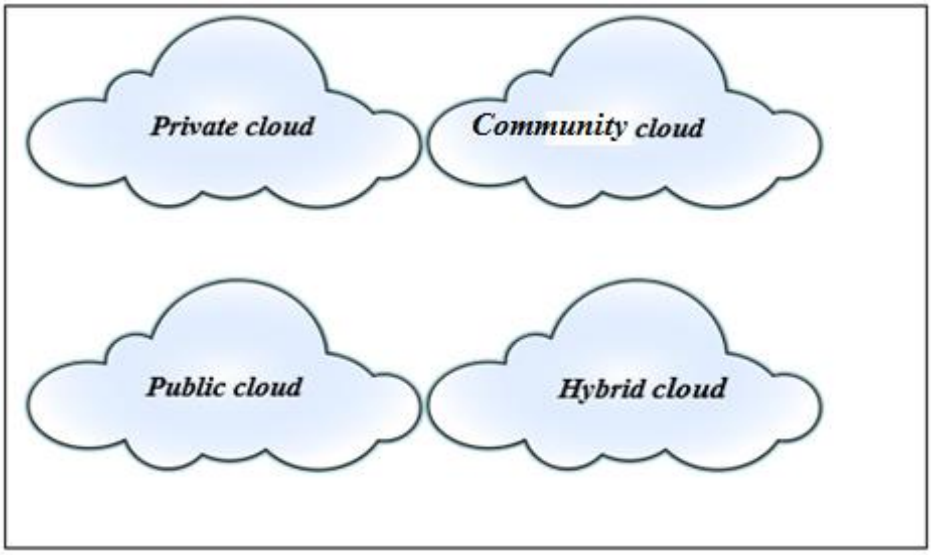

Figure 2.2 Cloud computing deployment models

Private cloud: This cloud is intended to be utilised by a single organisation acquiring a range of users, such as business units. The organisation is able to self-manage the cloud computer. Alternatively, it could be managed by a third party. The location of the cloud may be at, or away from, the organisation's premises (Mell & Grance, 2011).

Community cloud: The cloud is aimed at a particular use by a specific user's community that share common necessities with regard to security, policy and mission. Administration and ownership may be directed by a third party (Mell & Grance, 2011).

Public cloud: This is intended for public use. Its ownership and administration could be directed by a business or academic organisation, or government, or corporate administration and ownership may also happen (Mell & Grance, 2011).

Hybrid cloud: This is an integration between more than one individual entity but requires a common standard technology. This enables moving applications and data between one cloud provider and another (Mell & Grance, 2011).

2.1.5 Cloud computing service model

There are three kinds of cloud services (Leavitt, 2009; Mell & Grance, 2011):

- Infrastructure as a service (IaaS) is a complete computer infrastructure delivered through the Internet.
- A platform as a service (PaaS) is a complete or limited application development environment accessible from the cloud through the Internet, offering the facility of collaboration.
- Software as a service (SaaS) consists of a complete suite of computing applications available from the cloud for specific purposes, for example for enterprise resource management.

These services together embrace most computing services offered by cloud computing hosts, spread from hardware and software services, to complete computing environments.

2.1.6 Essential characteristics of cloud computing

Cloud computing has a wide range of characteristics that enables it to be at the forefront of computing technology. The main characteristics are as follows:

Flexibility: According to the scale and levels of demand, services may be flexibly provisioned and regulated automatically. Numerous services can be accessed at any given time for the customers (Buyya et al., 2009). In addition, computing facilities are accessible through any device that is available, such as smartphones, tablets, laptops, and desktop computers (Mell & Grance, 2011; Zhang, Cheng, & Boutaba, 2010).

Pooling of resources: To stabilise the loading among multiple consumers, the resources of the service provider are shared serving multiple tenants. Distinctive physical and virtual resources are dynamically allocated and reallocated to enhance services according to consumer demand. The location of the service provider remains anonymous to the customer, who has no knowledge of the particular location of properties like storage and memory (Mell & Grance, 2011; Zhang et al., 2010).

Cost effectiveness: One of the most important features of cloud computing is reduced costs. The flexibility and scalability of cloud computing allows cloud clients to avoid the expenditure of installing and maintaining many computing facilities (Linthicum, 2009).

User-centric: Once connected to a cloud, a user has access to data and services stored there, such as documents, images and applications. In addition, the data and services to which the client has access can be shared with others who connect to the cloud (Mell & Grance, 2011).

Powerful and dynamic: As clouds often connect hundreds and thousands of computers together, cloud computing creates computing power well beyond what can be achieved with a single desktop PC (Zhang et al., 2010).

Customisable and programmable: Automation is necessary with cloud computing to ensure access to resources. For instance, the data on one computer in the cloud needs to be duplicated on other computers to ensure the integrity of the data. This arrangement ensures that if a computer goes off-line, the data on that computer are available on another computer somewhere else in the cloud (Mell & Grance, 2011).

On the basis of the above points, it can be concluded that one of the major goals of adopting cloud computing is to cut down the infrastructure expenditure, either IT equipment or staff. Cloud computing is an affordable, flexible, reliable and highly efficient technology.

2.2 Cloud computing in education

Based on the above characteristics of cloud computing, it is clear that higher education systems can benefit from cloud capabilities, increasing internal efficiency and educational capabilities. The following sections cast light on the benefits of cloud based education, and the companies that provide cloud computing services to higher education institutions.

2.2.1 Benefitting from the cloud in the educational sector

Aljenaa, Al-Anzi, and Alshayeji (2011) and Dong et al. (2009) have identified factors that may have a positive effect on the adoption of cloud computing in educational organisations. They are discussed below.

As cloud computing can provide infrastructure as a service, it provides a diversity of advantages over traditional systems. From the outset, the centralised infrastructure of a cloud system reduces the need for task repetition on the local level at which the system is deployed, and thus decreases the resources, cost and time, needed to structure the infrastructure (Aljenaa et al., 2011). Another aspect is the limber nature of deployment. Once a cloud is running, the deployment process is swift across the organisation because of the reduced need for technical work to implement the services in individual schools or departments. Computers with minimal specifications, capable of launching a web browser, can be utilised as a web based platform for interactive learning (Aljenaa et al., 2011). Furthermore, educational institutions can benefit from the off-the-shelf SaaS, PaaS and IaaS without the burden of infrastructure set-up or maintenance (Kaur, 2015).

Another benefit of using cloud computing is that courses dispensed via cloud computing through a central location will result in standardised content delivery to numerous simulated classrooms. This can impart

synchronicity and consistency in learning and training at multiple locations, while ensuring students receive identical study material (Kaur, 2015). Pardeshi (2014) also emphasised that using cloud computing helps standardise and update the contents of the courses.

Kaur (2015) points out that with cloud technology in place, distance learning classrooms can be maintained from the vantage point of a small group of teachers which will assist to overcome the lack of qualified teachers.

Also, Kaur states that cloud computing provides course content backup which eliminates the risk of losing data in instances of system crashes. Various content types can be stored in the cloud, such as audio/video, documents, and applications. Pardeshi (2014) and Weaver (2013) mention that by using cloud computing, multiple students can work together on the same document simultaneously.

In the sphere of cloud computing, Kaur (2015) notes that software is updated automatically, providing the latest version of software. Administrative staff and educators can focus more on their institutional needs, rather than losing time on IT infrastructure and applications set-up. Thus, all the administrative activities will be performed in a speedier and more effective manner. Lakshminarayanan, Kumar, and Raju (2013) argue that using cloud computing will free IT staff from maintenance and update support.

On the basis of the above, it can be concluded that cloud computing provides solutions and improvements to higher education institutions. The use of the cloud helps to standardise and update educational contents, facilitates the collaboration between students and between the students and the teacher. Educational institutions benefit by overcoming the lack of IT staff and at the same time are freed from the burden of updating and maintaining the computer systems and applications. Moreover, by using cloud computing, system failure becomes less important because of the backup feature.

2.2.2 Cloud computing companies in higher education

Many cloud computing companies specifically seek to engage with educational institutions. Universities and schools all over the world are adopting cloud computing, either by purchasing or developing their own cloud computing resources and facilities (Sultan, 2010). This section presents some of the cloud computing services available on the market that could be utilised by higher education institutions. It will also give some specific examples of colleges and universities adopting cloud computing around the world.

Several companies propose programs for educational institutions. Examples of such programs involve Microsoft *Live@edu* (Alshwaier, 2012), newly added to Microsoft *Office 365*. *Office 365* contains *Word, Excel, PowerPoint, Outlook, OneNote, Publisher,* and *Access* (Microsoft, 2015a).

Additionally, Google offers a cloud program for educational purposes within its Google Applications for Education Suite (Google, 2016). Google is the market leader in cloud computing. Google's cloud offers high levels of security, and according to the Google Apps Terms of Service, users retain ownership of their data (Law, 2011).

The IBM Cloud Academy is a cloud computing program for the community. Other programs to suit their needs are presented to higher education institutions. These may involve teamwork and integration, infrastructure, and virtual desktop solutions (IBM; Sultan, 2010).

IBM's *SmartCloud* platform has several benefits. In particular, it enables flexibility and additional capacity for its users. IBM's platform is often the choice of large corporations due to its ability to provide services for customers with complex requirements. The platform can be built into an enterprise's existing data centre and/or offered as an additional service in an IBM Cloud Centre (Law, 2011).

Amazon Web Services introduces a program designed to support secondary and higher education students. From its own vantage point, the program offers Amazon users a new foothold in the education sector and aims to familiarise the next generation of cloud computing professionals with the tools and products of one of its fastest growing businesses (Amazon, 2011).

Myriad cloud-based applications and tools for education and cooperation are being used by higher education stakeholders (Aaron, 2012). Similar to Google Apps, other software groups like *Zoho* (Zoho, 2015), *OpenOffice* (Apache Software Foundation, 2011), and Microsoft *Office 365* (Microsoft, 2015a) are designed to meet the demands of educators. Software groups provide email facilities, document design and participation forums, along with chat facilities, virtual spaces for digital interaction, and calendars. Web-based tools such as Google *Scholar* (Google), RSS feeds, and *Zotero* are utilised to improve research and efficiency for instructors and students (Aaron, 2012).

Higher educational institutions that have adopted cloud computing as a teaching tool have realised efficiency factors. For example, efficiency was attained by Washington State University by adopting a virtualisation environment as an enabler for cloud computing. Their use of Google Apps email services enabled extensive savings at an institutional level (Sultan, 2010).

In the USA, the State University of New York (SUNY) system is involved in an contract with Microsoft to host its group of online collaboration tools through *Live@edu* (Microsoft, 2015b). In California, Westmont College embraced six cloud-centric service platforms (Sheard, 2010). The British government is constructing a cloud infrastructure for universities by investing 12 million Euros in a shared storage system, shared data management services, and data management applications. The University of Westminster, for example, saved an estimated one million Euros by adopting Google Apps (Sultan, 2010).

The use of cloud computing is becoming more widespread and its importance can be seen in colleges and universities across the USA and Europe. Cloud computing initiatives in higher education institutions are being financed by governments, allowing universities and schools to purchase cloud resources from services providers (as a third party) (Gray, 2010; InformationAge, 2011; Klug, 2014). Universities and schools are also tailoring their cloud computing environments (Bellenger, Bernhardt, & Goldstucker, 2011; Bernius & Krönung, 2012; Cappos, Beschastnikh, Krishnamurthy, & Anderson, 2009; Doelitzscher et al., 2011; Li & Toderick, 2010).

Cloud computing and e-learning are being combined in universities. Traditional e-learning systems were confined to universities and higher education institutions. Nowadays, cloud-based e-learning systems are practicable for any organisation (Laisheng & Zhengxia, 2011). An instance of cloud computing usage is building virtual computing environments and labs, especially in online education (Al-Zoube, Abou El-Seoud, & Wyne, 2010). As such, Al-Zoube et al. (2010) have suggested a cloud-based, personalised learning system built on a content management system, individual learning environment, and smart agents (Al-Zoube et al., 2010).

The use of cloud computing is not exclusive to e-learning systems or Google Docs. Libraries can also embrace cloud computing to access web hosting, web-based integrated library systems, loan systems, or repository systems, file sharing data storage, and backup (Han, 2013).

2.3 Cloud computing for education in developing countries

There is no fixed definition of what a ‘developing’ country is. The term is generally used to refer to countries – mostly in Africa and Asia – that are trying to take first steps toward putting in place features they see as desirable in countries with stronger, market economies or civil societies. Countries described as developing are often struggling with low standards of democratic government and public services, have low indexes of individual income, low gross domestic product and a poor literacy rate (Weerakkody, 2009).

The World Economic Situation and Prospects (WESP) classifies all countries into three classes based on their economies: developed economies, economies in transition and developing economies. There may be overlapping features between them. WESP classifies countries according to a number of characteristics, including whether they are net fuel importers or exporters, the per capita gross national income (GNI), human assets indices and economic vulnerability indices. Geographical location is also considered a marker of the status of a country. It is generally conceded that two common features of developing countries are a low gross domestic product and low per capita income (United Nations,2014). According to the WESP classification, Saudi Arabia is more than a developing economy, but not a developed country (United Nations, 2014).

All economic parameters show that the Kingdom of Saudi Arabia is 'developed'. However, the wealth supplied by a single commodity simply highlights the lack of diversity in the economy, and the need to broaden the economic base, which requires changes to the society, which is constrained by religious and cultural mores that enforce conformity, and the education system (Burgess, 2015).

While Saudi has many excellent schools and excellent infrastructure in places, along with a fine medical system, the modernisation of the country is very uneven, including in the educational system where pedagogic reform is lagging, although underway (Burgess, 2015)

Cloud computing is still in an early phase in Saudi Arabia due to a lack of experience, and therefore awareness, of the possibilities of ICTs (Kshetri, 2010). The international and national IT market, with the help of the country's government, has therefore paid much attention to introducing and encouraging the use of cloud computing, as they have in other developing countries. For example, IBM (the largest computer company worldwide) set up cloud computing centres in China, India, Vietnam, Brazil, and South Korea. Other big companies like DELL and Microsoft are actively trying to find and make use of opportunities in developing countries (Kshetri, 2010).

As noted in 2016 by the International Trade Administration (ITA) in the United States, a list of top 20 cloud computing export markets for the US IT industry (Table 2.1) include some developing countries which have made significant developments in their ICT sectors (ITA, 2016).

Table 2.1 Top cloud computing export markets (through 2016) (ITA, 2016)

1	Canada	11	China
2	Japan	12	France
3	United Kingdom	13	Netherlands
4	Brazil	14	Italy
5	South Korea	15	Sweden
6	Germany	16	Singapore
7	Switzerland	17	Spain
8	India	18	South Africa
9	Mexico	19	Chile
10	Australia	20	Malaysia

In developing countries, cloud activities are centred on the larger economies, such as China, India, South Africa and Vietnam (Kshetri, 2010). The biggest computing services market in Latin America is in Brazil, followed by Mexico and Chile. South Korea has a ready infrastructure and government financing, which enable the county to own one of the most stable cloud computing markets. Also in India, the government pays great attention to improvements in infrastructure and Internet access (Kshetri, 2010). China is adopting technology quickly in a rapidly expanding market. China's market features expertise, resources and commitment, which makes it appealing to the global cloud computing market (ITA, 2016).

In addition, the Gulf Arab countries are moving speedily towards cloud computing (Zeineldin, 2014). The DELL company reported that it will provide cloud service capabilities to companies in Saudi Arabia and the Middle East (Dickinson, 2015).

Table 2.2 Cloud application sectors that are being explored in developing countries (Kshetri, 2010)

Country	E-education	E-health	E-commerce	E-governance	E-environment	Tele commuting
China	X	X	X		X	
East Africa	X					
India	X	X				
Korea			X			
Qatar	X					
South Africa			X			X
Turkey	X					
Vietnam	X			X		
West Africa						

Universities in China, Turkey, and Qatar are participating in the IBM Cloud Academy. In addition, Indian universities make use of the big storage in cloud computing to develop innovative research, and Vietnamese government organisations and universities utilise the cloud in developing education applications (Kshetri, 2010).

Literature relating to cloud computing in the education sector in Saudi Arabia is scarce. Most of the cloud computing in Saudi studies are about users' acceptance, attitudes, and adoption of cloud computing in areas other than education; they are mostly in e-government and e-commerce. Table 2.3 records some of them.

Table 2.3 Cloud computing studies in Saudi Arabia

Source	Subject studied	Field
Al-Somali & Baghabra, 2016	intention to use cloud-based application	Saudi organisations
Mezghani & Ayadi, 2016	managers attitudes	Saudi firms
Yamin & Al Makrami, 2015	cloud computing applications	Saudi SMEs (small & medium sized enterprises)
Tashkandi and Al-Jabri ,2015	cloud computing adoption	Saudi higher education institutions
Alhammadi, Stanier, & Eardley, 2015	strategic decision making for cloud computing migration	
Alsanea, 2015	cloud computing adoption	Saudi government sector
B. H. Alamri and Qureshi, 2015	usability of cloud computing	Saudi higher education institutions
Alkhater et al., 2014	cloud computing adoption	Saudi enterprises
Alotaibi, 2014	cloud computing users' attitudes and intentions	
Alharbi, 2012;	users' acceptance of cloud computing	
El-Sofany, Al-Otaibi, & Alsanea, 2012	patient records exchange	Saudi hospitals
Alshwaier , 2012	cloud computing in e-learning	e-learning in Saudi
Alshuwaier, Alshwaier, and Areshey , 2012	applications of cloud computing	Saudi education
Chanchary & Islam, 2011	users' acceptance	Saudi e-government

Al-Somali and Baghabra (2016) targeted IT professionals from private and government organisations in Saudi Arabia to examine a model of cloud-based applications adoption. They found that technology accessibility, perceived vulnerabilities, individual characteristics and social image are all significant factors in cloud computing applications usage.

Mezghani and Ayadi (2016) studied factors that cause a negative attitude toward cloud computing adoption in Saudi firms. The findings showed that a focus on risk factors promoted negativity, whereas a positive understanding of the cloud, like perceived benefits, perceived ease of use and perceived usefulness, resulted in a positive approach to cloud computing.

Yamin and Al Makrami (2015) investigated the extent of using cloud computing in SMEs in Saudi Arabia. Alhammadi, Stanier, and Eardley (2015) discuss a model to support decision makers to migrate to cloud computing. Yamin and AlMakrami (2015) compared the results of their research with the results of other research in technologically developed countries in a technological context.

Alsanea (2015) and Chanchary and Islam (2011) conducted their studies in the Saudi government sector. Alsanea (2015) investigated the factors that affect cloud computing adoption in the Saudi government sector and developed a practical roadmap in order to assist government organisations to adopt cloud computing effectively. Chanchary and Islam (2011) discussed the current e-government system in Saudi Arabia and proposed a cloud based model with a rational inference agent that is anticipated to be more user-friendly. El-Sofany, Al-Otaibi, and Alsanea (2012) researched in Saudi hospitals and developed a conceptual framework for patient records exchanges between hospitals throughout Saudi Arabia.

Tashkandi and Al-Jabri (2015) investigated the factors that affect cloud computing adoption in Saudi universities. The findings showed that relative advantage, complexity, and data privacy are the most significant factors influencing the uptake and use of cloud computing.

Alamri and Qureshi (2015) attempted to understand the reasons and the needs behind adopting cloud computing in higher education in Saudi Arabia and discover the barriers to the learning process. The findings indicated that improvement in higher education is highly supported by professionals working in industry and academia.

Alshwaier (2012) examined how cloud computing can benefit e-learning education in Saudi Arabia in terms of cost, efficiency, reliability, flexibility and security; while Alshuwaier, Alshwaier, and Areshey (2012) analysed cloud computing applications, clarified some educational and research products and evaluated the successful application of cloud computing models at educational institutions.

According to the previously discussed benefits of cloud computing in the education sector, it is found that cloud computing provides potential benefits for education in developing countries. The next sections will further explain how cloud computing has come to be considered the ideal solution in some situations in developing countries, highlight some characteristics of academic institutions, and finally clarify some obstacles to the adoption of cloud computing in developing countries.

The implementation of cloud computing promises to provide flexible, on demand computational resources and applications by providing consumers with timely access to resources and services, with reasonable expenditure, ensured SLA (Service Level Agreement) and abridged entry effort (Armbrust et al., 2010; Creeger, 2009; Ograph & Morgens, 2008). With research and academic institutions in developing countries lacking cloud computing resources, services located in developed nations are financially attractive and developmentally advantageous. Cloud computing may be a viable resource and solution for particular educational institutions in various computing situations.

A large number of opportunities have emerged from the usage of cloud computing within developing countries looking to participate in global markets without the traditional infrastructure available to expedite trade (Laverty, 2011). The use of cloud facilities mitigates the cost concerns that particularly affect research and educational institutions in some developing countries, including larger institutions. Truong, Pham, Thoai, and Dustdar (2012) explained how cloud computing offerings could thus viably resolve issues for certain situations in educational institutions, especially:

- *research and educational institutions with unsatisfactory computing resources in some developing countries.* It is worth mentioning that this is not the situation in all developing countries; countries like China have access to the TOP500 supercomputers (TOP500, 2016).
- *high workload teaching academics, because teaching is often considered one of the most important obligations at the academic institutions in developing countries.* Teaching loads are substantial, and accompanied by considerable workloads for production and dissemination of learning resources by the same key staff. Thus, it is readily evident that there is a strong need for on-demand resources to support teaching activities (Truong et al., 2012).
- *groups with a small number of members with very limited budgetary resourcing.* Limitations to IT management sustainability are widely due to finance and resourcing issues (Truong et al., 2012).
- *women restricted by a culture* which makes it difficult to access higher education or hampered by an early marriage or transportation difficulties benefit from the access to information and communication offered by the cloud (Al Alhareth et al. (2013).

2.3.1 Characteristics of academic institutions in developing countries

Distinguishing characteristics exist within research and teaching activities. For example, IT hardware and educational software applications in the universities of developing countries are used only during the teaching semester, and not on a 24/7 basis. This differs from ‘regular’ usage, for which the primary function is email and storage (Truong et al., 2012). Cloud computing could supply all of these services on an as required basis, avoiding expensive downtime of real systems, as well as their purchase and maintenance. Furthermore, according to the literature, higher education institutions in developing countries are most often teaching-oriented rather than research-centred, requiring less investment in specialist IT equipment (Mundial, 2000; Rena, 2010; Truong et al., 2012).

In developing countries, highly trained and skilled workforces are produced at the university level. In general, teaching is assumed to be the principal activity in most universities. Small numbers of research-oriented universities or specialised research institutions do exist, but are rare when compared to teaching-

oriented universities. With regard to teaching, computing facilities are needed for student laboratory and library systems (Truong et al., 2012). Computing resources for teaching are frequently controlled by financial limitations, and characterised by the following properties (Truong et al., 2012) :

- There is a very high ratio of students to resources due to financial and expertise constraints, compared to the population; the number of universities is usually small. This can be seen in China and Vietnam. Resources shared by students, such as computer laboratories for practical courses, are often very limited.
- Commonly, student laboratory hours' conflict with classes. Access to laboratory facilities is frequently quite limited.
- In developing countries, academic institutions require IT resources at specific, intensely busy periods. The institutions, however, know in advance the extent of the required resourcing. Furthermore, due to high student numbers, these institutions would like to minimise reliance on in-house computing laboratories in order to manage their expenditure, whilst increasing access to the services.

Cloud computing may resolve issues of access and budgetary restraint experienced by research and educational institutions.

2.3.2 Potential benefits of cloud computing in developing countries

Greengard (2010) has posited several benefits resulting from cloud computing in developing countries. These benefits include ease of access to affordable computing infrastructure, augmentation of collaborative efforts, and the ability to approach the up-to-date hardware and software. The following table summarises the means by which cloud service models can be engaged in teaching.

Table 2.4 Engaging cloud service models in teaching, adapted from (Truong et al., 2012)

Cloud service model	Support for teaching activities
Software as a Service (SaaS)	Student use of standardised applications for labs. For instance, Google Documents can aid students in practical activities or spreadsheet processes Institutions could concurrently start educational software to decrease investment expenditure and to improve teamwork activities for the purpose of teaching.
Platform as a Service (PaaS)	Mainly beneficial for students who could employ PaaS for learning programming tools and environment. For instance, students could practice web programming by using Google App Engine to practicing web programming Students in economic and computational field could utilise PaaS (such as MathLab and R platform) to customize their implementing and analysis tools.
Infrastructure as a Service (IaaS)	Supply as requested machines for computer labs and personal use. Students can obtain customised virtual machines that might contain operating systems, laboratory exercises, and collaboration kits for their course work. From a university's perception, for processes that need heaps of machines within a limited period, such as parallel processing, IaaS could be utilised to reduce financial cost, and minimise logistical burdens.
Data-as-a-Service (DaaS)	DaaS can by facilitate teaching activities in terms of storage and providing teaching materials like course slides, content and exam papers.

2.4 Existing theories on technology adoption

It is easy to suggest that developing nations adopt cloud computing for educational enhancement or administrative efficiency. However, realistically, the adoption of new technologies is rarely a linear or quick process, as experience in developed nations has proved. This research assessed the main theories related to the adoption of new technologies in order to describe those most likely to affect Saudi Arabian educational institutions and individual students.

2.4.1 Adoption of technology at the individual level

Oliveira and Martins (2010) have noted that many theories surrounding technology adoption focus on the individual rather than the organisational level. Theories at the individual level encompass the implementation of technology for the formulation of a conceptual model. Within such a model, one will find the adoption of technology is impacted by beliefs, attitudes, and intentions. A variety of well-known theories exist for individual adoption including the:

- **Theory of reasoned action** (TRA) (Fishbein & Ajzen, 1975)

  At the individual level, the theory of reasoned action (TRA) enables the exploration of the connection between attitude and behaviour in technology adoption (Fishbein & Ajzen, 1975). However, the TRA is inadequate in its appreciation of the importance of specific behaviours that may be influenced by social factors.

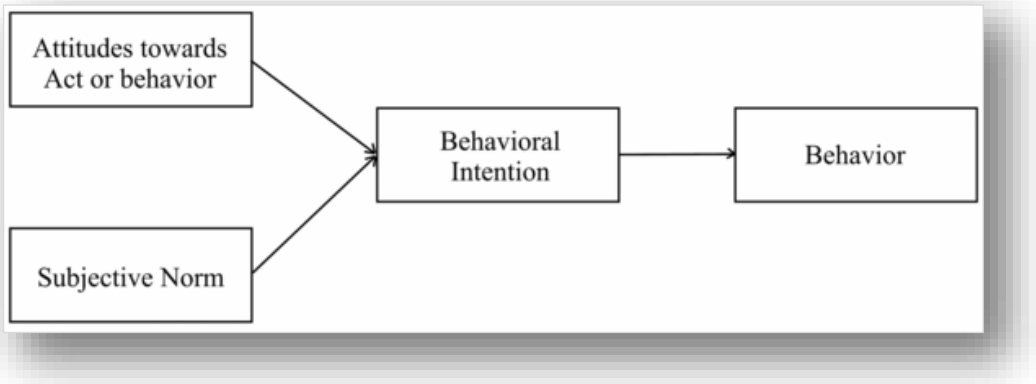

Figure 2.3 Theory of reasoned action (TRA) (Fishbein & Ajzen, 1975)

- **Theory of planned behaviour (TPB)** (Ajzen, 1991)

  Because the TRA failed to consider the social factors which influence an individual's behaviour, in 1991 Ajzen recommended an additional factor be included in a theory of technology adoption. The additional factor, referred to as *perceived behaviour control* resulted in a new theory called *the theory of planned behaviour* (TPB).

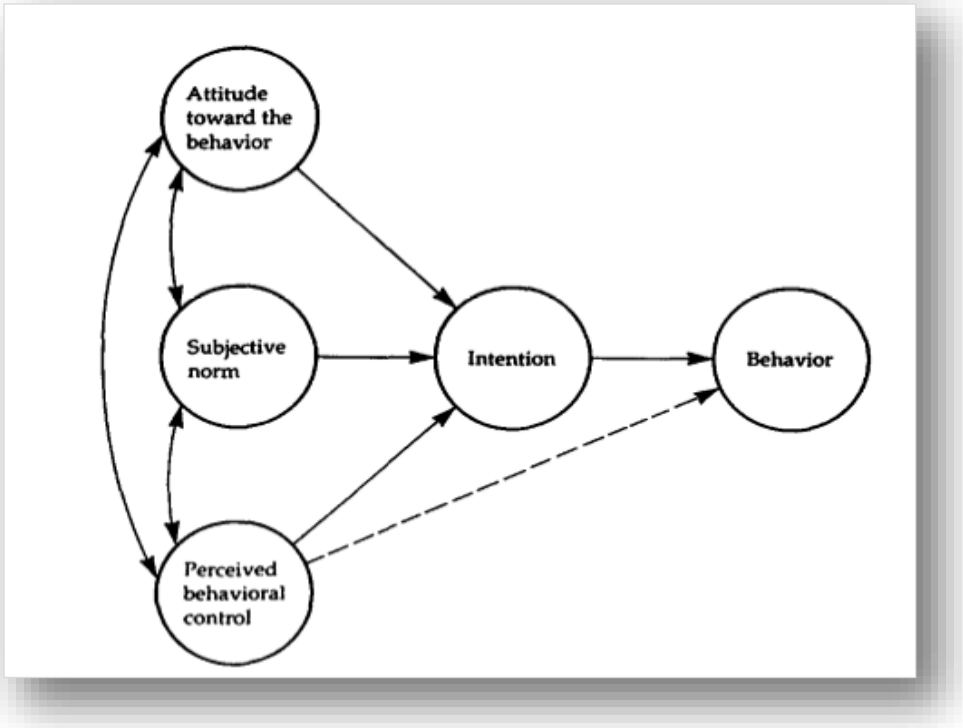

Figure 2.4 Theory of planned behaviour (TPB) (Ajzen, 1991)

- **Technology acceptance model (TAM)** (Davis, 1989)

  Drawing on the TRA as a model describing an individual's adoption of technology, Davis introduced a technology acceptance model (TAM) in 1989. The TAM consists of two factors that are critical in the adoption of technology by individuals – perceived usefulness and ease of use. *Perceived usefulness* denotes the degree to which the individual believes the technology will

enhance their job performance (Davis, 1989), while *perceived ease of use* describes how difficult or easy to use the individual feels the technology will be. In addition, Davis (1989) pointed out that the adoption of the technology would also be influenced by system characteristics, development processes and training (Davis, 1989), all of which are related to ease of use.

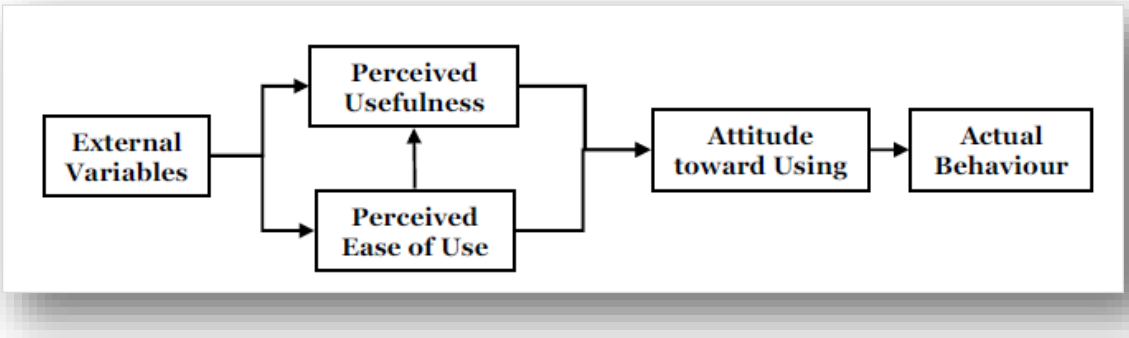

Figure 2.5 Technology acceptance model (TAM) (Davis, 1993)

- **Unified theory of acceptance and use of technology (UTAUT)** (Venkatesh, Morris, Davis, & Davis, 2003)

  UTAUT is a unified model bringing together eight main theories of individual technology adoption. It consists of four constructs:

  1) performance expectancy

  2) effort expectancy

  3) social influence

  4) facilitating conditions.

  The first construct corresponds to the perceived usefulness in TAM. UTAUT also brings in moderator factors such as gender, age, experience, and voluntariness of use.

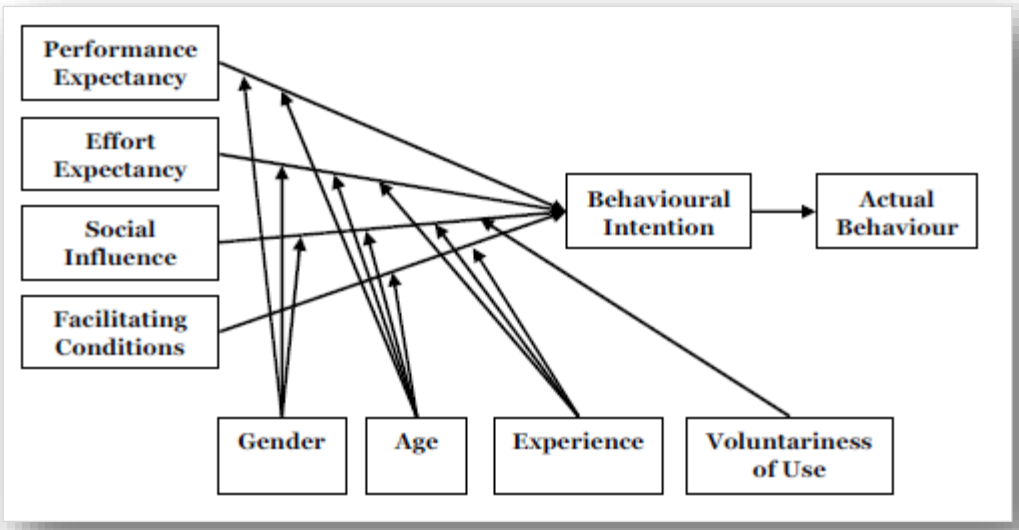

Figure 2.6 Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003)

2.4.2 Adoption of technology at the organisational level

In adopting IT, the previous theories related to the individual, largely disregarding the role of organisational and environmental features, and are inadequate for investigating the adoption of technology at the organisational level for two reasons:

- irregularities in reporting determinants for the adoption of technology (Darmawan, 2001)
- inadequate predictive capacity required to quantify the adoption of technology in organisations (Duan, 2012; Venkatesh, Morris, Davis, & Davis, 2003).

Duan (2012) has observed that organisational level theories share a common approach to investigating technology adoption in two ways:

- checking the exact phases in the adoption of technology (Rogers, 2010)
- suggesting various factor classes for predicting technology adoption (Sabherwal, Jeyaraj, & Chowa, 2006).

The prominent theories of adoption of technology at the organisational level include:

- **Diffusion of innovation (DOI)** (Rogers Everett, 1995)
  Rogers suggested the *diffusion of innovations* theory (DOI), encompassing five factors: relative advantage, compatibility, trialability, observability, and complexity. These factors provide the lens for examining the proposed innovation and aid in resolving whether to adopt IT (Kendall et al., 2001; Rogers Everett, 1995). Using Roger's model, Bradford and Florin (2003) stated that technical compatibility, technical complexity, and relative advantage were the three main factors which may influence the adoption of IT.
- **Resource-based theory (RBT)** (Barney, 1986); the Institutional Theory (IT) (Selznick, 1948)
  Fichman (1992) and Chen, Huang, and Lu (2005) have suggested that DOI lacks the ability to make predictions related to the adoption of complex systems because it focusses predominantly on technological influence, while prerequisites for the adoption and implementation of IT are organisational, technological, and environmental (Chen et al., 2005; Hamad, 2014). Lee and Cheung (2004) rejected DOI also primarily due to the overemphasis on technological characteristics when investigating technology adoption.
- **Technology-organisation-environment framework (TOE)** (Tornatzky & Fleischer, 1990).
  It was Tornatzky and Fleischer, as early as 1990, who proposed a theoretical framework consisting of three elements (organisation, technology, and environment), arguing that these features were the most influential in the adoption of IT. The next section discusses this theory.

2.4.3 Technology-organisation-environment framework (TOE)

The technological component of the framework consists of internal and external technologies pertinent to the organisation. These may be existing technologies and/or the technology to be implemented. This implementation process is affected by the context surrounding the technological features (Chau & Tam, 1997; Tornatzky & Fleischer, 1990).

The context of the organisation consists of the organisational features that may obstruct or encourage the adoption process. Examples of these features include the organisation's size and structure, support at the level of management, and the human resource attributes (Yoon, 2009). Organisations with supporting regulations and skilled human resources are more equipped to successfully adopt technology. Well-trained top managers are the most qualified to overcome obstacles to the adoption of technology within an organisation.

In addition, the size of the organisation affects the likelihood of the adoption of technology, with larger organisations more likely to have the necessary financial resources. Smaller organisations, however, are more flexible and can adopt faster (Troshani, Rampersad, & Plewa, 2011).

The organisational environment also consists of the organisation's commerce, competitors, and governmental policy or intention (Low, Chen, & Wu, 2011). These factors can either promote or impede the uptake of technology. In addition, strong competition inspires organisations to pursue aggressive technological policies and can motivate the rapid spread of new technology across firms (Kuan & Chau, 2001).

A selection of empirical studies have used the TOE framework in investigating the adoption of a multitude of technologies (see Table 2.5). Table 3.1 is based on Duan (2012) and expanded by the researcher. Iacovou, Benbasat, and Dexter (1995) utilised the TOE framework to uncover factors affecting small and medium companies' implementation of electronic data exchange (EDI). In the adoption of this technology, significant factors that were found by these researchers included external pressures, perceived benefits, and organisational readiness.

Melville, Kraemer, and Gurbaxani (2004) embraced the TOE framework in order to compare the technology adoption patterns of electronic business organisations in developed and developing countries, which led to the identification of critical determinants for engaging in electronic business, as well as the identification of factors, such as technological competency, size, level of consumer readiness, and competitive pressures.

Table 2.5 The TOE framework in technology adoption

Innovation	Study	Technology	Organisation	Environment
EDI	(Premkumar & Ramamurthy, 1995)	Internal need	Top management support	Competitive pressure Exercised Power
Open System Adoption	(Chau & Tam, 1997)	Perceived benefits Perceived barriers Perceived importance of compliance	Satisfaction with existing systems Formalisation on system development and management Complexity of IT infrastructure	Market uncertainty
IT Adoption	(Premkumar & Roberts, 1999)	Relative advantage Complexity Compatibility, and cost	Top management support Size IT expertise	Competitive pressure External support Vertical linkages
EDI	(Kuan & Chau, 2001)	Perceived direct benefits	Perceived financial cost Perceived technical competence	Perceived industry pressure Perceived government pressure
Internet Adoption	(Mehrtens et al., 2001)	Perceived benefits	Organisational readiness	External pressure
E-Business	(Cata, 2003)	Network Systems Infrastructure Compatibility Website security.	Culture Resistance toward IT applications IT skills	Competitive pressure Customer pressure Government regulation
E-commerce	(Premkumar, 2003)	Relative advantage Compatibility Complexity Cost	Top management support Size IT expertise	Competitive pressure External support Vertical linkages
E-market	(Joo & Kim, 2004)	Relative advantage	Slack resources Size	External pressure Buying power
B2B E-Commerce	(Chen et al., 2005)	Perceived benefits Perceived barriers Perceived importance of standard compliance	Scope Organisational culture	government regulatory, competence intensity
Web Adoption	(Lippert & Govindarajulu, 2006)	Security concerns Reliability Deployability	Firm size Firm scope Technological knowledge Perceived benefits	Competitive pressure Regulatory influence Dependent partner readiness Trust in web service provider

Innovation	Study	Technology	Organisation	Environment
Web Services	(Hackney, Xu, & Ranchhod, 2006)	Perceived benefits Perceived barriers Perceived importance of Compliance to IS unification	Complexity Need to evolve existing IS Unification on systems development and Management	External pressure
E-Government	(Altameem, 2007)	IT Infrastructure IT standard National information infrastructure Collaboration Security Relative advantage	Management Training Implementation Quality Organisational culture Technical staff Policy and legal issues Reward system BPR Organisational structure and awareness	Top management support Leadership Citizen-centric Funding
ERP	(Pan & Jang, 2008)	IT infrastructure Technology readiness	Size Perceived barriers	Production and operations improvement Enhancement of products and services Competitive pressure Regulatory policy
Virtual Worlds	(Yoon, 2009)	Relative advantage Compatibility Security Concerns	Top management support Organisation size Organisational readiness	Competitors pressure Customers pressure Intensity of competition Normative pressures
E-Commerce	(Jia, 2009)	Relative advantage Compatibility Complexity	Organisational readiness Leadership Core business activity Information intensity Innovation champion	Competitive pressure Business partner pressure Internationalisation Government Support from technology vendors
E-Procurement	(Teo, Lin, & Lai, 2009)	Perceived direct benefits Perceived indirect benefits Perceived costs	Organisation size Top management support Information sharing culture	Business partner influence
E-Procurement	(Hassan, Tretiakov, & Whiddett, 2010)	Relative advantage Compatibility Complexity	Top management support Employee IS knowledge	Competition intensity Partner readiness External pressure

Innovation	Study	Technology	Organisation	Environment
E-Commerce	(Ghobakhloo et al., 2011)	Perceived relative advantage Perceived compatibility Cost	Information intensity CEO's IS knowledge CEO's innovativeness Business size	Competition Buyer/Supplier pressure Support from technology vendors
Cloud Computing	(Low et al., 2011)	Relative advantage Complexity Compatibility	Top management support Firm size Technology readiness	Competitive pressure Trading partner pressure
E-Market	(Duan, 2012)	Perceived direct benefit Perceived indirect benefit	Firm size Organisation readiness Top management support	External pressure
Cloud Computing	(Espadanal & Oliveira, 2012)	Technological readiness	Top management support Firm size	Competitive pressure Regulatory support
B2B E-Commerce	(Sila, 2013)	Cost Complexity Network reliability Data security Scalability	Top management support Firm size Firm type Management level Trust	Pressure from trading partners Pressure from competitors
Cloud Computing	(Borgman et al., 2013)	Relative advantage Complexity Compatibility	Firm size Top management support IT expertise of business users	Competition intensity Regulatory environment

Additionally, examining the factors that impact the adoption of the RosettaNet standards for the sharing of business information (B2B), Yee-Loong Chong and Ooi (2008) used the TOE model. Teo et al. (2009) investigated a variety of factors associated with the adoption of e-procurement in Singapore by using the TOE framework. The study led to the identification of factors such as organisation size, senior management support, perceived benefits, and the influence of business partners as the leading reasons for the adoption of e-procurement.

In 2009, Dwivedi, Papazafeiropoulo, Ramdani, Kawalek, and Lorenzo (2009) adopted the TOE framework in order to examine adoption by UK SMEs of enterprise systems. To demonstrate the influence of information and communication technology (ICT) on the TOE framework, Srivastava and Teo (2010) advocated for policy makers' involvement in the development of e-government and e-business collectively. The TOE framework was also found suitable for scrutinising the adoption of e-commerce by manufacturing SMEs (Ghobakhloo et al., 2011).

TOE was later used in the development of a model for studying critical factors for Australian SMEs moving into the e-market (Duan, 2012). Furthermore, Nkhoma, Dang, and De Souza-Daw (2013) found that TOE can encapsulate cloud computing adoption factors into a single big picture. Nkhoma, Dang, and De Souza-Daw (2013) incorporated these factors as drivers (perceived benefits) and barriers (perceived technological barriers and perceived environmental barriers) to cloud adoption.

Troshani et al. (2011) have also explored organisational adoption of technology through TOE in a cloud computing context in the higher education sector (Troshani, Rampersad, & Wickramasinghe, 2013; Troshani et al., 2011). However, this study was based in Australia, a developed country, rather than a developing country, and did not incorporate the role of national culture. Similarly, Sharif, Davidson, and Troshani (2013) examined the adoption of e-government systems using the TOE framework, but once again it was in a developed country rather than a developing one.

A study from the USA uncovered that relative advantages, compatibility and top management support are the most significant factors influencing the managers' interests in cloud computing adoption., The institution size was not that significant (Tweel, 2012).

2.4.4 Technology adoption in developing countries

The Middle East is a region consisting of many individual nations, most of which are considered to be 'developing countries'. Consumers in these countries are typically perceived to be late adopters of new technology, and research results relating to technology diffusion do correlate with other developing countries (Al-Sukkar, 2005).

Technology adoption has been explored to a limited degree in developing countries, particularly in relation to cloud computing in the tertiary education sector. Existing studies have examined technology adoption in developing countries in non-education contexts such as e-government. For instance, Susanto and Goodwin (2010) applied TAM to the context of e-government adoption in Indonesia, and other authors have examined e-services adoption in Saudi Arabia, also at the individual level using TAM (Aldraehim, 2013; Aldraehim et al. 2013; 2012a; 2012b; Aldraehim, Edwards & Watson, 2012).

In addition, Alzharani (2015) examined UTAUT in an e-government context in Saudi Arabia, and also incorporated national factors such as national culture, privacy and trust (Alzahrani & Goodwin, 2012; Alzharani, 2015). Alharbi (2012) found high levels of user acceptance of cloud computing in Saudi Arabia. The research used TAM as a base. Another study proposed a revised unified theory of acceptance and use of technology (UTAUT) for cloud computing acceptance taking into account trust as a main construct in the model (Alharbi, 2014).

While these studies were useful in investigating technology adoption in developing countries from an individual perspective using TAM and UTAUT, they did not examine technology adoption at the organisational level using TOE frameworks, nor were they conducted in relation to higher education contexts. Other authors have explored the organisational perspective in developing countries, but they focussed on e-government and e-readiness at the organisational level rather than technology adoption *per se* at the organisational level using TOE (Alghamdi et al. (2011a; 2011b; 2013; 2014). Moreover, another study conducted by Chang et al. (2013) discussed the factors affecting the adoption of cloud computing. Chang's study used the TOE framework and DOI theory. Similarly, Alkhater et al. (2014) proposed a model that combines some aspects of the TOE with critical factors of other theories to inspect their impact on the organisation's intention to adopt cloud computing in Saudi Arabia.

In addition, Rosli et al. (2012) investigated the technological, organisational and environmental (TOE) influence on the adoption of audit technology among Malaysian audit firms, and Low et al. (2011) proposed a model based on the TOE framework to identify the impact of these factors on the decision to adopt cloud

computing in higher education in Taiwan (Low et al., 2011). Tashkandi and Al-Jabri (2015) analysed the factors that affect cloud computing adoption by higher education institutions in Saudi based on the TOE, but they did not include cultural factors.

This present study is therefore important because it investigated the adoption of technology at the organisational level with reference to cloud computing systems in the higher education sector in developing countries by incorporating the TOE theory and the role of national culture.

2.4.5 The influence of national culture

Independent variables that are critical in the prediction of success or failure of technological acceptance are cultural beliefs (Straub, Loch, & Hill, 2003). This has much to do with the specific uses and applications of a new technology within the social and cultural milieu. Technology and culture depend on one another. The former regulates the latter and is a defining factor in the systems of interaction in any society (Straub et al., 2003).

Due to an inability to operationally define national culture, there is difficulty in building a consensus on the role of national culture within the context of technology adoption, however (Davison, & Martinsons, 2003). Roseman, Dhawan, Rettek, Naidu, and Thapa (1995) describe culture as a way of life of a people; while Hofstede, Hofstede, and Minkov (1991, p. 5) define national culture as 'the collective programming of the mind which distinguishes the members in one human group from another'. Chang, Wang, and Wang (2001) emphasise the fact that there are a multitude of determinant factors for culture: language, religion, social structure, education, and political and economic philosophies.

In a multitude of studies, culture and information technology have proved to be connected. There does, however, remain a gap in the literature as to how national culture impacts the use of ICT (Seng et al., 2010), although considerable research has examined the relationships between adoption of IT and national and organisational culture (Al-Gahtani et al., 2007; Bagchi, Hart, & Peterson, 2004; Hill, Loch, Straub, & El-Sheshai, 1998; Ives & Jarvenpaa, 1991; Johns, Smith, & Norman, 2002; Shore & Venkatachalam, 1996; Straub, 1994; Straub, Keil, & Brenner, 1997; Veiga, Floyd, & Dechant, 2001). These studies highlight the significance of culture and its linkage to attributes of IT adoption and use.

Veiga et al. (2001) studied the influence of national culture on TAM variables using the perspective of IT implementation and acceptance. In a similar study, Twati (2006) investigated the impact of national and organisational culture on MIS adoption within Arab nations. The position of national culture in relation to citizens' adoption of e-government services by combining TAM with the Hofstede national dimensions was also studied by Alhujran (2009).

Tricker (1988) postulated a superb framework connecting information systems and culture utilising Hofstede's work. Hasan and Ditsa (1999) contrasted West Africa, the Middle East, and Australia according to Hofstede and Hall's dimensions, and concluded that most information technology production and enterprise imply cultures with low power distance, low avoidance of ambiguity and strong enduring orientation. Two models have been widely used in the business world: Hofstede's dimensions (1988; 1991) and Hall's perception of time and high-context/low-context models (1983).

Dasgupta, Agarwal, Ioannidis, and Gopalakrishnan (1999) determined that organisational and environmental factors exert important influence on information technology adoption decisions, while Edberg, Grupe, and Kuechler (2001) identified five outstanding issues applicable to global information system management. These include language, culture and geography, systems development and support, legal regulations and enforcement, and existing level of technology. Notably, Japanese culture remains unable to accept computer technologies; the dynamics of decision-making could explain the predilection for fax over email usage by the Japanese.

Straub et al. (2003) investigated the influence of culture on the interpretation of IT within Arab nations. A cultural impact model of information technology transfer (ITT) was developed to deduce the effect of culture, cost appeal, senior management support, and required staff time. Interviews and surveys in Jordan, Egypt, Saudi Arabia, Lebanon and the Sudan determined that Arab cultural values preclude the ready acceptance of systems and of IT (Al-Sukkar, 2005).

Although culture is being contemplated as a contributing factor to IT adoption, research to explore the impact of the national culture on IT adoption in Arab regions is sparse. While Aldraehim et al. (2013; 2012a; 2012b) and Alzharani (2015) examined the interplay between technology adoption and national culture in Arab regions, their work focused on the individual level utilising theories like TAM and UTAUT, rather than the organisational level in general and in particular in a tertiary education context.

Research is therefore lacking on the influence of culture on cloud computing adoption in Saudi Arabia. The need to examine the role of the national culture as one of the facets that influences the adoption of cloud computing in Arab nations such as Saudi Arabia remains clear. Hofstede's definition of a cultural dimension model, being widely recognised and accepted, has been chosen in this research as a theoretical framework to assess the significance of national culture on cloud computing adoption in Saudi Arabia.

2.5 Barriers to the adoption of cloud computing in developing countries

There are many logistical barriers to cloud computing adoption in developing countries that can be discussed together, namely: lack of connectivity, inadequate bandwidth, and unstable power supplies (Greengard, 2010). Jelonek and Wysłocka (2014) also added that the most critical barriers to the adoption of cloud computing in developing countries are: trust, security, portability, and the local language. Al Alhareth et al. (2013) tied the adoption of any new technology in Saudi with cultural beliefs since the society on the whole considers the adoption of any technology through the prism of beliefs and religious values, which it seeks to protect.

There exist several other adoption barriers for previously mentioned groups that are very specific to developing countries:

- **Cost.** Cost-benefit analysis from existing clouds indicates high financial costs for research and educational categories in developing countries, relative to their income. These costs will need to be reduced in these contexts to enable access to cloud computing (Greengard, 2010).
- **Service and infrastructure readiness.** Cloud computing infrastructure is not installed locally in developing countries. Many impacts on technical issues such as performance can be enhanced, while data compliance concerns can be simplified (Greengard, 2010).
- **Cloud computing expertise.** Research and educational categories in developing countries lack computational resources as well as cloud computing expertise. The usage of cloud computing is intended to reduce administrative load from non-IT staff, yet expertise in cloud computing is required. For example, there is a comprehensive deficiency of qualified IT experts, training programs and well trained eLearning academics in the region of North Africa (Greengard, 2010).
- **Information security concerns and compliance.** In accordance with other consumers of cloud computing, research and educational professionals in developing countries express various security concerns related to implementing cloud computing. Instances of collective, generally articulated security trepidations are data protection, user lock-in, and deficiency in control. (Chow et al., 2009; Kaufman, 2009; Truong et al., 2012).
  - With regard to security apprehensions and compliances, in developed countries cloud technologies are supported by law and regulations, but developing countries offer fewer legal restrictions and guidelines. This is a serious concern in any business in developing countries. Additionally, staff in public institutions must guarantee that the feature of paying according to usage follows government guidelines in relations to guarantee, liability, and insurance. These issues relate to cloud services as well.

- Weber (2011) posited that a specific apprehension regarding the reliability of data storage has emerged in the Arabian Gulf countries in the United Arab Emirates (UAE) and Saudi Arabia. Several countries own legislation governing data storage on computer servers beyond national borders or jurisdiction. For example, the US *Patriot Act* (an Act of Congress that was signed into law by President George W. Bush on October 26, 2001) forces companies in the USA to deliver data to the government without carefully inspected warrant procedure (Carlin & Curran, 2013), and many international firms are consequently worried about keeping critical data on USA-based cloud computer servers.
- Procedures were taken lately in India, United Arab Emirates, and Saudi Arabia to block the RIM (Research in Motion) blackberry devices or to trace Blackberry servers so national governments can observe messages. This was mainly due to Blackberry's advanced method of encryption which permits for protected communication of information unreachable to forces of security. Educational organisations in the Middle East could face issues in utilising cloud services because of government security concerns (Weber, 2011).

- **Reliability.** Reliability will remain a pronounced trepidation for Middle Eastern students and school that apply cloud computing. Extensive service providers in the USA and Europe could possibly be reluctant to dedicate sufficient resources as technical support and error fixes to the minor markets within the Middle East. Present Internet infrastructure in the Arabian Gulf and Egypt is exceptionally volatile, as an excessive amount of international traffic in the area is supported by a limited amount of undersea cables.

  (Weber, 2011).

  In 2008, the South-East Asia-Middle East-West Europe 4 (SEA-ME-WE 4) cable was disconnected thus instigating Internet failure in Egypt, India and the Persian Gulf. Due to a shortage of local data centres in the developing countries, 'providers such as Amazon, Google, IBM, Microsoft, and Sun Microsystems have started to launch more data centres to host cloud computing applications in several places globally to deliver redundancy and warrant reliability in the event of site outages (Al-Zoube et al., 2010; Weber, 2011).

2.6 Development of the conceptual model

Within the Arab world, there are a multitude of factors that can influence the successful adoption of cloud computing. A review of the literature reveals much of the extant cloud computing research has been focused on cloud adoption in developed countries. On the topic of cultural factors that influence cloud computing adoption in developing countries, however, research is limited and very little is known regarding nations like Saudi Arabia.

The number of research studies on the adoption of cloud computing at the organisational level in developing countries is limited. This study was designed to find out the impact of Saudi national culture on the uptake of cloud computing in Saudi universities.

It is important to know the theoretical perspective from which the research hypotheses and model were assembled. To select the most suitable theory as the framework for this study, various theories were considered, eventually leading to a conceptual model of the adoption of cloud computing by Saudi universities. The establishment of this cohesive model was achieved by integrating the technology-organisation-environment (TOE) framework with Hofstede's national culture dimensions.

The conceptual model provides the architecture for compiling, classifying, and de-segregating the research data to yield research findings (Johnson & Onwuegbuzie, 2004). This section discusses the conceptual model and hypotheses that stemmed from the literature review and forms the basis of the study.

The conceptual model provided the framework for data collection and analysis (Cooper, Schindler, & Sun, 2006; Ghauri & Grønhaug, 2005), and the architecture for compiling, classifying, and de-segregating the research data to yield research findings (Johnson & Onwuegbuzie, 2004). The section discusses the conceptual model and hypotheses that stemmed from the literature review and forms the basis of the study.

The constructs forming the conceptual model for the study were:

- relative advantage
- compatibility
- security concerns
- complexity
- top management support
- readiness
- competitive pressure
- regulatory support
- individualism–collectivism
- power distance
- uncertainty avoidance
- masculinity–femininity.

These factors have been established in the literature and through them technology adoption can be predicted. Figure 2.7 shows the proposed model for investigating cloud computing adoption in Saudi universities, and demonstrates the dependent and independent variables' relationships.

In order to provide a comprehensive framework for the study of cloud computing adoption in Saudi universities, two diverse components were combined to form the proposed conceptual model. The proposed framework validity was verified by analysing the collected data during fieldwork.

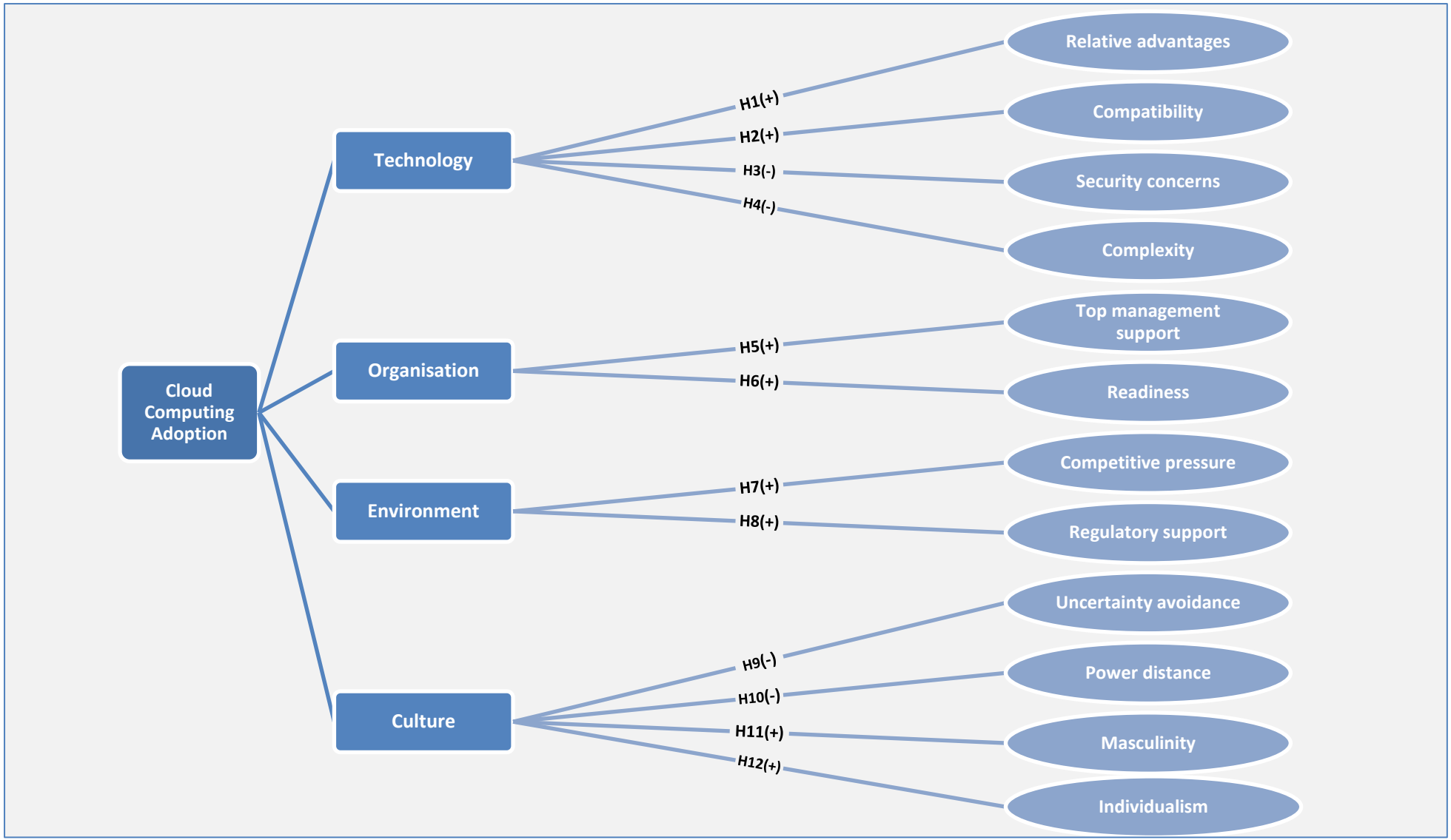

Figure 2.7 The hypothesised research model

2.7 Study hypotheses

The proposed conceptual framework combines two theories: TOE and Hofstede (Hofstede et al., 1991; Tornatzky & Fleischer, 1990). It consists of four main elements: technology, organisation, environment, and culture.

2.7.1 Technology factors

The technology factors are the properties of the technology to be implemented (Henderson, Sheetz, & Trinkle, 2012). According to Rogers (1983), there are five key features, any one of which or all may influence the adoption of cloud computing: trialability, observability, relative advantage, complexity, and compatibility. Nevertheless, Kuan and Chau (2001) discovered complexity, compatibility, and relative advantage were more important in affecting the adoption of IT. In this study, complexity, compatibility, relative advantage, and security concerns were considered to be the key elements from a technological perspective.

For organisations considering cloud computing, security is consistently considered to be a risk factor (Carroll, Van Der Merwe, & Kotze, 2011), and cannot be overlooked during preparations to adopt cloud technology.

Relative advantage. Relative advantage indicates benefits provided to a company through adopting a particular technology (Rogers, 2010). The provision of innovative, strategic, and operational effectiveness in any technological area offers clear advantages to an organisation contemplating its adoption, and provides a strong incentive in its favour (Greenhalgh, Glenn, Macfarlane, Bate, & Kyriakidou, 2004).

The researcher addressed this matter in interviews in order to isolate expected solutions from cloud computing. The responses were categorised, discarded, and reinforced by references from the literature. In this study, relative advantage denotes a decline in administration requirements, reorganised IT systems, reduced maintenance efforts, reduced software costs, and increased flexibility of computing resources.

As was found in the literature, one of the most significant cloud computing advantages is flexibility. The on-demand service characteristics of cloud computing enable users to consume computing resources such as software and storage when they are required. Thus users only buy according to their needs, and are charged only for the amount that they use (Carroll et al., 2011; Dillon, Wu, & Chang, 2010; Mahmood, 2011).

It was discovered that a major and valuable characteristic of cloud computing is its ease of accessibility. Cloud users may employ cloud services anywhere and anytime through diverse platforms (i.e. laptops, mobile phones, PDAs and personal computers) at the user's convenience (Carroll et al., 2011; Dillon et al., 2010; Yang & Chen, 2010).

One of the most appealing characteristics of cloud computing is both the initial purchasing cost and long-term usage costs. In comparison with traditional computing services, its purchasing cost offers significant advantages over rival means of computing (Fox et al., 2009). There are also major cost-saving features when using cloud computing in terms of energy, space and staffing, as the responsibility of updating applications and software belongs to the cloud provider, decreasing the overall cost (Voorsluys, Broberg, & Buyya, 2011).

Moreover, by reducing the quantity of hardware required for operation and the number of staff to maintain service, there are savings in maintenance costs (Voorsluys et al., 2011). Updates and other maintenance processes are held in the cloud, rather than locally on users' individual computers, thus ensuring simplification of regular maintenance procedures.

Based on the above, the following hypothesis was proposed:

H1: *Relative advantages of cloud computing positively influence the intention to adopt cloud computing.*

Compatibility. Rogers (2010) defines compatibility as 'the degree to which the innovation fits with the potential adopter's existing values, previous practices, and current needs'. Compatibility is also referred to as the extent to which the technology is suited to the organisation's existing normed occurrences and practices (Rogers Everett, 1995). According to Ihlsoon and YoungGul (2002), the adoption of new technology is burdened by alterations to current procedures and skills, while Kwon and Zmud (1987) and Hwa Chung and Snyder (2000) cite potential obstruction in systems innovation due to the incompatibility of new technology with current values and work practices. Thus compatibility can be underlined as a possible influential factor in the adoption of cloud computing by an organisation. Grandon and Pearson (2004) and Thatcher, Foster, and Zhu (2006) have argued that compatibility is the strongest driver for the adoption of technology when compared to other innovative features. Thus:

H2: *Compatibility positively influences the intention to adopt cloud computing.*

Complexity. According to Rogers (2010, p. 229), complexity is the 'the degree to which an innovation is perceived to be relatively difficult to understand and use'. Therefore, the likelihood of adoption is increased with ease of understanding associated with the use of the technology. Specialised cloud infrastructure (i.e. HP's Cloud System), when integrated with existing applications, may entail a degree of knowledge not present within the firm (Oliveira, Thomas, & Espadanal, 2014). Previous studies, such as those of Kwon and Zmud (1987) and Tornatzky and Fleischer (1990) had also indicated complexity has a negative impact on the adoption of innovative technology.

Thus, relative complexity is a factor that inhibits the use of cloud technology. The following conclusion can therefore be made:

H3: *Complexity negatively influences the intention to adopt cloud computing.*

Security. This qualitative research study uncovered contradictory findings in the literature regarding cloud computing security as discussed below.

Many interviewees expressed concerns about risk factors related to cloud computing. Security risk factors require careful consideration by organisations contemplating cloud computing usage (Carroll et al., 2011). In order to deter security breaches of sensitive and/or personal data within companies or government agencies, it is imperative data is secured (Bishop, 2003; Yang & Chen, 2010). Concerns around cloud computing security are well-founded, given the intersection of storage and computing in multi-user environments like a cloud computer system (Schneiderman, 2011; Wu, Shen, Wang, Zhu, & Zhang, 2011).

On the other hand, cloud computing is arguably a secure option, especially when using an internal private cloud. Cloud computing has more security features than individual servers (Khalil, Khreishah, & Azeem, 2014). The cloud gathers resources; subsequently, it supplies a contracted expert security cadre, whereas regular companies could be satisfied with a network administrator who may have not enough knowledge in cyber security issues (Khalil et al., 2014).

Ogigău-Neamţiu (2012) have argued that to help reduce threats, cloud computing stakeholders should invest in security implementation measures to ensure data is kept protected and private at all times. Concern that security cannot be achieved might cause organisational managers to resist the adoption of cloud computing by organisations. Hence:

H4: *Security concerns negatively influence the intention to adopt cloud computing.*

2.7.2 Organisational factors

Organisational factors are the multitude of factors within an organisation that facilitate or constrain actions (Lippert & Govindarajulu, 2006). These factors affect the association between the innovation adoption and organisational structure. The factors include:

- the scale of centralisation with the organisation
- the allocation of control and authority
- information links
- resources availability
- side communication
- the organisation's magnitude
- the willingness of support from top management (Tornatzky & Fleischer, 1990; Xu & Quaddus, 2012).

The most critical factor for the adoption of cloud computing is support from top management and readiness (T. Wang & Lai, 2014).

Top management support. Since cloud computing involves the resources distribution, services integration and the reengineering of processes, the role of top management is critical in the implementation process (T. Wang & Lai, 2014) since top managers have the power to influence organisational members. When the benefits of cloud computing are acknowledged, comprehended, and consented to, the resources necessary to push forward implementation will be ensured. This will foster smooth and efficient adoption. Failure on the part of top management to comprehend or to accept the benefits of cloud computing can result in opposition to the adoption process, and failure of the project (Altameem, 2007).

Special characteristics and skills, such as awareness, strategic thinking, and commitment to the project are required on the part of management (Ojo, Janowski, Estevez, & Khan, 2007). Pan and Jang (2008) pointed out that proactive management support facilitates the resolution of difficulties and control of complexities encountered when adopting IT. Another result of supportive management is that it encourages employees to accept and enjoy the benefits of new technology (Thatcher et al. 2006).

Altshuler and Zegans (1990) found that innovative organisations have the desire to support the change to a new technology by spending the time and effort to secure their employee's motivation. There are variety of reasons that cause people to resist change; for example, the lack of required skills to use the technology, the new change in the organisation structures and the reallocation of power (Wargin and Dobiéy, 2001) . Thus:

H5: *Top management support positively influences the intention to adopt cloud computing.*

Readiness. Organisational readiness is determined by the state of technological readiness within the organisation itself (Duan, 2012). Enhanced technological readiness involves both structural characteristics and specialised human resources. The structural characteristics are the platform or technological infrastructure already in place within the firm, such as network technologies and enterprise systems. Cloud computing services may be complementary, or be able to compensate in some manner, for example, by implementing collaborative document sharing solutions using cloud based storage.

Grandon and Pearson (2004) have suggested that the variables for adequately measuring the willingness of an organisation to adopt new technology are the financial and technological resources that the organisation allocates to the implementation of any new technology. Most readiness assessments also involve measuring the adequacy of human resources (Ojo et al., 2007) since employees capable of accessing and using information in a powerful and efficient manner are an imperative when transitioning from old to new technology (Abdalla, 2012).

Those within the organisation with the experience and skill to make use of cloud computing are considered the specialised human resources. These are employees with computer skills, IT specialists (O.-K. D. Lee, Wang, Lim, & Peng, 2009). Organisations with a higher level of technological readiness are generally better suited for the adoption of cloud computing. Hence:

H6: *Organisational readiness positively influences the intention to adopt cloud computing.*

2.7.3 Environmental factors

The environmental setting is the backdrop against which an organisation conducts its business. This environment is influenced by industry class, competitors, access to resources, and governmental impact (Lippert & Govindarajulu, 2006). Jeon, Han, and Lee (2006) and Scupola (2003) found that significant adoption of IT is greatly dependent upon environmental factors. Competition and regulatory environments have the greatest impact on the adoption of cloud computing (Zhu & Kraemer, 2002).

Competitive pressure. Competitive pressure describes the degree of exertion brought to bear upon an organisation by adversaries from within the industry (Zhu & Kraemer, 2002). It has long been recognised as a significant driver of technology diffusion. The adoption of new technology is often calculated as essential when competing in the marketplace. Ross (2010) argues that as a consequence of the high rate of technological change in business in general, it can be anticipated that an organisation's expectation for cloud computing will be that it will happen.

Adopting new technology is a strategic requirement when competing in the market, and Ross (2010) suggests that, consequent to rapidly changing technology, organisations will require cloud computing to satisfy their ongoing technological needs.

H7: *Competitive pressure positively influences the intention to adopt cloud computing.*

Regulatory support. Regulatory support is provided by the government to encourage IT innovation by firms (Thatcher et al., 2006). Current rules and regulations can be crucial in the adoption of technologies at the beginning. With support through investment, the government can influence and aid the passage of new legislation and regulations (Hamad, 2014). The government takes a vital role in the adoption of innovative technology due to its power to foster institutional environments that encourage private investment (Oxley & Yeung, 2001; Thatcher et al., 2006). Shore (2001) indicates that government support for the adoption of IT is visible when there are national incentives for training and sustaining a suitable IT workforce. Government support is a significant factor in IT adoption (i.e. Internet, e-commerce) (L. Chang et al., 2001; Grandon & Pearson, 2004; Hamad, 2014; Kuan & Chau, 2001).

It should be noted that government involvement is expected to be a positive influence towards the adoption of cloud computing. Therefore:

H8: *Regulatory support positively influences the intention to adopt cloud computing.*

2.7.4 Cultural factors

In order to develop a comprehensive model of culture, Hofstede (1991) investigated the social dimension of culture. Hofstede's study revealed the areas in which societies differ culturally.

In order to do this, Hofstede (1991) commissioned a large-scale survey of the employees of a multinational corporation, subsequently identified as IBM (information system research), and from the gathered data established four key cultural dimensions:

- uncertainty avoidance
- power distance
- emphasising individualism as opposed to collectivism or vice versa
- masculinity vs femininity.

The original theory which was used in this study has four dimensions. In 1991 Hofstede included a fifth dimension; long-term orientation (G. Hofstede, 1991). In 2010, Hofstede added a sixth dimension, indulgence vs self-restraint (Hofstede, 2011).

Uncertainty avoidance. Hofstede (2001, p. 148) specifically points out that 'uncertainty avoidance is not the same as risk avoidance' and explains, '…uncertainty is to risk as anxiety is to fear.' The literature further distinguishes real risk from perceived risk: 'actual risk includes financial, physical, or social risks associated with trying an innovation' (Nui Polatoglu & Ekin, 2001, p. 161), including 'considerable loss, in terms of financial, learning, and opportunity costs, if an incompatible alternative technology (other than the one purchased) comes to dominate the marke' (Sarin, Sego, & Chanvarasuth, 2003, p. 72).

Perceived risk, conversely, is determined by cultural factors and therefore tends to be more subjective and irrational (Hofstede, 1991). Both types of risk can typically be controlled or decreased with employee-trusted management experiences (Dadzie, Lee, & Dadzie, 2000); participant education by trusted sources; and appropriate placement with complementary products (Geissler, 2006; Sarin et al., 2003).

Various studies have been conducted in order to uncover the relationship between culture and IT/IS adoption. It was found that uncertainty avoidance is a significant factor influencing the adoption of ICT. The explanation behind this discovery is the possible risk factors associated with IT. Those who are less comfortable with uncertainty will be less likely to adopt, and therefore experience, new technologies (Leidner & Kayworth, 2006). Straub (1994) found that workers from Japan are less likely to implement and use email due to their high uncertainty avoidance. Thatcher et al. (2006) found that students from countries with high uncertainty avoidance were less likely to attempt innovation through new information technology. Al-Sukkar (2005) mentioned that similar results were found by Jarvenpaa, Knoll, and Leidner (1998) and Straub et al. (1997). The study reveals the Arab world's high ranking in the uncertainty avoidance dimension. Thus, people in Arab regions do not readily accept change, and are subsequently categorised as less risk-taking (Al-Sukkar, 2005).

According to Hofstede (1991), indecisiveness creates anxiety, resulting in feelings of threat in uncertain or unknown situations. The uncertainty avoidance index (UAI) depicts how people adapt or cope with ambiguous or unfamiliar circumstances. In high UAI cultures, people tend to adopt technology, law, rules, and religion to decrease the ambiguity of situations, by making events constructed, with probable outcomes. Organisations in high UAI cultures will avoid unwarranted perils, and only plan and complete those projects which are adequately familiar as to guarantee explicit approval within the market (Geissler, 2006).

Uncertainty issues are prevalent and may cause dilemmas for businesses new to cloud computing in the Arab world. In order to alleviate potential uncertainties involved in cloud computing, organisations in high UAI

cultures are motivated to remain with established technologies (Zhao, Scheruhn, & von Rosing, 2014). The following hypothesis is hence suggested:

H9: *High uncertainty avoidance negatively influences the intention to adopt cloud computing.*

Power distance. The degree to which the less powerful people acknowledge and accept that power is divided unevenly is called power distance. An example of power distance occurs when some individuals in a society receive the larger share of benefit and others the smaller share. The attitude of those receiving the smaller share represents the power distance. If the inequality is culturally unpopular, the low power distance will result in a striving for equality of power, decentralisation of power, and justice (Al-Sukkar, 2005; G. Hofstede, 1991). In a culture with a high power distance, the social elite are less challenged by ideas of equality, and have a enormous influence on the knowledge, attitude, and behaviour of other individuals (Veiga et al., 2001).

Technology is a major element in influencing and altering a society's power distance index (PDI). Talalay and Farrands (1997) discovered, 'in a global age the relationship between culture and technology is central to any complex analysis of power' and that 'technological advances determine to a large degree who has power, how much, and for how long' (1997, p. 27). Those who find themselves unable to acquire influence, especially young people and women, 'may find a voice in the 'information society' (Fleming, 2003) and thereby affect the power distance index (PDI) through their technical experience (Geissler, 2006).

According to Hofstede, the power distance dimension in the Arab community is high. Simply translated, the expectation from people in this particular region is that leaders will distance themselves from the group, and unequal power and influence are expected and accepted. Hofstede (1991) suggests that in countries within which organisations have high power distance, there is a structure of centralised decision making, authoritarian control, and formalised rules. An inclination to centralisation, authority, and formalisation creates supreme managers and heads of organisations under constrained hierarchical organisational structures. Adopting cloud computing may decrease managerial control of the organisation (Al-Sukkar, 2005).

The following hypothesis is suggested:

H10: *High power distance negatively influences the intention to adopt cloud computing.*

Masculinity. The fourth dimension in Hofstede's model is masculinity (MAS). Basically, he argues that gender differences come from the biological differences between men and women. Culture could be deemed masculine or feminine according to how a society defines and follows social norms. Hofstede's survey fleshes out two basic facts. First, historically, masculine cultures tend to be more militaristic and more competitive, while feminine cultures encourage enhanced cooperation. Masculine cultures focus more on ambition, competition, and material values. Therefore, to increase the competition, organisations with higher MAS scores are inclined to adopt new technologies (Zhao et al., 2014).

Individuals in low-MAS cultures are likely to adopt ICTs due to their preference for group decisions, and since individuals in high-MAS cultures are similarly likely to adopt ICTs to improve their ability to monitor the actions of fellow employees and cope with stress, it appears that this dimension of culture is a significant predictor of technology adoption in very high-MAS and very low-MAS countries but not in countries with MAS values near the mean (Geissler, 2006). The ranking for masculinity is also a strong indicator of a difference between males and females in Arab societies. In the Arab world, most top management jobs are assigned to males (Al-Sukkar, 2005). Hence, the following is hypothesised:

H11: *High masculinity positively influences the intention to adopt cloud computing.*

Individualism – collectivism. The propensity of low individualism (IDV) culture members to be conversant with other members of their culture appears greater. While Karahanna, Straub, and Chervany (1999) support this notion, a country's low IDV score may not inevitably lead to amplified use of ICTs (Fleming, 2003; Suraya, 2003), as other factors included in the PDI and UAI dimensions may at least temporarily, if not permanently, constrain communication to conventional face-to-face methods (Geissler, 2006).

Individualism is the lowest Hofstede dimension in the Arab world, which indicates that people in the region place importance on groups and families. The American culture is high in individualism (Al-Sukkar, 2005). The individualism and collectivism index epitomises the association between the singular and the communal, or group, in a particular society. A leaning toward individualism and collectivism influence the decision making of a person within their society. An individualistic culture cultivates more reliance on self, rather than seeking conference with a neighbouring collective or group before reaching a conclusion.

In the countries with high scores for individualism, for example, converting from one religion to another is a highly individual activity. In high collectivism countries, it is highly probable that people will adopt the

views of their surrounding groups. In organisations with a high-individualistic culture, employees are more autonomous (Zhao et al., 2014), following their own pace and schedule in completing business processes. The following hypothesis is then suggested:

H12: *High individualism positively influences the intention to adopt cloud computing.*

Table 3.1 outlines the research hypotheses.

Table 3.1 Research hypotheses

Hypotheses	Descriptions
H1:	Relative advantages of cloud computing positively influence the intention to adopt cloud computing.
H2:	Compatibility positively influences the intention to adopt cloud computing.
H3:	Security concerns negatively influence the intention to adopt cloud computing.
H4:	Complexity negatively influences the intention to adopt cloud computing.
H5:	Top management support positively influences the intention to adopt cloud computing.
H6:	Organisational readiness positively influences the intention to adopt cloud computing.
H7:	Competitive pressure from competitors positively influences the intention to adopt cloud computing.
H8:	Regulatory support positively influences the intention to adopt cloud computing.
H9:	High power distance negatively influences the intention to adopt cloud computing.
H10:	High uncertainty avoidance negatively influences the intention to adopt cloud computing.
H11:	High individualism positively influences the intention to adopt cloud computing.
H12:	High masculinity positively influences the intention to adopt cloud computing.

2.6 Summary

The literature review provided an overview and analysis of cloud computing technology, the role of cloud computing for education, and cloud computing adoption in developing countries, which includes Saudi Arabia because of a number of developmental factors, including technology sophistication. The overview of cloud computing technologies was presented with detailed discussion about the delivery model, storage, and services. The role of cloud computing in higher education was highlighted, including its benefits for acquiring knowledge and how Saudi universities can employ it. Cloud computing for education in developing countries was discussed. Characteristics of academic institutions, the potential benefits of cloud computing for education and the barriers to adoption in developing countries were explored. All of the previous topics were prerequisite in order to develop the conceptual model and the study hypotheses which were covered in the last section of this chapter.

This chapter has presented an extensive review of the current theories concerning the adoption of technology. After careful evaluation of the suitability of each theory, the TOE framework was designated as the theoretical foundation of this study with the purpose of directing the progression of a conceptual model, due to the thoroughness of the TOE framework. A conceptual model was subsequently proposed, consisting of four areas of focus, involving technology, organisation, environment, and culture. Twelve hypothesised factors were considered significant determinants of the adoption of cloud computing in Saudi universities.

Chapter 3

Research methods

After discussing the development of the conceptual model in the previous chapter, this chapter discusses the **mixed method approach** which was used to collect data during the study. Mixed method approaches include qualitative and quantitative methods which were adopted for data collection and analysis in this study.

The **qualitative research** employed the method of in depth **semi-structured interviews**. The interviews were conducted with some key decision makers at PNU of academics and administrators as the first and largest women's university in the world. The gathered data were subjected to a thematic analysis involving a coding 'theme', which produces data sets that can be organised in a manner appropriate to the research goals. The themes begin broadly and become more and more specific.

Quantitative research involved developing and deploying a **large-scale survey** to establishing the attitudes and the beliefs of Saudi university staff and academics who are involved with information systems. This survey allowed the researcher to determine the levels of interest in cloud computing adoption, as well as investigate the current use of information systems and cloud computing at the university. **Structural equation modelling** (SEM) was utilised to analyse the quantitative data generated by the survey.

Research methods

The purpose of this research is to investigate the influence factors related to cloud computing adoption decision in Saudi universities. It sought to investigate the factors by hypothesising a conceptual model. This model was then tested with survey. The research method is related to the overall purpose of the research, which might be exploratory, descriptive or explanatory (Saunders, Lewis, & Thornhill, 2011) or a combination of the three. The methods used to gather data are an element of the research design.

3.1.1 Exploratory research

In the current study, exploratory research was useful as uptake of cloud computing in the Saudi context is at an early stage. Exploratory research is useful when theory is limited. It is therefore used to enhance topic understanding (Hair, Black, Babin, Anderson, & Tatham, 2010), to discover new phenomena and to inquire about and more clearly understand current phenomena. Exploratory research generally involves reviewing the literature, engaging with experts in the field and/or conducting focus groups (Saunders et al., 2011).

The exploratory stage used qualitative research methods to answer the research questions: what technological, organisational, environmental, and cultural factors influence the decisions related to cloud computing in Saudi Arabian universities? The exploratory stage was used in this study for a number of reasons. Firstly, it is important for the formulation of the conceptual framework. In hypothesis development, the exploration with key informants is beneficial in the refinement of existing variables and discovering new variables. According to Blaxter (2010), this practice contributes to the refinement of the conceptual model and the validation of variables under investigation. Secondly, exploratory research is also useful in the development of a research instrument for other empirical studies. In this study, exploratory research was applied in undertaking in-depth interviews to decide on the key variables to be studied, to refine the conceptual model and to develop the quantitative instrument that will be used in subsequent quantitative testing.

3.1.2 Descriptive research

Descriptive research describes the phenomenon being studied without making an effort to analyse the reasons for its state or behaviour. Researchers use it to structure and specify designs and to measure characteristic-centred findings generated from research questions. Theory-driven hypotheses guide the process and give rise to an outline of what needs to be measured (Hair et al., 2010). The overall objective of descriptive research is to accurately portray findings (participants and events) within a study. Prior to entering the field to collect data, it is necessary to have a clear and concise picture of the phenomena being investigated (Saunders et al., 2011).

Considering the lack of formalised studies on cloud computing adoption in universities, descriptive research was also necessary. It involved the calculation of means and variances, proportions and associations between variables, and the overall characteristics of the study (Cooper et al., 2006). Simultaneously, descriptive research was used to outline the structure for explanatory research.

3.1.3 Explanatory research

After the qualitative phase, quantitative research was conducted. Quantitative research was used in the second stage of this research as its larger samples and statistical significance levels provided statistical generalisation of the findings to a population (Zikmund & Babin, 2006). A large-scale survey was used for studying the attitudes and the beliefs of Saudi university staff who are involved with information systems. This survey allowed the researcher to determine the levels of interest in cloud computer adoption, as well as to investigate the current state of using information systems and cloud computing at their university.

Explanatory research attempts to determine the relationship between variables within the study (Saunders et al., 2011), testing whether one event causes another (Hair et al., 2010).

The research design implemented in this study incorporated all three types of research. As illustrated in Figure 3.1, this study is based on two main phases of qualitative research, followed by quantitative research. The former consists of exploratory research and the latter incorporates descriptive and explanatory research.

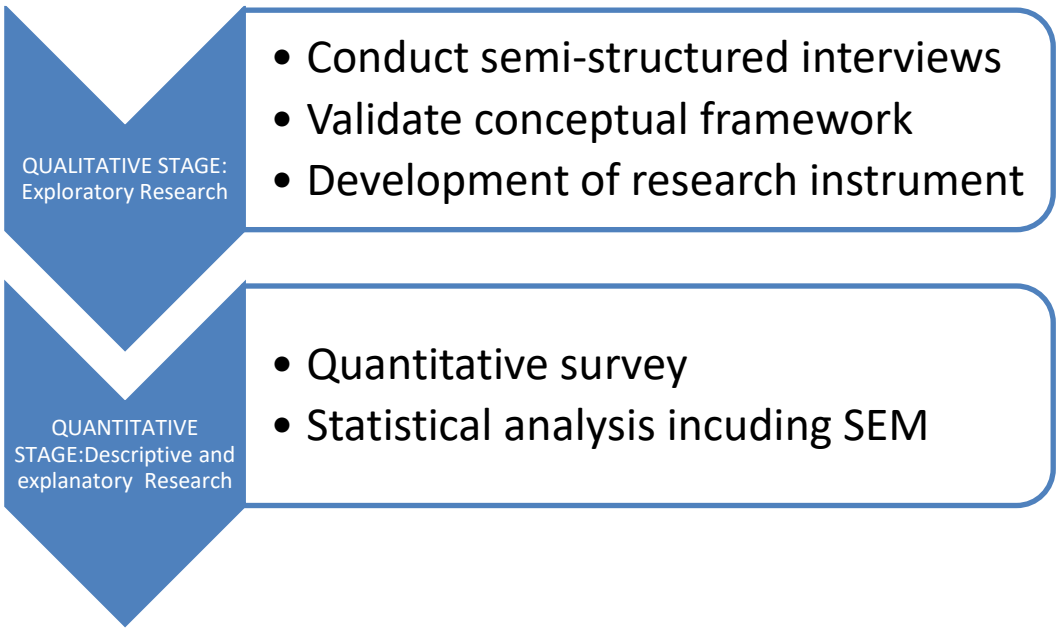

Figure 3.1 Overview of the research methods

3.1.4 Use of mixed-methods research

When a study uses qualitative and quantitative research methods, various approaches and techniques demonstrate that it is mixed-method research (de Waal, 2001). Theoretical elements of the study were integrated with the data gathered from field studies, permitting the researcher to begin a widespread review of relevant theory, and pair that review with methods of collecting and analysing qualitative and quantitative data. Mixed-methods research is common in the fields of health and social sciences, where it is felt that integrating quantitative and qualitative data during an individual study contributes to a clear and in-depth understanding of the research issue (Creswell & Clark, 2007; Teddlie & Tashakkori, 2003).

The rationale behind combining more than one method in a single research study is that either a qualitative or a quantitative method is inadequate by itself to grasp all aspects of the research problem. Qualitative and quantitative methods complement each other and produce strong data and analysis (Creswell & Clark, 2007). Mixed methods are suited to a research problem in which one data source may be insufficient. Mixed

methods allow results to be more fully explained, and for exploratory findings to be more rigorously tested. The role of a second method is to reinforce the main method when theory is implied, and research goals can be handled more accurately by using multiple phases.

The use of multiple methods is widespread, but it is hard to definitively decide how the components should integrate or link to each other (Tabachnick, 2001). Nevertheless, the data can be combined, and conclusions may be extracted from a single research study when the quantitative and qualitative methods are appropriately integrated (Creswell & Clark, 2007; Teddlie & Tashakkori, 2003).

The qualitative data augments the quantitative by supplying conceptual and instrumental development, and facilitates the data collection stage. For the duration of the data analysis phase, the qualitative data help in illustrating, explaining, validating and forming a base for the quantitative results. Research using both techniques is very time consuming, and collection and close analysis often have to be limited to just one of the methods, which is informed by the other (Alsanea, 2015).

In this research, qualitative and quantitative methods complement each other. In stage one, the qualitative method was applied for induction (MacDaniel & Gates, 1991; Wimmer & Dominick, 1994). The qualitative approach was used in order to expose information extracted from the interviewees' standpoint, such as barriers and current status in relation to technology. The results of the qualitative research were used to build theories for further testing, using quantitative methods (Aaker, Kumar, & Day, 2008; Creswell & Clark, 2007). The theory in this study was extended to embrace all discovered factors from the literature review and the interviews.

3.2 Phase 1: Qualitative research

In this study, multi-method qualitative and quantitative approaches were conducted. Qualitative research serves to explore and validate the variables under investigation. The qualitative research employed the method of in depth semi-structured interviews. The following sections describe the interview data collection procedures.

3.2.1 Interview method

As noted by Oates (2005), the interview is the most effective and comprehensive qualitative research tool. Moreover, interviews can reveal other data sources useful to the researcher, such as extraneous factors that might influence the final research outcomes.

An in-depth semi-structured interview method was employed in this part of the study. The conceptual model and the supporting literature all combined to provide the basis for formulating the interview questions. The interviews were designed to uncover cloud computing adoption drivers, along with other matters associated with cloud computing adoption – good or bad – and how these should be addressed in the Saudi environment.

> *Semi-structured interviews are designed to have a number of interviewer questions prepared in advance, but such prepared questions are designed to be sufficiently open that the subsequent questions of the interviewer cannot be planned in advance but must be improvised in a careful and theorised way. (Wengraf, 2001, p. 5)*

Questions can be made more detailed or focussed in specific areas depending on interviewees' responses and the researchers' interpretation. This is advantageous over a pre-set list from a structured questionnaire. Semi-structured interviews allow the researcher to explore issues in more depth, whilst making sure the main focus of the discussion remains within agreed upon boundaries.

When the interview guide was nearly ready, the researcher began to categorise individuals from various cadres, who were then contacted for questioning within Princess Nourah University (PNU). The interviews were conducted with eight key members of PNU.

The reason for conducting the interviews at Princess Nourah University was because it represented the first and largest women's university in the world (PNU, 2015). It is a public women's university sited in Riyadh in Saudi Arabia. The university also attempts to use the latest programs and technologies to facilitate Princess Nourah University employees' working together with the enhancement of automation in order to boost efficacy and productivity. It utilises the most up-to-date and modern IT systems (PNU, 2015). These reasons have made Princess Nourah University a good choice to conduct the exploratory stage of this research study.

All the interviews were consistent in terms of the questions and their sequence. Given the exploratory nature of the research study, a semi-structured interview method was justified over more structured interviews. The semi-structured interviews afforded the researcher the ability to refine variables identified in the literature and allow for the discovery of new variables. Semi-structured interviews were preferred over unstructured interviews in order to build on the conceptual model that emerged from the literature. They were also used for this study to permit the researcher to obtain precise, in-depth information by allowing the interviewees to express themselves freely and at some length (Cooper et al., 2006; Rampersad, 2008).

3.2.2 Pilot test

The original interview questions were tested in interviews with one IT academic at a Saudi university and one Saudi IT PhD student. They were chosen because they had the same academic background as the real audience, and they had experience in the IT field. This assisted the researcher to test the questions and manage the timing of the interview. The pilot interviews allowed the researcher to modify the questions and format where necessary, and to ensure that the interviews generated maximum data. Moreover, while Arabic was still the preferred language of communication, although some of the technical terms had to be defined in English, as the Arabic vocabulary lacked the requisite words. Approximately 40 minutes was sufficient for the entire interview. There was some feedback from the pilot study that was used to improve the interview questions.

3.2.3 Interview procedure

The research interviews were conducted at Princess Nourah University. The interview participants were selected based on their position in the university.

Interview participants. Five of the participants were from the university's senior management. Senior managers were chosen because they had a comprehensive overview of the university goals, vision, and practises, and were decision makers at PNU. Two other interviewees were in middle management, and one was a computer specialist who was expected to know how to deal optimally with the latest available technology in the university.

Only one of the interviewees was male, one of around 10% of the population of PNU staff who worked mostly as either academics or in the IT management department. As was culturally appropriate, the male staff were located in buildings separated and far from the female sections. The interview with the male staff member was conducted by email.

In order to preserve the privacy of the interviewees, who could be easily identified by their position at the time of the research, each participant has been assigned an alias. The researcher was satisfied by eight interviews because a consensus was reached on the key factors impacting the adoption of cloud computing (Rampersad, 2008).

Table 3.2 PNU staff aliases

No.	Simple participant aliases
1	Interviewee A
2	Interviewee B
3	Interviewee C
4	Interviewee D
5	Interviewee E
6	Interviewee F
7	Interviewee G
8	Interviewee H

Organising and conducting the interviews. The selected interviewees were contacted via email and invited to participate in the study. The researcher asked them to contact her directly if they were willing to participate in an interview and to arrange a time for an appointment. The following details were provided in the email:

- The researcher introduced herself.
- The time required for the interview was explained.
- The objectives of the study were discussed.
- Participants were guaranteed that their identity would not be revealed, and that their participation would be confidential.
- The information sheet and the letter of introduction were attached to the email (see Appendix A).

The sessions were conducted in a noise appropriate environment allowing for the greatest level of privacy. Each interview lasted for approximately 30 to 40 minutes. The interviewees were asked the interview questions in sequence and permitted to give a full answer to each question. The researcher needed to write down each answer as the respondents preferred not to be recorded. At the end of the interviews, the interviewees were asked if they had any questions regarding any aspect of the interview and were thanked for their time and cooperation. This thesis obtained an approval from Flinders University's Social and Behavioural Research Ethics Committee (SBREC) prior the establishment of the data collection see Appendix D. The data were stored in the university's servers.

3.2.4 Qualitative data analysis techniques

For the purpose of the study, the data analysis followed a thematic process, including encoding the information attained from the interviews guided by themes that emerged from the literature (Boyatzis, 1998). The methods of data analysis used in this research included:

- gaining an understanding of the interview dataset by meticulously reading through all the raw data from the interviews
- coding the data and removing duplication (Miles & Huberman, 1994) [the raw data is quoted in this thesis when needed to enrich qualitative insights, thus helping with the interpretation of the information summarised (Patton, 1990).]. The codes were produced by inspecting the data set using specified questions which the researcher found information (Braun & Clarke, 2006). The theme could be generated manually or by using computer (Boyatzis, 1998). This thesis used manual way.
- Searching for themes, by reviewing each code within the text and sorting the codes into classes to find common themes ((Braun & Clarke, 2006)
- critically examining the data and field notes to ensure that the analysis was focussed on addressing the research questions and that the summarised data could be interpreted correctly by the reader (Miles & Huberman, 1994).

***A priori* codes for the qualitative phase.** For the sake of interpreting and explaining the data of the qualitative phase, it was important to begin with some codes. The literature offered the initial material for developing the codes, which were enhanced by themes from the questions (Table 3.4). Thereafter, chunks of materials from the interviews could be coded as part of the analysis.

The themes. Based on the literature, four main themes were identified. They were: technological factors; organisational factors; environmental factors; and cultural factors. The participants' responses were read carefully, and incorporated into themes by using the list of codes. The conceptual model of this research was the foundation for designing the interview questions. All collected data from the interviews was classified and identified for placement in the proposed model.

Table 3.3 ***A priori* codes for use in data analysis**

Themes	Technological	Organisational	Environmental	Cultural
Code	Relative advantage Compatibility Security concerns Complexity	Top management support Readiness	Competitive pressure Regulatory support	Uncertainty avoidance Power distance Masculinity Individualism Language & religion

3.3 Phase 2: Quantitative research

The goal of this quantitative stage was testing and validating the refined proposed model. The survey method was selected to collect the data.

According to Pinsonneault and Kraemer (1993), the survey is a critical measurement method in applied research. The survey method is widely used when applying quantitative statistics in data analysis. The survey was used to gather data regarding the factors that affect cloud computing adoption. The questionnaire consisted of 48 questions (see Appendix D).

3.3.1 Survey instrument development

For data collection, a reliable survey instrument was evolved. The survey instrument validating paradigms presented by Churchill Jr (1979) and Straub, Boudreau and Gefen (2004) were employed for guidance (Figure 3.4).

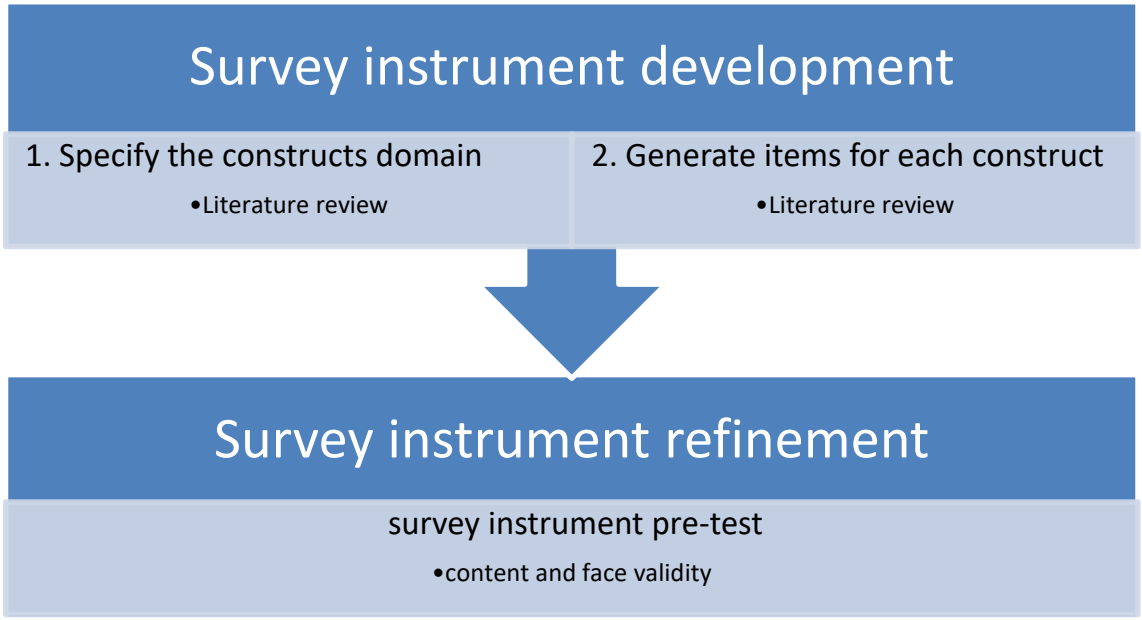

Figure 3.4 **Survey instrument development procedure consisting of two main processes: survey instrument development and refinement [Adapted from Churchill (1979)]**

Survey instrument development entails the construct's domain specification and the individual construct's item generation (Churchill Jr, 1979; Straub et al., 2004). The construct's domain specification was completed by extensively reviewing the literature on cloud computing and the adoption of technology in universities. The literature review led to the identification of the following constructs:

- relative advantages
- compatibility
- complexity
- security concerns
- top management support

- readiness
- competitive pressure
- regulatory support
- language and religion
- uncertainty avoidance
- power distance
- masculinity/femininity
- individualism/collectivism

as the main factors that could affect cloud computing adoption in Saudi universities. Thus, the factors are the foremost constructs in the survey instrument. Each construct's item generation was also undertaken on the foundation of the literature review (Table 3.4).

Table 3.4 Operationalisation of and constructs measurement items

Construct/Factors	Resources
Technology context	
Relative advantage	(Borgman et al., 2013), (Low et al., 2011), (Yoon, 2009), (Premkumar & Roberts, 1999), Tashkandi and Al-Jabri ,2015
Compatibility	(Borgman et al., 2013), (Low et al., 2011), (Yoon, 2009), (Premkumar & Roberts, 1999), Tashkandi and Al-Jabri ,2015
Complexity	(Borgman et al., 2013) (Low et al., 2011), (Premkumar & Roberts, 1999), Tashkandi and Al-Jabri ,2015, Alsanea, 2015
Security concerns	(Yoon, 2009), (Lippert & Govindarajulu, 2006), Tashkandi and Al-Jabri ,2015, Alsanea, 2015
Organisational context	
Top management support	(Borgman et al., 2013) (Espadanal & Oliveira, 2012), (Low et al., 2011), (Yoon, 2009), (Premkumar & Roberts, 1999), Tashkandi and Al-Jabri ,2015, (Duan, 2012)
Readiness	(Espadanal & Oliveira, 2012), (Low et al., 2011), (Yoon, 2009), Alsanea, 2015, (Duan, 2012)
Environmental context	
Competitive pressure	(Espadanal & Oliveira, 2012), (Low et al., 2011), (Yoon, 2009), (Lippert & Govindarajulu, 2006), (Premkumar & Roberts, 1999), Tashkandi and Al-Jabri ,2015, Alsanea, 2015, (Duan, 2012)
Regulatory support	(Espadanal & Oliveira, 2012), Tashkandi and Al-Jabri ,2015, Alsanea, 2015
Cultural context	
Uncertainty avoidance	Al-Sukkar, 2005, Alhujran, O. (2009)
Power distance	Al-Sukkar, 2005 , Alhujran, O. (2009)
Masculinity/femininity	Al-Sukkar, 2005, Alhujran, O. (2009)
Individualism/collectivism	Al-Sukkar, 2005, Alhujran, O. (2009)
Language and religion	Al-Gahtani, Hubona, and Wang (2007), (Tanasyuk and Avgerou (2009).

Once the constructs were directly operationalised by the observed variables, the decision for the adoption of cloud computing could be measured using four options:

- Has no intention
- Will adopt within 12 months
- Already adopted
- Do not know.

Other variables were operationalised as multi-item constructs, measured using a 5-point Likert scale ranging from strongly agree (1) to strongly disagree (5) (see Appendix D). The 5-point Likert scale was employed as it is a common scale that would reduce respondents' frustration level and increase response rate and quality through its familiarity (Babakus & Mangold, 1992; Sachdev & Verma, 2004)

The survey consisted of three major parts: (1) demographic information; (2) current use of information systems at the university; and (3) factors that affect cloud computing adoption.

Part 1 sought demographic information, such as personal details about the participant's: gender, age, years of experience, qualifications, current occupation and university name.

Part 2 of the questionnaire sought to find out about the current use of information systems which serves education and administration sections at the university using two different sets of items measured by two different scales. Firstly, the respondents addressed seven issues related to the biggest challenges facing IT activities in the university, and rate them on a four point scale as Very Important, Important, Moderately Important, or of Low Importance. Answering this section was not a must so the participant could just ignore an item about which they were not confident.

Secondly, respondents were presented eight items regarding the computer applications in use at the university. The instrument employed a 5-point Likert scale to describe the frequency of using the applications, for which the points were: Never, Rarely, Sometimes, Often, and Always. Again, response was not obligatory. This section was just for IT staff in universities, not for all the participants.

Finally, Part 3 of the questionnaire asked respondents to indicate the factors that were most influential in their selection or non-selection of cloud computing. The items were developed with reference to TOE theory (technology, organisation, and environment), as well as Hofstede's theory of cultural dimensions.

The first item in Part 3 included one about the cloud adoption intention of the university. This was followed by 16 items relating to the technology context in terms of relative advantages, compatibility, complexity, and security concerns. A third group of six items investigated the organisational context in terms of top management support and readiness.

The fourth group of six items was designed to investigate the environmental context in terms of competitive pressure and regulatory support. Part 3 of the questionnaire concluded with 19 items to investigate the cultural context in terms of uncertainty avoidance, power distance, masculinity/femininity, individualism/collectivism, and language and religion.

Table 3.5 Survey constructs and measurement items

PART 1:		SCALE
Demographics and current activities	Name of your university, age , gender, qualification, position, experience (no of years)	
PART 2:		
challenges facing the university's IT activities?	• Concerns about data security • Inadequate IT staff levels • Inadequate IT systems • Inadequate end-user skills • Insufficient training for IT staff • Insufficient training for end users • Inadequate Internet access	4 -point Likert scale Very Important, Important, Moderately Important, Low Importance
Applications in use at the university	• Content management • Email • Office productivity (such as word processing) • Programming/software development • Social networking/Web 2.0 (such as Facebook) • SMS/text messaging (such as SMS Cloud) • Telephone and voice services/VoIP • Web conferencing (such as Skype)	5-point Likert scale Never, Rarely, Sometimes, Often, Always
PART 3: Cloud computing adoption		
	University's intention about cloud computing adoption	Has no intention Will adopt within 12 months Already adopted Do not know.
Section1: Technology context	• The use of cloud computing reduces system administration • By using cloud computing, the information technology system is always up to date. • Cloud computing reduces hardware and software maintenance efforts. • Costs of purchasing software for every personal computer are reduced. • Cloud computing involves access to data from anywhere. • Cloud computing leads to ease of upscale or downscale of computing resources as required	5-point Likert scale Strongly agree Agree Undecided Disagree Strongly disagree

	• The use of cloud computing is fully compatible with current university work • The use of cloud computing will be compatible with existing hardware and software in the university • Cloud computing adoption is consistent with the university's strategy • The skills needed to adopt cloud computing are too complex for employees of the university • Integrating cloud computing into existing system landscape is difficult • The use of cloud computing requires a lot of mental effort • By using cloud computing sensitive data is protected from unauthorized persons • By using cloud computing there are worries about data loss. • Data will be controlled by the service provider • Intellectual property rights could be stolen	
Section 2: Organisational context	• The university's management supports the adoption of cloud computing. • Top management in the university has a clear strategy towards IT • Top management in the university offers training courses to use IT • There are necessary skills within the university's staff to implement cloud computing • There is limited and inconvenient wireless Internet access on campus. • There are limited Internet enabled computers available on campus.	5-point Likert scale Strongly agree Agree Undecided Disagree Strongly disagree
Section 3: Environmental context	• Many large universities are currently adopting cloud computing • Many large universities will be adopting cloud computing in the near future • Cloud computing is recommended by the government • The regulations that exist are sufficient to protect the users from risks associated with cloud computing • There are no laws regarding ownership and responsibility for customer data. • Budgeting for the availability of technology in the education sector is limited.	5-point Likert scale Strongly agree Agree Undecided Disagree Strongly disagree
Section 4: Cultural context	• Language problems in using technology is considered as a barrier in adopting cloud computing. • Some services in cloud computing don't support Arabic languages. • Possibility to find an inappropriate websites (advertising) with content inappropriate to the Islamic context considered as a barrier in adopting cloud computing • Lack of laws to organize and keep Islamic boundaries while using cloud • It is important to have job requirements and instructions spelled out in detail so that people always know what they are expected to do	5-point Likert scale Strongly agree Agree Undecided Disagree Strongly disagree

	• People should avoid making changes when their outcomes are uncertain • Order and structure are very important in a work environment • Managers expect workers to closely follow instructions and procedures • Managers should make most decisions without consulting subordinates • Employees should not question their manager's decisions. • Decision making power should stay with top management and not be delegated to lower level employees • Managers should not delegate important tasks to employees • Men usually solve problems with logical analysis; women usually solve problems with intuition • Solving organisational problems usually requires an active forcible approach which is typical of men • It is preferable to have a man in a high level position rather than a woman. • Individual rewards are not as important as group welfare • Group success is more important than individual success • Being accepted by the members of your work group is very important • Employees should pursue their goals after considering the welfare of the group	

3.3.2 Survey instrument refinement

A pre-test was employed to check the survey instrument. Content and face validity were assessed at the pre-test (Hair et al., 2010; Saunders, 2004).

Content validity is the extent to which the items in a survey represent all of the relevant elements of the construct being measured (Hair et al., 2010; Straub et al., 2004). Hair et al. (2010) suggest that the contents of the survey are assessed using word comprehension, logical sequencing, and consistency in interpretation, as well as gauging the scope of the survey in its entirety. Face validity is regarded as the assessment of a scale or particular item within a scale being able to measure its intent (Saunders, 2004). It is proposed by Saunders (2004) that survey/questionnaire items can be validated at face level using the assistance of friends and/or family at a minimum.

In this study the content validity of the survey instrument was assessed using the expertise of three officials well versed in instructional technology (IT) working in different Saudi universities. Each official was asked to examine the survey on a question-by-question basis for relevancy of content, structure and word usage. The three university officials also rated the content validity of the survey based on its entirety. They were asked to provide feedback addressing content completeness and order of measurement items. The end product was an amended survey based on the feedback of the IT experts involved.

To achieve face validity of the questionnaire for this study, the expertise of two Computer Science PhD students was employed on the first draft to assess the comprehension of each item. The resulting feedback noted questionnaire length and ambiguous items. When these concerns were addressed, the length of the survey was reduced and various questions were reworded for improved clarity.

3.3.3 Translation of questionnaire

The survey instrument was translated into Arabic by the researcher because the Arabic language is the first language of the researcher and the participants in Saudi universities. The verbal equivalence between the Arabic and English versions was checked through double translation by the researcher and by an IT PhD colleague, and comparisons were made to ensure the correspondence of the meaning between the two versions. The Arabic version was reviewed by an Arabic language teacher from Saudi Arabia. The survey instrument was then sent to four PhD and Masters students from different majors in Saudi Arabia for pre-test. This was done to assess clarity, readability, and understanding, and to gain an initial idea of the time required to complete the survey. A minor revision resulted in rewriting some statements in the survey instrument.

3.4 Delivering the survey

A research population consists of the set of all cases from which a researcher draws a sample to study (Creswell & Clark, 2007; Saunders, 2004). A sample is used when the researcher does not have access to the full population, has insufficient time, or is limited by cost.

3.4.1 Population sample

It is appropriate to choose a representative sample of the population in order to conduct a research study. One of two sampling methods is generally adopted for research – probability and non-probability sampling. For probability sampling, the researcher applies a pattern for selecting each participant or case. For non-probability sampling, on the other hand, the probability of selecting each participant or case from the entire population is unknown (Saunders, 2004; Vogt, 2006).

Zikmund and Babin (2006) note that the choice between probability and non-probability sampling depends on criteria such as research questions, objectives, and research methodology (i.e., external validity). In addition, probability sampling is commonly associated with the use of survey-based research, while non-probability sampling is more frequently associated with case study research (Saunders, 2004). Probability sampling dominates research practice due to its ability to preserve the validity of a study and aid in generalisability, while reducing bias in participant or case selection since a pre-established pattern guides sample selection (Vogt, 2006).

Probability sampling was accordingly applied in this study. According to Saunders (2004), the use of probability sampling involves identifying an appropriate sampling frame based on the research questions and aims, and deciding on a sample technique and sampling size.

Sampling frame. For any probability sample, the sampling frame is "a complete list of all the cases in the population from which your sample will be drawn" (Saunders, 2004). This study was focused on investigating cloud computing within Saudi universities and the population was a complete list of 26 government universities. This list of universities was attained from the Ministry of Higher Education (http://he.moe.gov.sa/en/studyinside). At these universities, those in academia, IT staff, and deans of the colleges or departments of Computer and Information Science were contacted because of their expertise in the field of information technology, and their insight into various advances in the field.

Sample size. Hair et al. (2010) strongly suggests that selecting a suitable sample size is the beginning of the process of generating a consistent and reliable outcome upon data analysis. Two approaches were used in

order to assure an adequate sample size for this study. Firstly, the required sample size for the data analysis technique was calculated. The primary data analysis technique was structural equation modelling (SEM), the main requirements of which consist of a minimum sample size greater than the number of correlations in the input data matrix (Hair et al., 2010). This amounts to a ratio of 1-2 respondents per item. With an estimated 48 items in the model, the required sample size for the usage of SEM analysis was approximately 240 to 280. Secondly, factors surrounding the size of the population, the required margin of error, level of significance, and the statistical technique in the analysis of the data were taken into consideration (Saunders, 2004).

Sampling technique. With an appropriate sampling framework and requisite sample size identified, the researcher went on to select an appropriate sampling technique suitable for the probability sample. Stratified, cluster, and random sample are the technique choices for a probability sample. A stratified sample is acceptable when the sampling framework contains dichotomous groups, for example, adopters or non-adopters of the technology. Cluster sampling shares the qualities of stratified sampling because it allows the division of the population into subgroups (Henry, 1990).

A random sampling technique is ideal for studies where the geographical area is wide or there is a heavy usage of online questionnaires for collecting data. Random sampling was used in this study in order to obtain a comprehensive sample. A total of 1600 participants was selected randomly from 26 universities throughout Saudi Arabia .

3.4.2 Questionnaire distribution

The questionnaires were distributed online and as paper copies. The survey was made available on a dedicated website and 1600 emails were sent to 26 Saudi universities. Email addresses were derived from the universities' websites. The email explained the purpose of the research and invited the receiver to participate before directing participants to the website. Follow-up reminders were sent by email to the same cohort after two weeks. A total of 398 responses was received. Therefore the response rate was 24% which is consistent with the average response rate of 25% of similar studies (Rampersad, 2009)

With regard to the paper questionnaires, the researcher personally handed out the questionnaire in only one university (Princess Nourah University) with a formal letter from the Department of Scientific Research in PNU.

3.5 Quantitative data analysis techniques

Structural equation modelling (SEM) was used to analyse the data because it is a very useful way to test theories. It enables researchers to test whether latent variables in a pre-specified hypothesised theoretical model are related to each other (Hair et al., 2010). Using SEM, the researcher can express a theory containing a set of latent and observed variables in order to define the relationships between these variables.

SEM is a technique for examining how well a theory fits a data sample (Hair et al., 2010). It is a process involving two steps: validating the measurement model, and fitting the structural model (Hair et al., 2010; Kline, 2005). To analyse the data, *AMOS* (analysis of moment structures) Version 22 and *SPSS* Version 22 were used. *SPSS* is often used for generating descriptive statistics, charts, tables, and plots of distribution and trends (Arbuckle, 2009). *AMOS* is a tool for performing complex SEM analysis (Arbuckle, 2009).

Prior to conducting these multivariate statistical analyses, examination of the data and scale reliability were conducted, the purpose being to determine if they met the basic assumptions required for further analysis. This project used Cronbach's alpha, a measure of reliability that provided an indication of the consistency of the responses across items.

3.6 Ethical considerations

At all times during the study, the rights of the participants were kept in mind. Privacy, anonymity and confidentiality were considered always (Aleid, Rogerson, & Fairweather, 2009; Neuman & Neuman, 2006). Sapsford and Jupp (2006) have pointed out that professionalism demands that respondents' consent is sought and confirmed, that research parameters are clarified before participants begin their contribution, that the participants' anonymity and privacy is guaranteed, and that all electronic and physical copies of the survey are safe from unauthorised access.

3.7 SummaryAfter development of the conceptual model in the previous chapter, Research methods that were adopted for this study were explained in this chapter. In order to answer the research questions, the use of the mixed-method approach was utilised and described. In addition, the use of interviews and the design of the survey were discussed. It was noted that the study was divided into two phases – qualitative and quantitative. Qualitative research was useful in the exploratory stage to develop the conceptual model and hypotheses from the literature, and to serve as a basis in the design of the quantitative research. The influences factors related to cloud computing adoption decision were gathered in the conceptual model. The quantitative research was useful in providing explanatory or causal evidence and in advancing theory.

Chapter 4

Qualitative findings

Qualitative methods were utilised in this study in the exploratory stage in order to confirm the relevant factors affecting cloud computing adoption in Saudi universities. The data from this stage contributed to the refinement of the conceptual model that arose from the literature review and served as a base for the next research stage.

4.1 General observations in relation to the context of the research – PNU

The analysis of the data showed that all university members exhibited excitement about the idea of adopting cloud computing. The top managers displayed awareness of the importance of adopting cloud computing, but responsibility for the process was unclear, and staff were waiting for suitable action to begin from somewhere. As interested as they were, the staff did not know much about the significance of the technology and required more information.

4.1.1 Current use of the cloud at PNU

Ironically, cloud computing is actually available at PNU, where there is a cloud service in partnership with Microsoft to allow communication and information sharing between the students and staff (PNU, 2016a), and PNU has a very ambitious vision to automate the university (PNU, 2016b). Thus, ICT systems run on university servers are already in use in the teaching and learning context, running software such as *Blackboard*, the library system, the student information system, and smart classrooms. Moreover, the university uses – for maintenance and technical support – an interactive system between the university employees and the technical support staff. The system receives reports of and manages technical problems. Within the management context, PNU uses different systems like *Oracle* ERP, document and correspondence management, and an archiving system.

The universities in Saudi Arabia are gender segregated, which means that male and female students and staff are on different campuses, but they can contact each other via video conferencing, with male professors and faculty members broadcasting lectures and attending virtual meetings. PNU is a female-only university, and male staff represent only around 10% of the population of PNU employees. They work mostly either as faculty members or in the IT management department. Based on Saudi tradition, the male employees are located in buildings far from the female departments.

PNU has a frequently updated website which provides many services to university stakeholders, as well as a private email system, and a large wireless network throughout the campus. Every staff member is provided with a quality computer.

4.1.2 Findings from the interviews at PNU

Thematic analysis was used to investigate the factors derived from the literature. The main findings were categorised into four main themes:

- technological factors
- organisational factors
- environmental factors
- cultural factors.

The results were matched in those themes to make them easier to recognise. The interviews were conducted with key members of Princess Nourah University (PNU).

4.2 Technological factors

The technological context included four factors: relative advantages, compatibility, security concerns, and complexity.

4.2.1 Relative advantage

The findings of the analysis of the qualitative data revealed that the relative advantage of cloud computing was one of the factors that would promote its adoption by the university. Its advantages would motivate them to start using information technology the university already has and give them the chance to perceive the benefits of cloud computing.

Results from the interviews indicated that the relative advantages of cloud computing appealed to the participants and that they wished to adopt the technology soon. This was agreed with previous studies such as (Dwivedi et al., 2009; Ghobakhloo et al., 2011; Premkumar & Roberts, 1999; Sin Tan, Choy Chong, Lin, & Cyril Eze, 2009). One of the top managers (Interviewee_B) at PNU explained that cloud computing was attractive to staff who could easily be persuaded to use it:

> *Cloud computing has very attractive features which facilitate convincing the staff to commence using it without any resistance.*

In this study, *relative advantage* denotes a reduction in administrative requirements, updated IT systems, reduced maintenance efforts, reduced software costs, and increased flexibility of computing resources. Various interviewees noted that the cloud made it very easy to access resources as required, thereby removing pressure on staff since additional resources could be accessed during periods of heavy workload:

> *By using cloud computing, resources are scalable, and this is will help to handle the pressure during busy periods such as exams. (Interviewee_D)*

> *It is amazing for the university to be able to grow or shrink computing resources as required. (Interviewee_G)*

Additionally, Interviewee_H mentioned that the cloud benefitted the students as well as staff since data could be stored centrally while any device could be used to access it:

> *Joining the cloud will help in solving a major problem in the university; provision of computers for each student is a serious issue especially with the growth of student numbers each year. So by using the cloud, students can use their own laptop or iPads to follow their peers.*

Similarly:

> *Easy access will help remote employees to use any applications via the Internet from anywhere using their mobile or laptops. (Interviewee_F)*

So, it was discovered that a major and valuable characteristic of cloud computing is its ease of accessibility.

Another of the most appealing characteristics of cloud computing is cost saving. Some of the interviewees mentioned that saving the cost of upgrading software licensing and the maintenance is a great benefit of cloud computing. Interviewee_D stated that:

> *Cloud services can help save money in many ways, including server maintenance and power, in addition to software licensing. The university finds difficulties in getting or upgrading software licensing or getting the latest version for each computer, but by using cloud computing it wouldn't be the university's responsibility. This also will create the benefit of decreasing the administration efforts and reduce hardware and software maintenance efforts.*

Similarly:

> *If system updating will not be the university's responsibility, that will be of great benefit in keeping the system and applications always updated, and save huge time, cost, and efforts that can be redirected to other fields. (Interviewee_H)*

The majority of participants commented positively on the relative advantages of cloud computing and argued that the relative advantages of its adoption would be important when deciding to adopt this technology.

4.2.2 Compatibility

The interview findings showed that compatibility had a positive effect on cloud adoption. Computing with the existing information infrastructure was considered important and influenced the willingness to adopt. This is consistent with (Chebrolu, 2010; Espadanal & Oliveira, 2012), who also found that compatibility has a positive correlation with cloud computing adoption. A variety of interviewees underscored compatibility awareness at the university. They agreed that applying cloud computing is a convenient method to fulfil the university's vision and maximize its infrastructure. Interviewee_A stated:

> *The University aims to provide innovative methods for education and learning which can be integrated into academic programs, such as e-learning. In addition, it intends to develop work procedures by using modern approaches.*

Similarly, Interviewee_C mentioned:

> *The University is equipped with the latest technology and smart devices and using cloud computing will activate them efficiently and achieve the university's strategy.*

Thus, this means that compatibility of cloud computing with existing information infrastructure is an important factor in the adoption process.

4.2.3 Complexity

The university considers this factor to be an obstacle to the adoption of any new technology, particularly cloud computing. This was compatible with (Tashkandi & Al-Jabri, 2015) and (Powelson, 2011) that observe a negative relationship between complexity and the adoption of cloud computing. The outcomes indicated that cloud computing complexity may hinder the university from upgrading its services to cloud computing, particularly if staff are not up-to-date with the modern technology.

One of the interviewees expressed concerns regarding cloud system complexity when the principal operators or adopters have no clear indication, or find it difficult to comprehend and deal with, but saw advantages in greater ICT education. Interviewee_E stated that employee training is a better way to ease dealing with cloud adoption:

> *If we find cloud computing too complex I think, we should spend more effort into training.*

On the other hand, some interviewees see that dealing with cloud computing does not need complex skills. Interviewee_H mentioned that:

> *Dealing with the cloud does not require complex skillset to manage if the person receives proper training.*

Moreover, Interviewee_F stated:

> *When using cloud computing, people do not have to worry about how storage systems work or which settings are optimal for certain applications. So, end users don't have to possess complicated skills to finish their work.*

In addition, emphasis was placed on the availability of expertise. IT experts in the university would be called upon to transfer sensitive data to the cloud, and successfully integrate current applications with the cloud. Interviewee_B declared:

> *I think that integrating current applications with the cloud and transferring our data to the cloud are core issues that have to be done using proper approaches, or else they will turn into a huge problem.*

It was noticed that interviewees at all levels and professional positions strongly expressed the view that cloud computing must not be complicated and must be user friendly. In conclusion, interviewees were realistic about complexity as an issue in cloud adoption. Working in the cloud could simplify the use of ICT, but the introduction of the technology required a thoughtful process.

4.2.4 Security concerns

This qualitative research study uncovered contradictory findings regarding cloud computing security. Many interviewees expressed concerns about risk factors related to unauthorised access and data ownership. This is consistent with (Alsanea, 2015; Dillon, Wu, & Chang, 2010; Zissis & Lekkas, 2012). Some of the interviewees stated that unauthorised access and data ownership are the biggest security concerns. One of the top managers, Interviewee_B, emphasised this by stating that:

I think security concerns about cloud computing have various forms of risk. One of them is access of unauthorised persons to students' private information or study records.

Similarly:

Data ownership and responsibility could be compromised in a cloud. It is somewhat threatening to feel that you do not have control of your own data (Interviewee_G).

Interviewee_D stated:

There are always some risks when handing over the university's data, manipulating it and storing it in infrastructure you do not own or control.

Intellectual property was another dimension of security concerns of cloud computing, as stated by Interviewee_H:

I know there are huge benefits associated with cloud computing. However, intellectual property issues in the cloud continue to be an unclear area for both the organisation and the provider.

For others, cloud computing appealed as a secure option, especially when using an internal private cloud, as confirmed by Interviewee_B, who stated that there is a solution for unauthorised access:

Of course, security is a very important issue but recently, new solutions have been developed to run firewalls proprieties, deciding access authorities, and using encryptions.

But in case of using public or hybrid cloud computing, the concerns are still there, as Interviewee_C declared:

The importance of public or hybrid cloud computing advantages are more clear in the following cases: small colleges that have low levels of computerisation, or have a lack of staff with adequate IT skills, or those who care about their data security. Such small colleges can solve these situations by contracting with a cloud service provider, so it can adopt state-of-the-art applications and services without the need for employing IT staff, with the additional benefit of saving maintenance and installing costs.

To conclude, security is a critical factor for the university in deciding to adopt cloud computing. Furthermore, this concern could be conquered by supplying all necessary technical and management preparation.

4.3 Organisational factors

The organisational context includes two factors: senior management support and readiness.

4.3.1 Top management support

Analysis of the findings from the interviews indicated that top management have the power to influence organisational members. This finding was compatible with other studies like (Dong, Neufeld, & Higgins, 2009; Liao & Tseng, 2010; Xu & Quaddus, 2012). Some interviewees agreed that the success of adoption process depended greatly on the commitment of senior management. Interviewee_F supported the importance of top management support:

> *It is a crucial distinction between top managers, that some have a clear and precise strategy about what cloud computing is and the benefits it brings.*
>
> *Moreover, the more top management provides supports to the university, the more the adoption process become easier.*

Interviewee_A said:

> *PNU has a clear vision of adoption for the university's private cloud and takes firm steps to commitment to this vision.*

One side of a supportive management is to encourage employees to accept the benefits of the new technology by providing training courses to get the most benefits from the proposed technology:

> *In the case of adopting a new technology, it is critical for top managers to prepare employees and keep them on track. Employees cannot master new technology by themselves. For this reason, encouraging employees and offering training courses should occur (Interviewee_F).*

Interviewee_H expressed her view about the difficulties of getting training courses.

> *Most academics don't make use of training courses due to many reasons such as a lack of spare time and a lack of coordination with other academics to cover the curriculum. Furthermore administration takes higher priority compared to completing teaching and updating one's academic skill level.*

Interviewee_G added:

> *The training courses provided in the university are totally up to the employee and there is no follow up procedure taken to appraise the employee's level.*

Similarly:

> *Lack of motivation and follow up procedures from the upper management affects the effective usage of the university resources (Interviewee_F).*

Interviewee_B pointed out that the support of top management can overcome the change resistance of some employees by encouraging and supporting:

> *The reactions of introducing a new technology in a work place… varies between employees. Some might welcome change, but others will resist change. As a top manager, I see it is important to introduce the new technology slowly by offering training courses… When adopting cloud computing, the role of top management is crucial. They must encourage and support their employees, so that they will be willing to learn new skills and adapt to change.*

So, the findings show that most of the interviewees recognised the importance of top management rules, and how top management can facilitate the adoption process.

4.3.2 Readiness

Cloud computing technology requires an appropriate IT infrastructure. All interviewees insisted that IT infrastructure was required before cloud computing could be adopted. This is consistent with previous studies (Hong & Zhu, 2006; Lumsden & Anabel, 2013; Oliveira & Martins, 2010; Yoon, 2009). Readiness for using cloud computing tools was considered essential before their introduction. For example, an (Interviewee_E) indicated that the infrastructure is a major factor before adopting cloud computing:

> *It is impossible to implement any computer system without a proper infrastructure.*

Interviewee_A talked about PNU readiness:

> *I think the university infrastructure is ready for cloud adoption. Hardware requirements are updated and the university is equipped with the latest IT devices.*

Interviewee_H mentioned a wireless network weakness as a major obstacle faced from adopting cloud computing in the university:

> *I think the local wireless network coverage on campus is not strong enough to apply cloud computing effectively.*

Human resources readiness is also included within organisation readiness, as found in the literature (Oliveira & Martins, 2011; Tornatzky & Fleischer, 1990; Wang, Wang, & Yang, 2010). Employees should have the knowledge and the skills to use the new system efficiently. Some interviewees insisted on staff preparation to success adoption. One top manager (Interviewee_D) stated that:

> *I think almost all the technology resources are available currently to adopt a new technology, but we still need to prepare employees to make the best from it.*

Similarly:

> *Most of the staff don't have the knowledge to make use of their computers and facilities effectively. (Interviewee_F)*

Another top manager (Interviewee_B) added:

> *Most of the available systems are inactivated and not involved in the work routine due to the lack of knowledge and training.*

It could be concluded, therefore, that organisations in which employees were trained/experienced and ready for IT systems and tools were more suited to the adoption of cloud computing.

4.4 Environmental factors

The environmental context includes two factors: competitive pressure and regulatory support.

4.4.1 Competitive pressure

The findings show that the main external pressure on the university is to keep PNU abreast with the latest technology. Prior studies have found that competitive pressure increases a firm's incentives to seek new technology innovations so as to maintain a competitive edge (Iacovou, Benbasat, & Dexter, 1995; Kamien & Schwartz, 1982). Interviewee_A confirmed that competitive pressure strongly influenced universities to adopt cloud computing in order to get a higher position among other universities:

> *No doubt, the surrounding environment has a direct effect on the university's decision. The competitive pressure faced by the university is a strong incentive to adopt new technology, to keep our university abreast with technical advancements to improve our university's high ranking among local and international education institutions.*

One of the top managers (Interviewee_B) asserted that:

Most of the leading universities in Saudi Arabia and in the world use the latest learning technologies. This puts more pressure on our university to compete as the largest women's university in the world; especially as we have the potential (financial and technological) to be one of the best universities in Saudi and even internationally.

Adopting new technology is often a strategic necessity when competing in the market place. Competitive pressure is an additional factor driving an increased need for cloud computing.

4.4.2 Regulatory support

Data from the interviews indicated that Saudi government support for the adoption of cloud computing is one of the most significant factors influencing universities to adopt it. The Saudi Arabian government supports the utilisation of new technology to modernise Saudi education. This finding is consistent with preceding studies in other countries such as (Pan & Jang, 2008; Zhu, Kraemer, & Xu, 2006). Interviewee_D stated that government supports adopting new technologies by encouraging and funding:

Certainly, the government plays a significant part in supporting us to reach our goals by introducing new technologies. It supports us by allocating sufficient funds for investing in technology.

Similarly:

In my opinion, the support from government is a crucial issue. (Interviewee_B)

In contrast, many interviewees declared their concerns about regulatory factors. Some interviewees mentioned that regulations and lack of experience could negatively affect cloud computing adoption. Interviewee_F stated that :

Lack of regulations could hinder the adoption of any new technology especially cloud computing.

Another Interviewee_B stated that:

I think cloud computing is a pretty new technology in the Middle East society and no clear regulations have been established yet... The external resources such as consulting firms and other technical support resources have weak commitments and lack of experience.

Similarly:

> *Many questions should be answered before cloud adoption, such as: does the cloud provider have the right to access the data? Who is legally responsible for the data security? What will happen to the data after the service is terminated. (Interviewee_C)*

> *Most regulations – if they exist – lack clarity for cloud services, because they still are not technologically specific enough. (Interviewee_H)*

In summary, the support and encouragement of the government is fundamentally essential and can motivate universities to accelerate the adoption of cloud computing, as government authority will help in solving any problems that may appear between involved parties when using this service. Appropriate regulations and laws must be published by the Saudi government, which **must** take responsibility for sponsoring and developing the process of adoption.

4.4.3 Cultural factors

The cultural context includes five factors: uncertainty avoidance, power distance, masculinity, and individualism.

Power distance (PD). Power distance describes how individuals view power distribution in organisations. The analysis of the interviews demonstrated that power distance could play a negative role in the adoption cloud computing. This is consistent with (Abdulrab, 2011; Al-Sukkar, 2005; Erumban & De Jong, 2006; Zhao, Scheruhn, & von Rosing, 2014). Interviewees conveyed their views by the following statements that admitted that Saudi organizations were hierarchical and that employees accept this style:

> *In Saudi, people accept a hierarchical order in which everybody has a role where centralisation is common and bosses expect subordinates fulfilling what they are told to do. (Interviewee_G)*

> *Most Saudi and Middle Eastern organisations have a hierarchical style where managers have control and task distribution authority. On the author hand, employees accept and do their work. (Interviewee_F1)*

One of the top managers, Interviewee_B, stated that a gap existed because of power distance while others encouraged eliminating the gap by getting employees closer to their bosses:

> *Some managers failed in communicating with subordinates because of the power distance, which could hinder the adoption process.*

The other top managers added:

> *While the university decision makers are powerful and respected by their subordinates, they are not comfortable with taking advice from their employees or consulting them. (Interviewee_D)*

> *Managers should encourage their subordinates to freely express their doubts and disagreements when making decisions. (Interviewee_C)*

Interviewee_E stated that:

> *In general, managers and directors are not always as aware of the technologies and emerging trends as is IT staff. So, managers should consult and take their staff advice.*

In summary, power distance is considered a significant issue. Managers could contribute to improving adoption by understanding the negative effect of large power distance between them and their subordinates, and find ways to lessen the impact.

Uncertainty avoidance (UA). Uncertainty avoidance pertains to a society's tolerance for uncertainty and ambiguity. The findings from the interviews highlighted the fact that uncertainty avoidance was high among participants in this research. This is consistent with (Al-Sukkar, 2005; Erumban & De Jong, 2006; Hermeking, 2005; Zhao et al., 2014). This was confirmed by most of the interviewees. They agreed that most people in Saudi society avoid the unfamiliar and unknown. Interviewee_B stated that:

> *Adopting new technology in the university and taking the responsibility to make any new project successful is considered very risky. Taking the decision to change indicates the courage to avoid uncertainty involved in the project... In our culture people always avoid the unknown. They mostly prefer traditional procedures, as long as they do the job. This could postpone change.*

Interviewee_B also declared that:

> *In general, decision makers in our society are not risk takers when dealing with IT projects. For some of them, new technologies are something unknown and there are no definite expected results that they can rely on, so they may choose to avoid risks.*

The top manager (Interviewee_F) added:

> *People here like to be controlled by well-known rules which mostly come from religion and cultural concepts.*

And Interviewee_H stated that:

> *Some academics didn't feel the need for online education or technologically equipped classrooms. It is more likely that they fear that these new technologies would introduce barriers to adopting technological improvements.*

Uncertainty avoidance is a significant factor that can affect the speed of the adoption process. Understanding the impact of uncertainty avoidance on IT adoption is important, and finding ways to overcome it is something that needs to be considered.

Individualism (IDV). Individualism defines the degree of individualism compared to collectivism in a culture. The interview data indicated that collectivism hampers the adoption of cloud computing, whereas the inclination to act as an individual could contribute to its uptake. This is consistent with (Abdulrab, 2011; Zhao et al., 2014). Interviewees showed that Saudi society tends towards collective living and achievements, and avoid facing new situations individually. Interviewee_A stated that:

> *People here tend to view themselves as members of groups such as families and tribes.*

Interviewee_H added:

> *People in our society prefer group achievements rather than individual accomplishments.*
>
> *The Saudi society is controlled by tribal systems that have very strong relationships, which means people take care of their direct family, extended family, and extended relationships. (DH3)*

One of the top managers mentioned:

> *The priority in our society is still the group, generally, there is no chance for individuals to participate in making big decisions. Interviewee_B*

In summary, for cultures in which the emphasis is on group decision making and action, the spread of new technologies is slower than in those cultures in which the individual generally makes decisions for themselves.

Masculinity (MAS). Masculinity refers to the distribution of roles between genders in a culture. A society is described as masculine if emotional gender roles are perceived as distinctly different. Males are assumed to be firm, harsh, and focused on material success, while females are assumed to be more modest and tender.

According to studies (Gudykunst & Mody, 2002; Van Everdingen & Waarts, 2003), the MAS cultural dimension impacts IT adoption, which consistent with the interviewees opinions. One of the top managers (Interviewee_C) asserted that:

> *Saudi society utilises a hierarchy model in which mangers are expected to be decisive and firm. The significance is on competition and performance.*

Regarding gender roles and the expected behaviour of the two genders, some interviewees declared that authority and technical positions were mostly exercised and taken by men:

> *If you mean by masculinity, the difference between male and female, I think our society experiences a high level of gender differentiation, since females are always controlled by male authority and males dominate a significant portion of the society. (Interviewee_D)*

> *Most or almost all the IT services are centralised and under the control of the ICT department of the university which is controlled by male power. Based on the cultural and moral tradition in Saudi Arabia, the male employees are located in buildings far from female departments. The communication between male management and female staff are always via the female technical support team who mostly have very limited power to deal with technical problems. (Interviewee_G)*

So, masculinity impacts the adoption of technology, in that masculine cultures tend to be more inclined to adopt ICT.

4.5 Emergence of new factors

New factors emerged during the interviews that were important to the interviewees, and the researcher considered them worth adding to the conceptual model.

The new factors were language and religion, which were highlighted in the literature as significant in cultural contexts. They are discussed here together due to the close functional relationship observed in the interviews. They were added to the cultural context of the conceptual model.

In terms of dealing with technology and information, language was considered to be a barrier to adopting a new technology. This is consistnent with Maitland and Bauer (2001) and Grazzi and Vergara (2012). Interviewee_H declared that new technologies are mostly offered in English, and that not all members of the society had English mastery:

> *Of course language is considered as a big barrier to adopting cloud computing or any other information technology, because initially the majority of Saudi end users may not be familiar or comfortable when using the technology which is generally in English.*

Another interviewee (Interviewee_F) added that not all tehnolgies were compatible with religious regulations, especially when dealing with the Internet:

> *Regarding the religion barrier, the introduction of new technology is generally resisted by some individuals, as it offers access to unlimited resources. This unprecedented access that is made available by these technologies may not always abide with the regulations of religion.*

One of the interviewees (Interviewee_C) saw that the cloud as a good way to improve communication across the university because aspects of the culture could be accommodated:

> *In Saudi Arabia, the schools and universities are gender segregated which means that there is a separation of men from women in social settings due to the application of Sharia law. With cloud computing, interaction between both genders has been facilitated. Both male and the female staff are now able to communicate with one another with ease by using virtual conferences and other social applications.*

Language – the primary means of human communication – is critically important because it is a gateway for knowledge transfer in the digital age (Gloor, 2012). The literature supported the observation that language is an important obstacle to IT diffusion, especially in developing countries. Al-Gahtani, Hubona, and Wang (2007) and Vatanasakdakul, Tibben, and Cooper (2004) have pointed out that amongst many barriers to IT diffusion in developing countries, language disparity can be ranked as one of the most severe. English was the predominant language in the development of IT and in the ongoing development of new technology in the IT field, and is consequently the principle language used on the web (Chieochan, Lindley, & Dunn, 2002; Perry & Schneider, 2000).

Vatanasakdakul et al. (2004) argue that language should be integrated more comprehensively into Hofstede's culture dimension because of its significance as an integral aspect of all cultures (Evers & Day, 1997; Hall, 1973). The domination of the Internet by English-language websites is a well acknowledged issue for non-English speakers (Lazarus & Mora, 2000; Shapiro & Rohde, 2000; Thomas et al., 2005). This can be more of an impediment for non-English speaking, mature aged people and the less educated, who are less likely to speak a foreign language (Thomas et al., 2005).

Regarding religion, Slowikowski and Jarratt (1997) indicate that cultural factors, specifically, 'traditions', 'religion' and 'fatality' play important roles in the adoption of innovation. Religion is a critical cultural element, and a convincing identifier in global as well as regional geopolitical conflicts (Tanasyuk and Avgerou (2009). Furthermore, as Hill, Loch, Straub, and El-Sheshai (1998) state, religion plays a significant role in the lives of Arabs. Religion affords the foundation for their beliefs and ethical restraints.

4.6 The revised conceptual model

After conducting the qualitative data analysis, a revised conceptual model was developed and is presented next. Generally, no radical changes were made to the conceptual model originally derived from the literature and presented in Chapter 3. The conceptual model grounded in the extended TOE framework hypothesised the factors required for the adoption of cloud computing from four dimensions: technology, organisation, environment, and culture.

The revised model took into account the new factors that were discovered to influence the adoption of cloud computing. The purpose of the revised model was to establish the main factors and their context, in order to deepen the understanding of the nature of the problem, as shown in Figure 4.1.

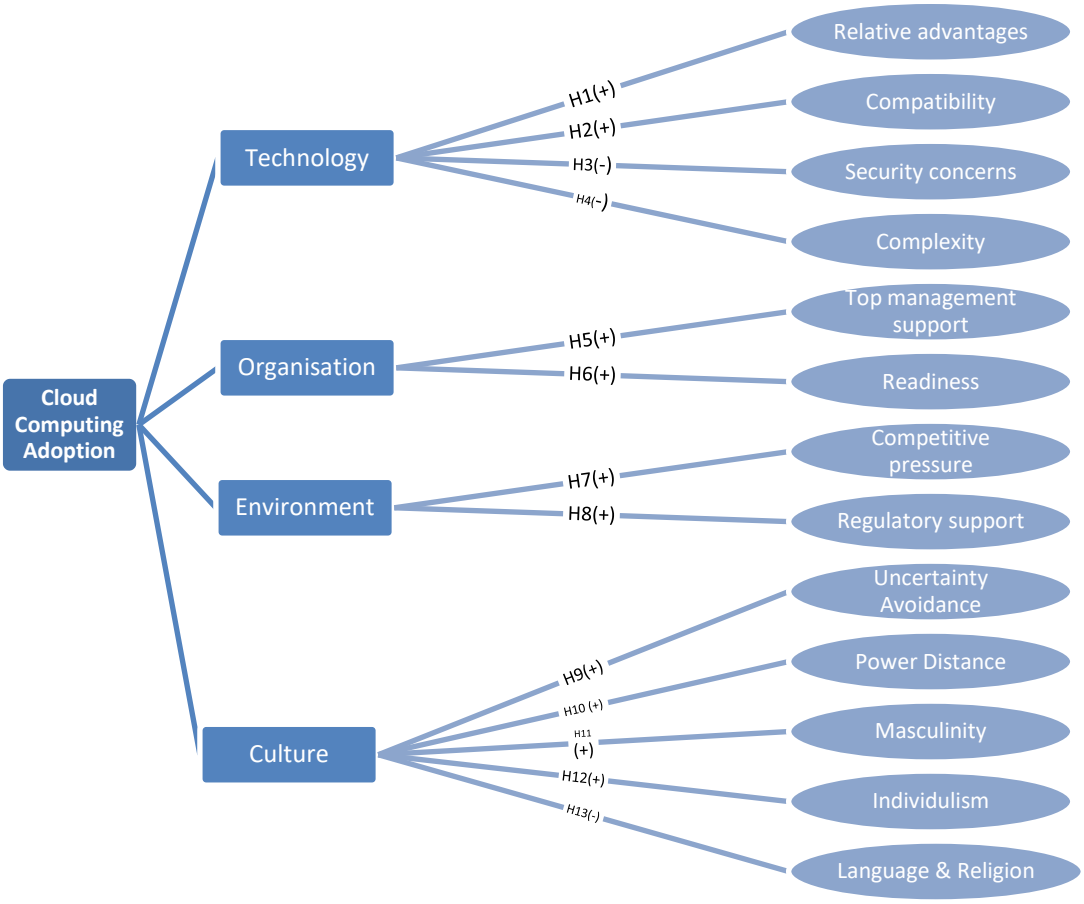

Figure 4.1 The revised model (after adding the new factors)

4.7 Summary

This chapter has covered the analysis of the qualitative data gathered from the interviews. It discussed the issues facing Saudi universities when they considered moving onto the cloud. The study exposed new factors that may influence the adoption of cloud computing, which were not existing in the initial conceptual framework. This step was crucial to confirming the critical factors that affect cloud computing adoption in Saudi universities.

All the factors and issues that have been discussed are classified in four categories: technological factors, organisational factors, environmental factors, and cultural factors. The technological context includes four factors – relative advantages, compatibility, security concerns, and complexity. The organisational context includes two factors – top management support and readiness. The environmental context includes two factors – competitive pressure and regulatory support. And the cultural context includes five factors – uncertainty avoidance, power distance, masculinity, individualism, and language and religion.

The four key contexts of this study have been developed and designed according to the theoretical background discussed in Chapter 2. The literature review and the interview analyses demonstrate that these factors are vital and should be carefully taken into consideration when adopting cloud computing in Saudi universities.

In addition, the findings from the interviews contain important information provided by personnel from PNU University, some of whom are decision makers. Therefore, where their opinions are favourable toward the cloud, taking their interest into consideration will ease the shift to cloud computing.

Moreover, the qualitative outcomes led to new factor(s) (language and religion) being introduced. Consequently, a revised conceptual model is presented in this chapter as seen in Figure 4.1. The next chapter shows in detail the survey findings for the quantitative research to test the revised model that was presented in this chapter.

Chapter 5

Quantitative findings

This chapter presents the results of the quantitative findings for this study. The survey was conducted between October 2014 and February 2015. In this chapter, the quantitative survey data is described regarding personal information and the current situation at Saudi universities, along with a detailed analysis of SEM, and the testing of the hypotheses.

5.1 Brief summary of quantitative data collection

There are 26 public universities in Saudi Arabia, among them Princess Nourah University (PNU) is the only all-female university and King Fahd University of Petroleum and Minerals is the only all-male university. There are also ten private universities, and most of them are for both men and women (MOHE, 2013). Most of the universities have separate campuses for each gender. Male and female academics teach on the female campuses, with the lectures presented by the males via closed-circuit TV or screen. Only male academics are allowed to teach on the male campuses (Al-Omar, 1998; Mengash, 2001).

An electronic survey was used to collect data from the public universities only. Invitation emails were sent to 1600 potential participants at all 26 Saudi public universities. These e-mails were sent to academics and deans, as well as university administrators and technical support staff. The survey was viewed by 1398 people, and there were 398 completed responses. In addition, a paper-based questionnaire was distributed at Princess Nourah University only. A total of 70 copies was distributed and 50 completed questionnaires were collected. A total of 448 paper and non-paper-based questionnaires was collected. After screening the questionnaires for missing data, outliers, and normality, 421 usable responses were left.

5.2 Descriptive statistics

5.2.1 Personal information

As mentioned, the surveys were distributed to all 26 government universities around Saudi Arabia, and 23 of them participated in the survey. The largest proportion of responses (43.2%) was from PNU in Riyadh. Initially, the research was to be conducted only at PNU as the largest female only university in the world. The university's multidisciplinary design combines culture and the latest educational methodology, making PNU fertile soil for the study. Only at PNU was the survey distributed in paper form and online, and the paper-based surveys led to higher responses. Paper-based surveys ensure precise identification of the key participants, which minimises the chance of low response and completion rates (Kinnear, Taylor, Johnson, & Armstrong, 1993; Rampersad, 2008).

After the survey was successfully distributed at PNU, the study was extended to include other universities in Saudi Arabia. The next highest percentage of completed responses was from Dammam University at 18.8%. Dammam University is located in one of the largest cities in Saudi Arabia and the university has a heavy IT focus. The Dean of Information and Communication Technology at Dammam University reported that the university was working on significant electronic projects involving high quality technology with the support of students and employees (Riyadh, 2013).

The next highest responses ranged from 6.9% to 3.6%. They were from the largest universities in Saudi Arabia, which are located in other main cities, including Riyadh (the capital city), Jeddah (main west port), Dammam (main east port), AL Madinah and Makkah (holy cities). The rest of the responses were from different universities around the country, and each of these accounts for less than 2% of the responses.

The following pages present the respondents' background characteristics with regard to age, gender, level of education, position, and experience.

Age. As shown in Table 5.1 and Figure 5.1, female respondents between 20 and 29 years of age and between 30 and 39 years accounted for just under a third of the total respondents, followed by the 40 to 49 years old age group, with just under 10% of the respondents. Finally, only about 2% of respondents were females 50 years of age or over. Turning to the male participants, just over 10% of respondents were in the 30-39 years age group, followed by just over 6% of respondents aged between 20-29 years and also between 40-49 years. Finally, 3.1% of respondents were males 50 years or over.

Table 5.1 Percentage of the respondents according to their age group by sex

Age group	Female	Male	Total
Between 20 – 29	30.2	6.2	36.4
Between 30-39	32.5	10.7	43.2
Between 40-49	9.3	6.2	15.5
50 or over	1.9	3.1	5

Only 5% of the respondents were 50 years of age or over. This could be due to the fact that participants over 50 years may not be interested in cloud computing and IT in general, or may be unaware of the IT system at the university. According to Alshumaim and Alhassan (2010), computers were introduced to all secondary schools in 2001, when the Ministry of Education in Saudi Arabia recognised a need to eliminate computer illiteracy.

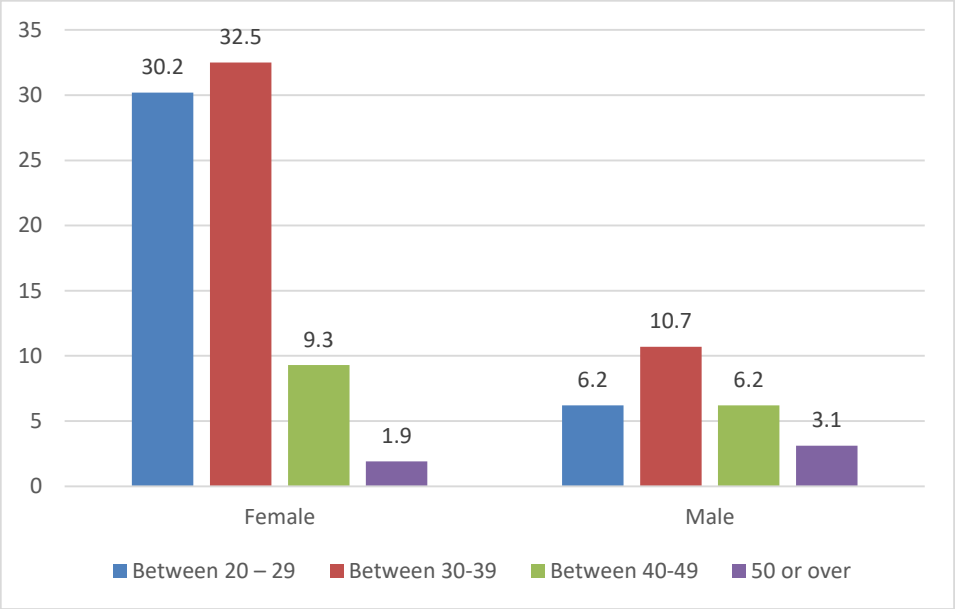

Figure 5.1 Chart of the respondents according to their age group by gender

Therefore, it is possible that the older group, aged 50+, may not have been formally educated about computers. The younger generation, that is, the majority of the participants, are likely to have contributed more to the survey because they use the computer system on an almost daily basis.

On the other hand, Figure 5.2 shows that there was a higher number of males than females in the group aged 50+. This could be because females are more likely to retire before males (TradingEconomics, 2016) in Saudi Arabia, where the retirement age for women is 55 while for men it is 62, which means men work more years.

Gender. The percentage of females participating in the survey was 73.9%, which is higher than the percentage of males at 26.1% (see Figure 5.2). The ratio of male to female staff in Saudi universities is 3:2 (Arabia, 2013), which contrasts with the male-female ratio among the participants of this research. The reason for the difference is that 43.2% of the participants were females from PNU, and all-female university.

Figure 5.3 illustrates the percentage of each gender among the participants. When the participants from PNU are removed, the gender balance of the respondents moves closer to the normal ratio, with 56% of respondents being female (Figure 5.3).

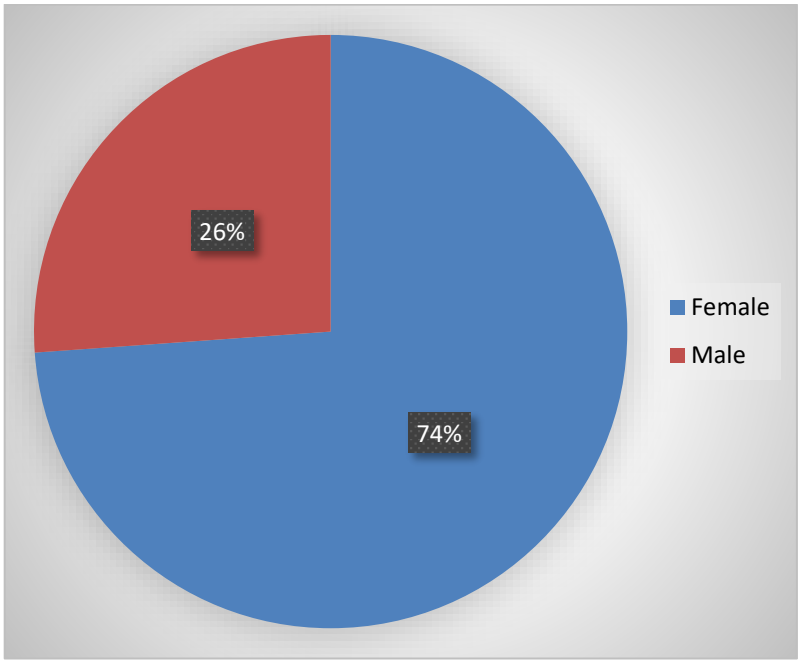

Figure 5.2 Percentage of male and female respondents

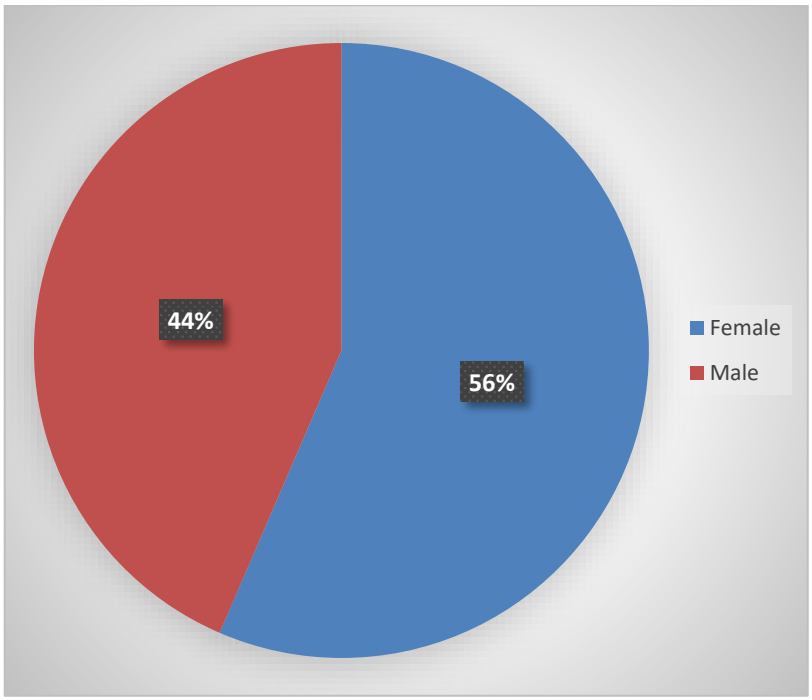

Figure 5.3 Percentage of male and female respondents without PNU

Qualifications. The survey shows a high percentage of participants held Bachelor's degrees at 39.2% (female 32.3%; male 6.9%) and Master's degrees at 32.5% (female 24.9%; male 7.6%). 23.5% (female 12.6%; male10.9%) had a PhD. The percentage of people with a diploma or high school qualification as their highest level of study was 4.8% (female 3.6%; male 0.7%). See Table 5.2 and Figure 5.4.

Table 5.2 Percentage of the respondents according to their qualification by gender

Qualification	Female	Male	Total
Doctorate	12.6	10.9	23.5
Master degree	24.9	7.6	32.5
Bachelor	32.3	6.9	39.2
High School	0.5	0	0.5
Diploma	3.6	0.7	4.3

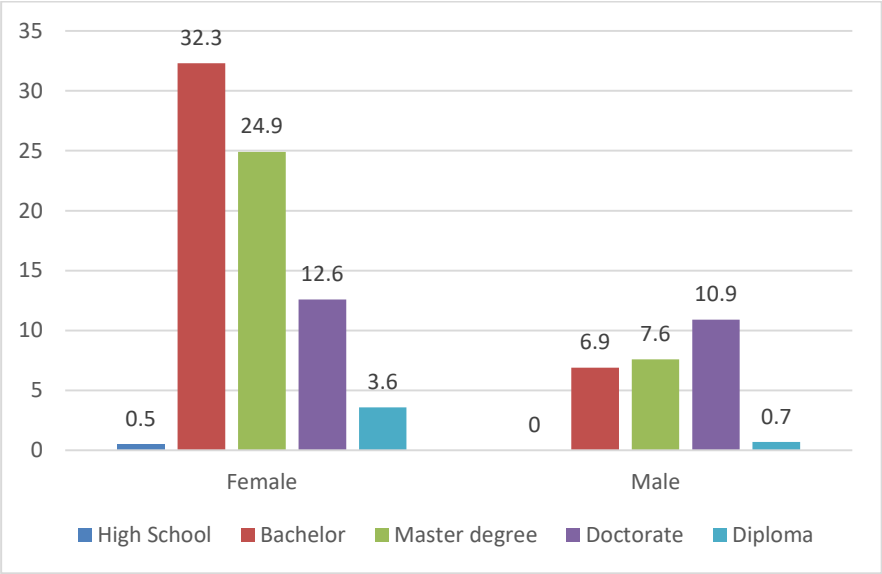

Figure 5.4 Chart of the respondents according to their qualification by sex

Position. Table 5.3 and Figure 5.5 indicate that most of the participants held an academic position (58%), followed by those who were management staff (19.7%) and IT managers/staff (13.3%). A small number of deans (6.4%) and top managers (2.6%) responded to the survey, most likely because there are only a few of these positions at each university compared with academic staff.

Another possible reason is that deans and top managers have insufficient time available to participate in surveys. Male respondents also hold a higher relative proportion of top management and respondents who are deans or department heads, the numbers of these are almost equal to the number of female respondents despite the total number of male respondents only being about a quarter of all respondents.

Table 5.3 Percentage of the respondents according to their position by sex

Position	Female	Male	Total
Top Management	1.4	1.2	2.6
Dean/Department head	3.8	2.6	6.4
IT Manger/Staff	8.8	4.5	13.3
Management staff	17.6	3.3	20.9
Academic	42.3	14.5	56.8

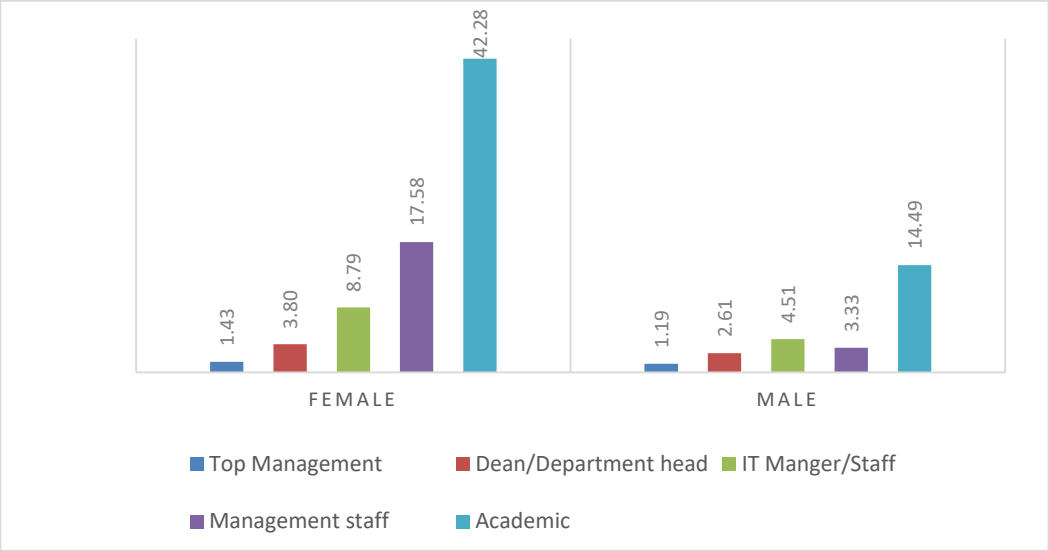

Figure 5.5 Chart of the respondents according to their position by sex

Experience. Table 5.4 and Figure 5.6 show a high percentage of participants were women who had less than three years of experience working in the university (25.9%). When male respondents are added the total number of respondents with less than three years of experience, this cohort makes up roughly a third of the total respondents. Respondents with 10 years or more experience accounted for a total of 26.2% of all respondents (16.2% female; 10% male).

Table 5.4 Percentage of the respondents according to their experience by gender

Experience	Female	Male	Total
Less than 3 years	25.9	7.4	33.3
3-5 years	15.4	2.9	18.3
6-8 years	9.3	3.8	13.1
9-10 years	7.1	2.1	9.2
More than 10 years	16.2	10	26.2

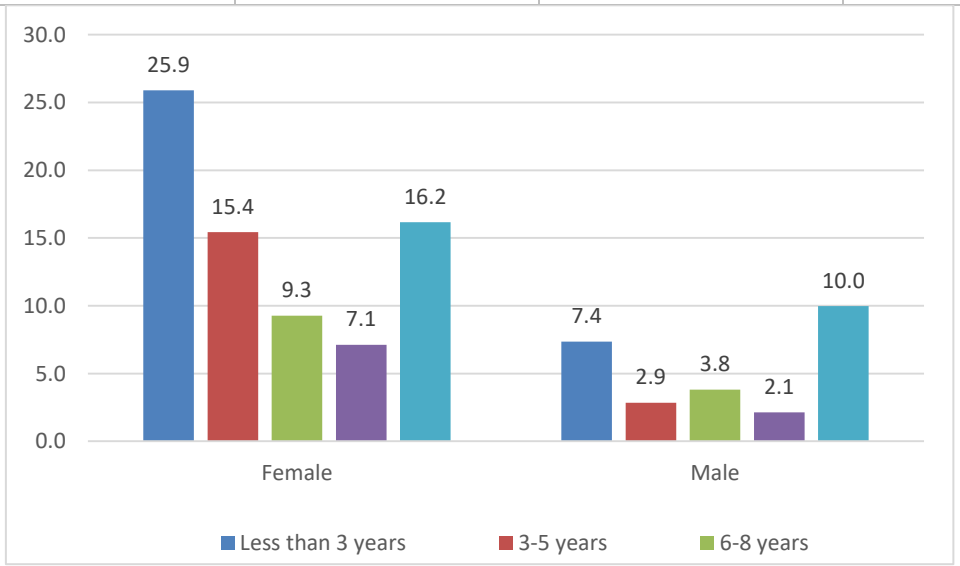

Figure 5.6 Chart of the respondents according to their experience by gender

5.2.2 The current situation at Saudi universities

This section outlines the challenges faced by Saudi Arabian universities (as listed in Table 5.5) in terms of the uptake of ICT, and notes which applications are currently being used in the universities.

Concern regarding data security was one of the greatest issues with IT, with 63.4% of respondents identifying security as very important. After security, insufficient training courses for IT staff were a very important issue for about half the respondents. All other challenges were identified as being very important or important by at least two thirds of respondents (Table 5.5).

Table 5.5 Percentage of responses to IT challenges in Saudi universities

Challenges	Very important	Important	Moderately important	Low importance	No answer
Concerns about data security	63.4	22.8	9.5	2.6	1.7
Inadequate Internet access	49.4	27.8	12.1	7.6	3.1
Insufficient training for IT staff	45.6	32.8	11.2	4.3	6.2
Inadequate IT staff levels	44.9	34.4	12.1	3.8	4.8
Inadequate end users skills	38	33.7	19	5	4.3
Inadequate IT systems	37.8	34.2	14	6.7	7.4
Insufficient training for end users	35.9	35.4	20.2	5.5	3.1

Figure 5.7 illustrates the percentage of participants who considered IT challenges 'very important' identified by gender. Figure 5.8 shows that the greatest number of cloud adoption challenges in the university were related to data security concerns for both male (70%) and female (60.1%) respondents. As a result, universities are hesitant about moving to cloud technology, as a move to the cloud is regarded as exposing them to the risk of compromised data.

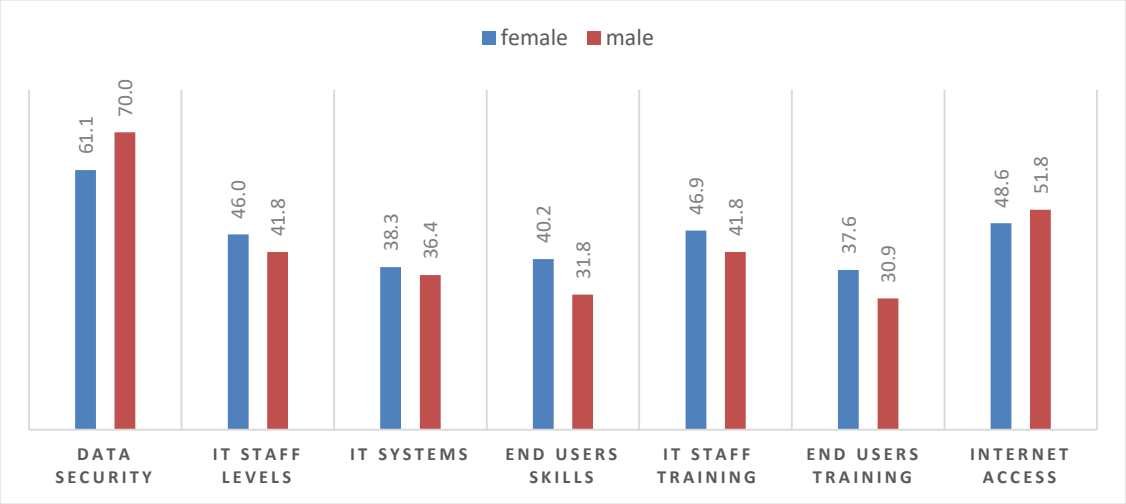

Figure 5.7 The percentage of participants who considered IT challenges 'very important' recorded by gender

Figure 5.7 illustrates the fact that Internet access was the next greatest challenge for both genders. It was noted that Internet access was not sufficient to allow academics to run applications and programs in the cloud instead of downloading whole programs onto each individual computer.

Furthermore, inadequate IT staffing levels and insufficient training for IT staff were viewed as challenges in adopting cloud computing, especially for women. As shown in Figures 5.8 and Figure 5.9, most of the IT staff who responded to the survey only had a Bachelor's degree as their highest qualification (79%) and are relatively inexperienced. (Just over a third had only three years' experience.)

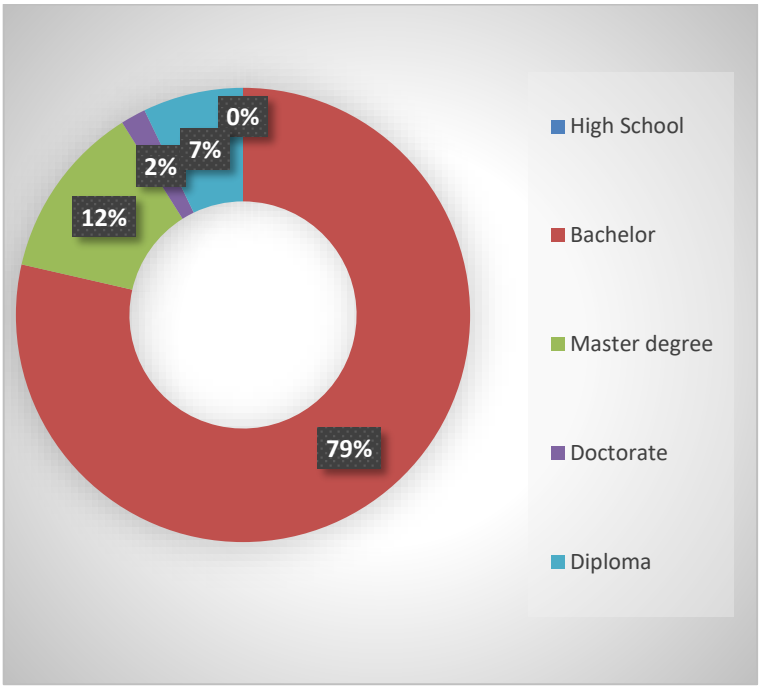

Figure 5.8 IT manager/staff by qualification

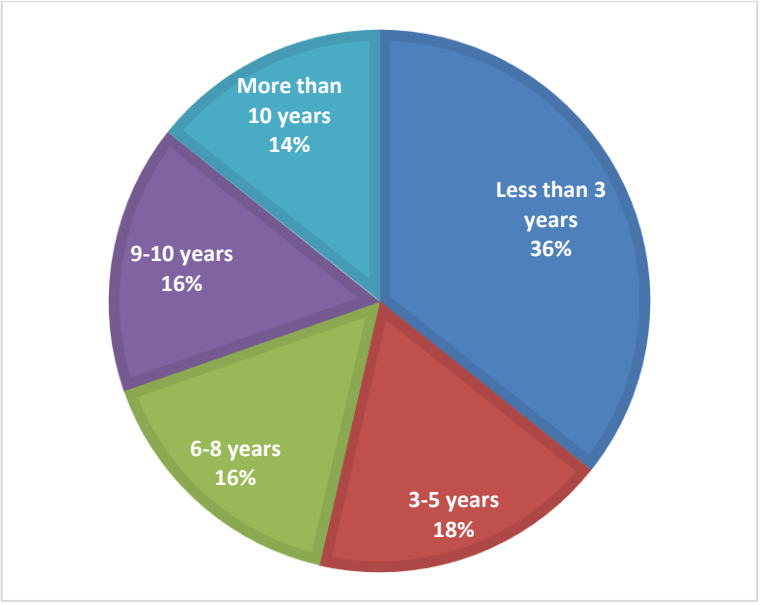

Figure 5.9 IT managers/staff by experience

This suggests that the universities have relatively under qualified employees doing IT related tasks, which could negatively affect the ability to adopt cloud computing. All employees need more training to enhance their knowledge of the university systems that they use and support.

In addition, end users' skills and training must also be considered as cloud computing adoption challenges, and inadequate IT systems must be improved to accommodate sophisticated computing activity.

This study has revealed the variation of cloud-based resources and facilities that are available to universities (Table 5.6). Email has been the most readily adopted service, with 39% of the participants using it daily. Office productivity (such as word processing) and social networking programs (such as *Facebook*) are also popular (Figure 5.10). The least used service is content management, which is to be expected because content management is an advanced step in cloud based services.

Table 5.6 Cloud based services always in use in Saudi Arabian universities

Application	Never	Rarely	Sometimes	Often	Always	No Answer
Content management	16.9	14.5	14.0	5.9	11.2	37.5
Email	25.9	3.1	1.7	1.9	39.0	28.5
Office productivity (such as word processing)	24.5	4.3	2.9	4.3	34.9	29.2
Programming/software development	12.6	15.9	14.0	10.2	13.8	33.5
Social networking Web 2.0 (such as Facebook)	18.5	8.1	12.6	9.7	23.0	28.0
SMS/text messaging (such as SMS cloud)	19.0	11.2	14.0	9.5	16.6	29.7
Telephone and voice services /VoIP	15.2	11.4	15.2	11.2	18.1	29.0
Web conferencing (such as Skype)	12.6	12.8	17.3	12.4	14.0	30.9

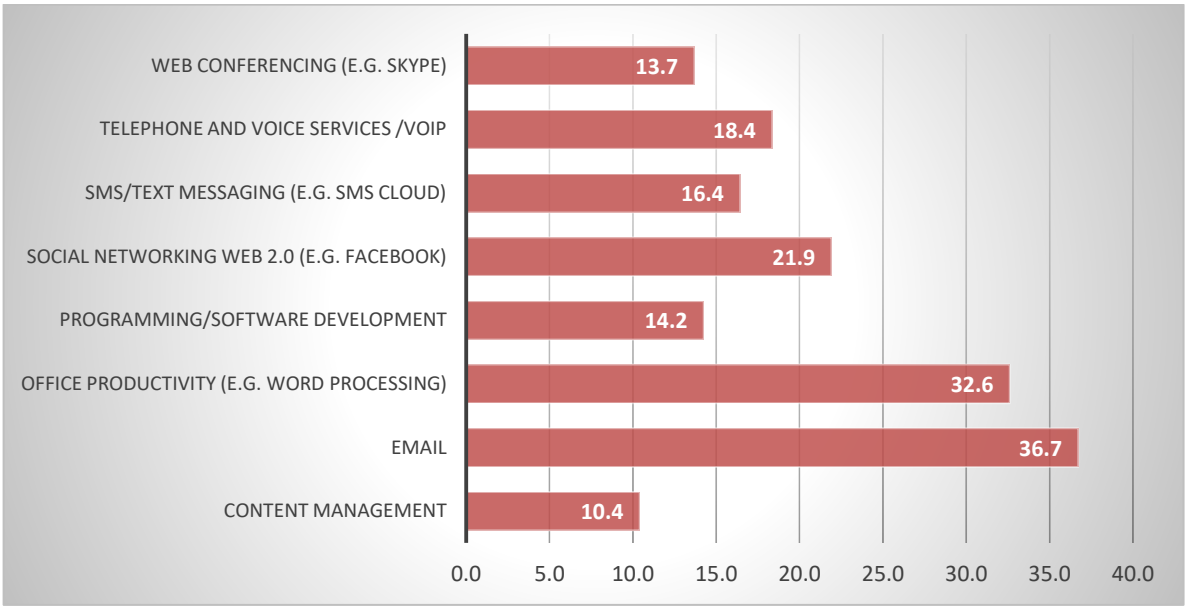

Figure 5.10 Cloud based services always in use in Saudi Arabian universities

To date, cloud computing has not been widely accepted. Figure 5.11 shows that only 16.2% of the participants have already adopted cloud computing in their universities and that 42% have no intention at all of using cloud computing (Figure 5.12).

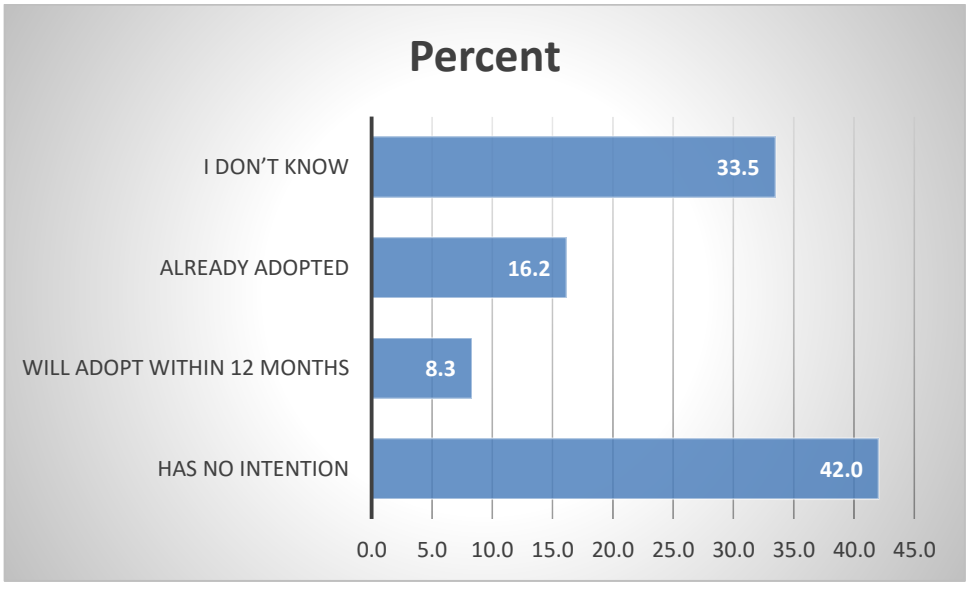

Figure 5.11 Intention to adopt cloud computing

From the top managers' and deans' point of view, most currently have no intention of adopting cloud computing or are uncertain (Figure 5.12).

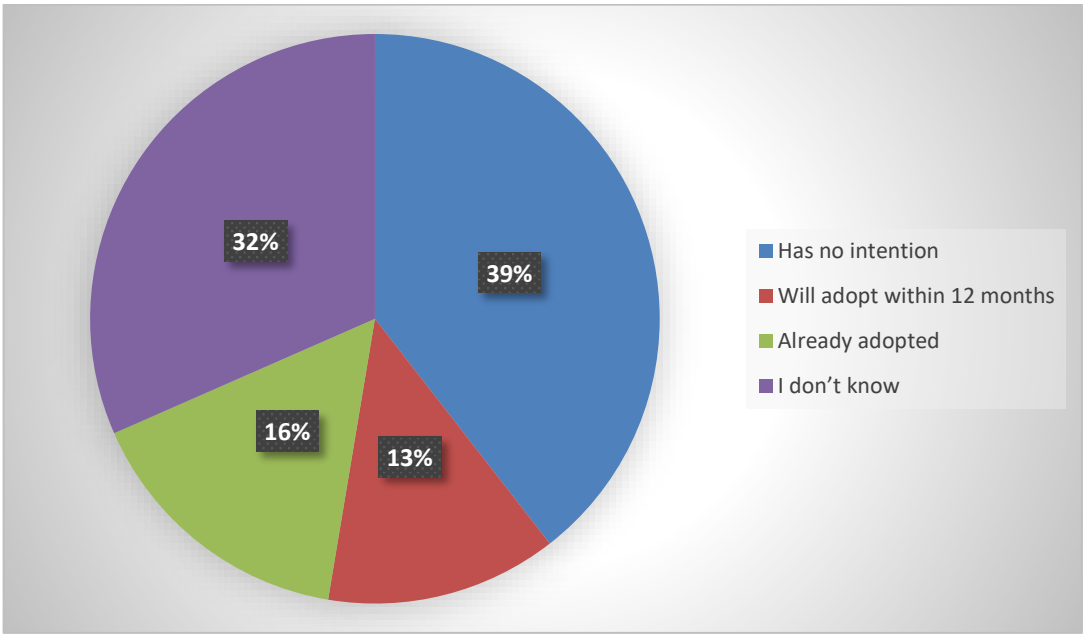

Figure 5.12 Intention to adopt cloud computing form top managers and deans' point of view

Figure 5.12 shows that only 16% of the top managers and deans have already adopted cloud computing and 13% will adopt it within 12 months. The majority (39%) have no intention to use it.

5.2.3 Preparation for analysis: Examining the data

Data examination is the first step in the analysis process. Hair et al. (2010) mention that the researcher should inspect the data for completeness and consistency before starting analysis. Before undertaking the SEM analysis, some substantial steps in multivariate analysis should be taken. SEM assumes that there are no missing values in the data set (Muthén, Kaplan, & Hollis, 1987). Missing data is, therefore, a serious matter when using SEM as a data analysis method (Hair et al., 2010; Kline, 2005). The data set also needs to be normally distributed (Byrne, 2013; Schumacker & Lomax, 2004). This includes dealing with outlier, kurtosis and skewness in the data set (Cruz, 2007). Cruz (2007) emphasises that to get precise outcomes when using SEM, it is essential to make the data set ready by applying suitable data screening processes. The next section discusses the tests applied in order to detect kurtosis and skews to assess the normality of the data set.

Data screening. Preceding the formal data analysis, measures were taken to increase the validity of the conclusion (Fox-Wasylyshyn & El-Masri, 2005). The data were initially scrutinised for missing data, checked for errors, and analysed to assess for outliers and normality (Byrne, 2013).

There were no errors because the data were exported directly from ACSPRI (Australian Consortium for Social and Political Research Inc.) to *SPSS* 22.0. Furthermore, many items were asked in a reverse way to

ensure that the respondents had been attentive to the questions in the questionnaire: CPX1, CPX2, CPX3, RD1, RS1, UA2, PD1, PD2, PD3 and PD4.

Missing data

Missing data are items left unanswered by the respondents on the survey (Hair et al., 2010). Items left unanswered can impact the analysis on a variety of levels. Missing values can (a) result in a reduction of sample size for the overall analysis and (b) bias results at the time of analysis (Byrne, 2013; Hair et al., 2010).

To remedy missing data effectively, a number of methods was adopted. For the paper survey, missing data were handled on two levels. For the first level, missing demographic data did not result in the non-usage of the survey since these missing data had little to no impact on the statistical analysis. In another case, missing data relating to factors influencing the adoption of cloud computing led to the use of list-wise deletion of data. List-wise deletion was performed if the participant left 70% or more of the questions unanswered (Hair et al., 2010). For 23 cases, the surveys were completely removed from the analysis after list-wise deletion. 425 surveys remained for analysis.

For the second level, remaining missing data were dealt with by expectation maximisation (EM) imputation made by *SPSS* v.22 software. The EM imputation approach used by the *SPSS* missing value analysis module uses a maximum likelihood approach for estimating missing values (Little & Rubin, 2014).

Outliers

Outliers are extreme data points that deviate from the mean values (Hair et al., 2010). Outliers could be seen and noticed as strangely low or high value on a variable, or could be either a group of values across more than one variable. As stated by (Byrne, 2013), the outliers' presence can significantly affect the resulting model fit, estimation of parameter and standard errors (Byrne, 2013). To successfully pinpoint outliers in the dataset, the standardised residual and the Cook's distance were computed (Byrne, 2013; Hair et al., 2010).

The standardised residual was used to scale the deviation between the observed frequency and its expected frequency. A data value is judged as an outlier if its standardised residual is greater than 3.0 or smaller than -3.0 (Hair et al., 2010).

The Cook's distance is a total measure that demonstrates the impact of a specific data value on the fitted values for the dataset (Cook & Weisberg, 1982). According to Byrne (2013), a survey response is deemed

impactful if the Cook's distance is greater than 1. Using *SPSS* 22.0, the deletion of three cases was required after the calculation of the standardised residual and the Cook's distance.

Normality

Normality, that is, correspondence to the normal distribution, refers to the distribution shape for a variable. Normality can be examined by looking at the histograms and checking the values of skewness and kurtosis. The data are considered to be normally distributed if it is bell-shaped, and the values of kurtosis and skewness are close to zero (Hair et al., 2010).

(George & Mallery, 2003) mentioned that kurtosis is a measurement of the flatness or peaked-ness of the distribution. If the kurtosis value is near zero, it shows that a shape is close to normal. If the value is positive, it shows that a distribution is more peaked than normal, and if the value is negative, it shows that a shape is flatter than normal. In general, when the value ranges between ±1.0 that will be idle and between ±2.0 will be acceptable.

Skewness is a measurement of how much a distribution of a dataset deviate from the mean (George & Mallery, 2003; Hair et al., 2010). George and Mallery (2003) argue that a value between ±3.0 is acceptable. The skewness and kurtosis values in this study indicated that they sat within the recommended ranges. Skewness was no greater than 3.0 and the kurtosis value was between ±2.

As mentioned before, to derive accurate results using SEM, data should be normally distributed (Cruz, 2007; Byrne, 2010; Kline, 2005). In SEM there are estimation techniques, such as maximum likelihood (ML). However, ML does not supply precise results when the non-normality of the data set is clearer (Brown, 2014). Therefore, another estimation technique was used in this study to check the normality – the Kolmogorov-Smirnov (K-S) test. The K-S test is used to judge whether there is a significant difference between the observed variables distribution and a normal distribution (George & Mallery, 2003). The findings (the significance value) derived from the K-S test for each observed variable highlight the degree to which the data diverges from normality. The data is non-normally distributed if a significance value approaches 0.000 (George & Mallery, 2003).

In this study, the K-S test detected that the data set deviated from normality, meaning data were non-normally distributed (see Appendix E). Consequently, appropriate procedures were conducted in this study.

As mentioned above, the results derived from K-S test indicate that the data were non-normally distributed. So, to deal with this matter, a bootstrapping technique was used. Bootstrapping is one of the most commonly accepted techniques to deal with non-normal data (West et al., 1995; Brown, 2006; Byrne, 2010; Kline, 2005). According to Byrne (2010, p 331), it 'enables the researcher to create multiple subsamples from an original database'. This lets the researcher try the SEM model in a state of multivariate normal distribution to obtain accurate results (Byrne, 2001).

Thompson (1994) has said that one of the main bootstrapping limitations is that it demands a big sample (larger than 40). Thus bootstrapping technique was appropriate for use in this study because the sample was N=421.

Scale reliability. There were 13 independent scales used in the survey questionnaire to measure the construct proposed in the conceptual model:

- relative advantage
- compatibility
- complexity
- security concerns
- top management support
- readiness
- competitive pressure
- regulatory support
- language
- religion
- uncertainty avoidance
- power distance
- masculinity
- individualism.

To make certain of how consistently those scales captured the meaning of the model constructs, a scale reliability analysis was conducted in order to evaluate the internal consistency and item total correlation. This is explained in the next two sections.

Internal consistency denotes the extent to which answers are coordinated and consistent across the variables within a particular measurement scale. Cronbach's (1951) alpha coefficient is usually used to measure the internal consistency, which calculates the correlation of a group of items and true scores. If Cronbach's alpha is low, it means variables perhaps do not demonstrate, or poorly demonstrate, the construct.

According to Churchill (1979), to evaluate the quality of the measurement scale, Cronbach's alpha should be the first evaluation measure used. In addition, (B. Kline, 2005) has proposed that the value of excellent internal consistency is around 0.90; a value of very good internal consistency is around 0.80; and a value for adequate internal consistency is 0.70. However, Hair (Joseph F. Hair, 2006) suggests that the value of the lower boundary of acceptability is 0.60 to 0.70. Table 5.7 shows the Cronbach's alpha for the measurement scales of the constructs. The values extended from 0.604 to 0.835, which were in the acceptable range. The measurement scales displayed good consistency.

Table 5.7 Constructs' Cronbach's alpha

Constructs	Number of cases	Number of items	cronbach's Alpha (α)
RA	421	6	0.773
CPT	421	3	0.826
SC	421	4	0.650
CPX	421	3	0.822
TMS	421	3	0.824
RD	421	3	0.801
CP	421	3	0.815
RS	421	3	0.823
LR	421	4	0.620
UA	421	4	0.604
PD	421	4	0.835
MF	421	3	0.816
IC	421	4	0.653

5.3 Structural equation modelling (SEM)

Hair et al., (2010) state that structural equation modelling (SEM) is a statistical practice that permits the researcher to observe multiple interrelated dependence relationships in an individual model. SEM is steadily increasing in popularity in the science research community because it is flexible in interchanging between the tested theory and the sample data (Chin & Newsted, 1999). In addition, in comparison to the traditional statistical approaches, SEM provides the ability to model the relationships between observed variables and latent variables, and the relationships between a large number of latent variables (Chin & Newsted, 1999).

SEM is composed of two separate models: the measurement model and the structural model (Hair et al., 2010). The measurement model examines the relations between the latent variables and indicators. The structured model examines the relationships between the latent variables (unobserved variables) (Hair et al., 2010; Hox, 2010). The next sections discuss the measurement and structural models which were used to test the proposed model and the hypothesis.

5.3.1 Measurement model

One of the most essential components of applied multivariate statistical analysis is the application of structural equation modelling (SEM) (Pugesek, Tomer, & Von Eye, 2003). The use of SEM in the analysis of data in this study was based on its potential to embrace latent variables for the purpose of representing abstract concepts, while accounting for error in measurement and simultaneously measuring covariance among variables in the model when assessing validity (Hair et al., 2010). The measurement model assesses the appropriateness of newly formed latent variables, as they are gathered together to determine whether they are connected enough to their indicators (Hair et al., 2010). The measurement model is applied to assess the reliability and validity of the constructs before continuing with the structural model (Brown, 2014).

In order to assess the contribution of each variable and measure the adequacy of the measurement model, *confirmatory factor analysis* (CFA) was conducted. Using *AMOS* 22.0, a CFA was conducted based on the results of survey data collected from the survey respondents. CFA allows the researcher to statistically test the hypothesised model in order to replicate the samples (Byrne, 2013; Hair et al., 2010).

CFA is composed of three procedures. The first process is the model specification process. This requires defining the set of relationships which the researcher would like to check and deciding how to set the construct in the model. A sufficient sample size of 421 valid surveys and the multivariate normality distribution fulfilled the maximum likelihood method requirements. The second process is an iterative model modification process in order to evolve a foremost group of items to demonstrate a construct over the refinement and retesting process. Based on the previous process, items that do not meet reliability and validity assessment will be dropped. The last process is estimating the goodness of fit (GOF) of the total model in order to check the range to which the data support the measurement model.

5.3.2 Overall model fit

In order to measure the model fit, there are many different measurement of fit indices. They are usually categorised into three groups: absolute fit indices, incremental fit indices, and parsimonious fit indices.

Hair et al. (2010) point out that *absolute fit indices* determine how well the model specified by the researcher reproduces the data. *Incremental fit indices* assess how well the estimated model fits relative to some

alternative baseline models (Hair et al., 2010). The *parsimony fit indices* deliver information about which model between groups of competing models is the most preferable, taking into account its fitness relative to its complexity (Hair et al., 2010). Researchers do not have a preference for a particular fit measure for SEM (Hair et al., 2010).

In this study, three absolute fit indices, two incremental fit measures, and one parsimonious fit index were chosen. The absolute fit indices were: goodness of fit index (GFI), the root mean square error of approximation (RMSEA), and the standardised root mean residual (SRMR). The incremental fit measures were: comparative fit index (CFI) and the Tucker-Lewis index (TLI); and in the parsimonious fit index, the ratio of X2 to degree of freedom (X2/df) was used to evaluate the measurement model. Tables 5.8 and 5.9 present the purpose of each GOF statistic and the guidelines for acceptable values for these statistics.

Table 5.8 The goodness of fit measures

Category	GOF index	Recommended value	References
Absolute fit indices	GFI	> 0.90	(Hair et al., 2010; Kline, 2005)
	RMSEA	<0.05	(Hair et al., 2010)
	SRMR	≤ .08	(Kline, 2005)
Incremental fit indices	CFI	> 0.90	(Hair et al., 2010; Kline, 2005)
	TLI	> 0.90	(Hair et al., 2010; Kline, 2005)
Parsimony fit indices	X2/df	< 3.0	(Hair et al., 2010; Kline, 2005)

Table 5.9 The purpose of GOF statistic

GOF	Purpose
Goodness of Fit Index (GFI)	Independent of sample size
RMSEA	Measures the mean discrepancy between the population estimates from the model and the observed sample values
Standardised Root Mean Residual (SRMR)	Used to assess the overall fit of a model
Comparative Fit Index (CFI)	Compares the proposed model with the null model
TLI	Compares the proposed model to the null model.
χ2/df	Takes into account the degrees of freedom

5.3.3 Assessment of construct validity

The next step after achieving the confirmatory factor analysis (CFA) model fit is evaluating the validity of each construct. Construct validity is the degree to which a set of measured items truly mirrors the theoretical latent construct that those items are intended to measure (Hair, 2006).

Usually this assessment requires convergent and discriminant validity (Hair et al., 2006). *Convergent validity* indicates the degree to which the indices of a specified construct come together or converge to a high ratio of variance in common to measure the same construct. It asserts that the scale has a mutual relationship with other known measures of the concept. In this study, the convergent validity assessment emphasised the factor loading.

Hair et al. (2010) state that high loadings on a factor denote that they come together on some common point. Furthermore, they suggest that the factor loadings should be more than 0.50. Bollen (2014) argues that significant t values should be sufficient to prove convergent validity. As a consequence, the variables' reliability is considered as an indicator of convergent validity in addition to significant factor loadings. It is specified by inspecting the R^2 value; the value of R^2 provides a measure by which to assess the reliability of the variables. As suggested by (Bollen, 2014), an acceptable reliability of the variable R^2 value should be more than 0.50.

Discriminant validity refers to the extent to which the measure is certainly new, and not just a throwback of other variable. It means a construct is really distinct from other construct.. For this study, discriminant validity could be evaluated by reviewing the correlation coefficient between each pair of variables.

If the value of the correlation coefficient is truly big (i.e., greater than 0.850), then the variables of interest could demonstrate the same concept and should be integrated as a single variable (Tabachnick, 2001). In addition, this study used the average variance extracted (AVE), which represents the total amount of variance in the indicators, accounted for by the latent construct. Therefore, higher values of the AVE show that the items are truly representative of the latent construct. An average variance extracted (AVE) of at least 0.50 gives support for convergent validity.

5.3.4 The proposed model

This study tested the proposed model's suitability to analyse the observed data using the bootstrap ML estimation techniques supplied by *AMOS* 22.0. The proposed model consisted of 13 latent variables of the proposed model using several indicators (items) to approve the factor structure for the variables. A total of 48 items was utilised in the measurement model. These items were obtained from the literature (Table 5.10).

Table 5.10 Constructs and the items

Variable Item	Constructs	No of Items	Code Name
1	Relative advantages	6	RA_1, RA_2, RA_3, RA_4, RA_5, RA_6
2	Compatibility	3	CPT_1,CPT_2,CPT_3
3	Security concerns	4	SC_1, SC_2, SC_3, SC_4
4	Complexity	3	CPX_1,CPX_2,CPX_3
5	Top management support	3	TMS_1,TMS_2,TMS_3
6	Readiness	3	RD_1,RD_2,RD_3
7	Competitive pressure	3	CP_1,CP_2,CP_3
8	Regulatory support	3	RS_1,RS_2,RS_3
9	Language & religion	4	LR_1,LR_2,LR_3,LR_4
10	Uncertainty avoidance	4	UA_1,UA_2,UA_3,UA_4
11	Power distance	4	PD_1,PD_2,PD_3,PD_4
12	Masculinity/Femininity	3	MF_1 ,MF_2,MF_3
13	Individualism / Collectivism	4	IC_1,IC_2,IC_3,IC_4

The fit statistics and indices for the proposed measurement model are summed up in Table 5.11, whereas the proposed measurement model is illustrated in Figure 5.13.

Table 5.11 GOF Indices for the proposed model

Measurement model	GFI	RMSEA	SRMR	CFI	TLI	x2/df
Recommended	>0.90	<0.05	≤ .08	>0.90	>0.90	<3.0
Obtained	0.910	0.013	0.0387	0.992	0.990	1.081

As presented in Table 5.11, the model exhibited a good level of fit (x2/df = 1.081; RMSEA = 0.013; SRMR = 0.0387; TLI = 0.990; CFI = 0.992; and GFI=0.910). All the indicators (factors) and significant loadings were greater than 0.50 ($p < 0.001$) on their respective constructs. However, the factor loading of some items was less than 0.50 and the squared multiple correlation (SMC) was less than 0.30, which means the coefficient paths of these items were insignificant (Byrne, 2010; Hair et al., 2010). Therefore, these items were eliminated from constructs in the revised model in the next section as shown in Table 5.12. The eliminated items were: RA_5, SC_3, LR_4, UA_2, and IC_1.

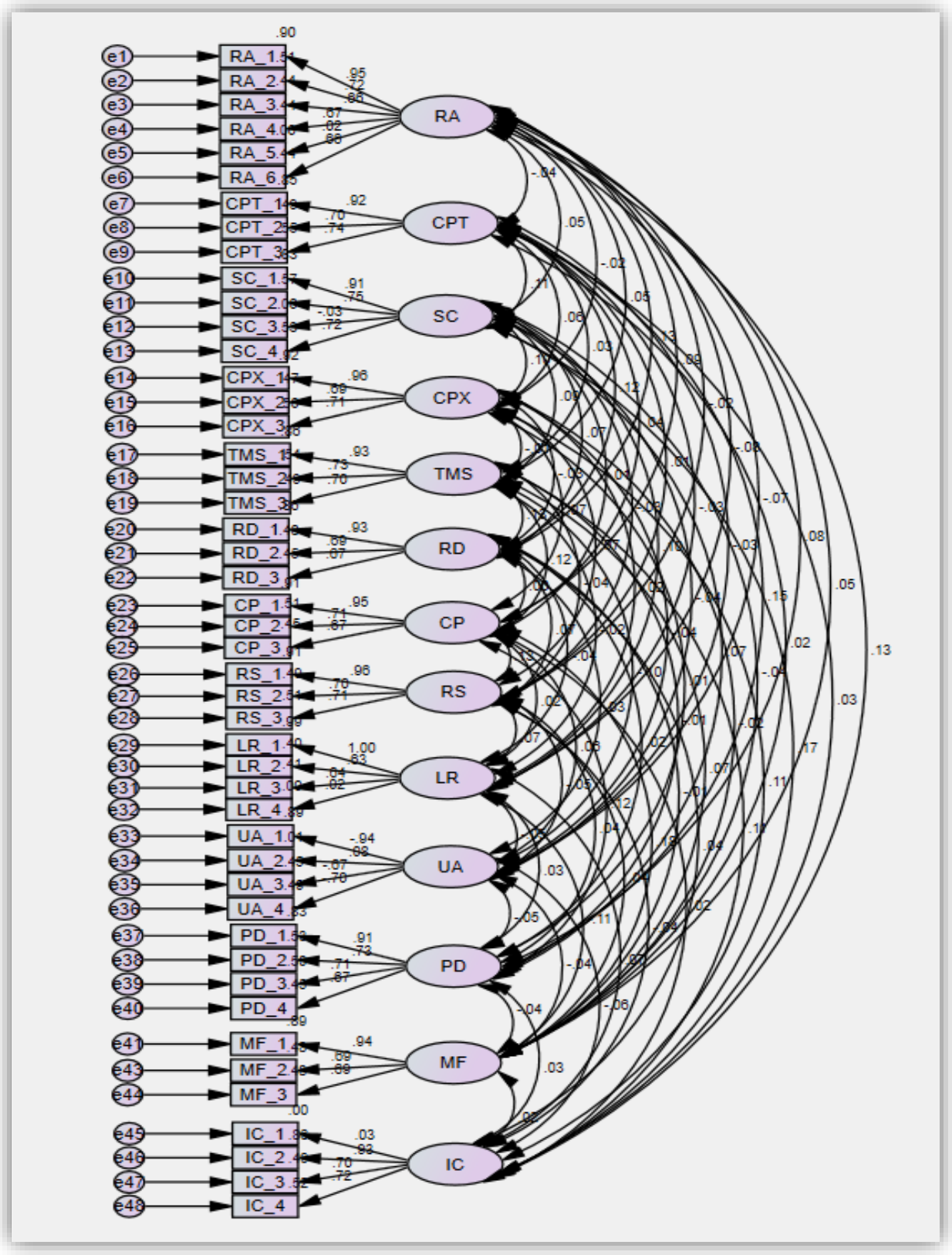

Figure 5.13 The proposed model

Table 5.12 Factors loading and SMC

Items	SMC	Items	Loading
IC_1	0.001	RA_6	0.664
IC_2	0.863	RA_5	0.023
IC_3	0.488	RA_4	0.666
IC_4	0.523	RA_3	0.66
MF_1	0.887	RA_2	0.717
MF_2	0.484	RA_1	0.951
MF_3	0.483	CPT_3	0.74
PD_1	0.828	CPT_2	0.702
PD_2	0.528	CPT_1	0.923
PD_3	0.499	SC_4	0.725
PD_4	0.447	SC_3	-0.032
UA_1	0.893	SC_2	0.754
UA_2	0.007	SC_1	0.912
UA_3	0.45	CPX_3	0.707
UA_4	0.492	CPX_2	0.686
LR_1	1.005	CPX_1	0.96
LR_2	0.391	TMS_3	0.702
LR_3	0.403	TMS_2	0.732
LR_4	0.02	TMS_1	0.928
RS_1	0.914	RD_3	0.668
RS_2	0.491	RD_2	0.692
RS_3	0.508	RD_1	0.926
CP_1	0.907	CP_3	0.669
CP_2	0.507	CP_2	0.712
CP_3	0.448	CP_1	0.952
RD_1	0.857	RS_3	0.713
RD_2	0.479	RS_2	0.7
RD_3	0.446	RS_1	0.956
TMS_1	0.861	LR_4	-0.021
TMS_2	0.535	LR_3	0.634
TMS_3	0.493	LR_2	0.625
CPX_1	0.922	LR_1	1.003
CPX_2	0.471	UA_4	0.702
CPX_3	0.499	UA_3	0.671
SC_1	0.832	UA_2	-0.085
SC_2	0.568	UA_1	0.945
SC_3	0.001	PD_4	0.668
SC_4	0.525	PD_3	0.707
CPT_1	0.852	PD_2	0.727
CPT_2	0.493	PD_1	0.91
CPT_3	0.548	MF_4	0.695
RA_1	0.904	MF_3	0.696
RA_2	0.513	MF_1	0.942
RA_3	0.436	IC_4	0.723
RA_4	0.443	IC_3	0.698
RA_5	0.001	IC_2	0.929
RA_6	0.441	IC_1	0.031

5.3.5 The revised model

A revised model was established based on the assessment of factor loading and squared multiple correlation (SMC). This resulted in eliminating five items at the iterated convergent validity and reliability analysis stage since all the items with loading < 0.50 and SMC< 0.30 were dropped as shown in Table 5.13.

Table 5.13 Initial and final number of items in each construct

Construct	No. of Items		Dropped items
	Initial	Final	
Relative advantages	6	5	RA_5
Compatibility	3	3	-
Security concerns	4	3	SC_3
Complexity	3	3	-
Top management support	3	3	-
Readiness	3	3	-
Competitive pressure	3	3	-
Regulatory support	3	3	-
Language & religion	4	3	LR_4
Uncertainty avoidance	4	3	UA_2
Power distance – Initial	4	4	-
Masculinity/Femininity	3	3	-
Individualism / Collectivism	4	3	IC_1.

The fit indices for the revised model are summed up in Table 5.14, and the revised measurement model is depicted in Figure 5.14. The model exhibited a good level of fit (x^2/df = 1.057; RMSEA = 0.012; SRMR = 0.036; TLI = 0.990; CFI = 0.992; and GFI=0.917).

Table 5.14 Indices for the measurement model

Measurement model	GFI	RMSEA	SRMR	CFI	TLI	x2/df
Proposed model	0.910	0.013	0.0381	0.990	0.990	1.081
Revised model	0.917	0.012	0.036	0.992	0.990	1.064

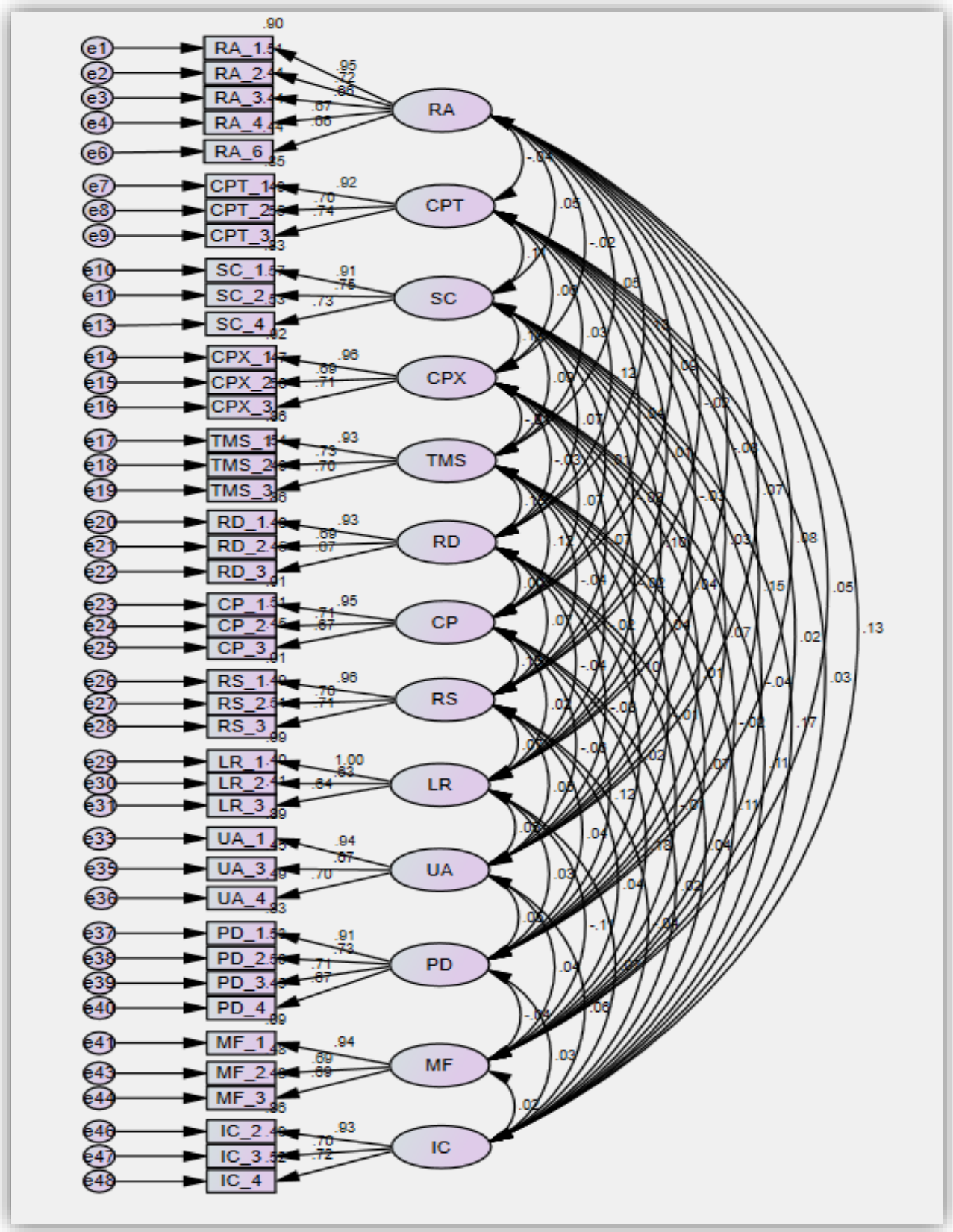

Figure 5.14 The revised model

All the indicators (factors) had significant loadings greater than 0.50 ($p < 0.001$) on their respective constructs as shown in Table 5.15. The factor loading, t-value and significance level of each variable shown in the tables provide a measure for the convergent validity. The value of R^2 provides a measure by which to assess the reliability of the variables.

Table 5.15 Reliability and validity results of final measurement models

Construct/Factors	Loading	t-value	R^2	Composite Reliability	Average Variance Extracted
Relative Advantage (RA)				0.855	0.547
RA_1	0.951	f.p.	0.904		
RA_2	0.716	***	0.513		
RA_3	0.660	***	0.436		
RA_4	0.666	***	0.443		
RA_6	0.664	***	0.440		
Compatibility (CPT)				0.827	0.620
CPT_1	0.923	f.p.	0.852		
CPT_2	0.702	***	0.493		
CPT_3	0.740	***	0.548		
Complexity (CPX)				0.833	0.631
CPX_1	0.960	f.p.	0.922		
CPX_2	0.686	***	0.471		
CPX_3	0.707	***	0.499		
Security Concerns (SC)				0.841	0.641
SC _1	0.911	f.p.	0.831		
SC _2	0.754	***	0.569		
SC _4	0.725	***	0.526		
Top Management Support (TMS)				0.834	0.630
TMS _1	0.928	f.p.	0.861		
TMS _2	0.732	***	0.535		
TMS _3	0.702	***	0.493		
Readiness (RD)				0.811	0.594
RD_1	0.926	f.p.	0.857		
RD_2	0.692	***	0.479		
RD_3	0.668	***	0.446		
Competitive Pressure (CP)				0.827	0.620
CP_1	0.952	f.p.	0.907		
CP_2	0.712	***	0.507		

Construct/Factors	Loading	t-value	R^2	Composite Reliability	Average Variance Extracted
CP_3	0.669	***	0.448		
Regulatory Support (RS)				0.838	0.637
RS_1	0.956	f.p.	0.914		
RS_2	0.700	***	0.491		
RS_3	0.713	***	0.508		
Uncertainty avoidance (UA)				0.822	0.611
UA_1	0.943	f.p.	0.890		
UA_3	0.671	***	0.450		
UA_4	0.703	***	0.494		
Power Distance (PD)				0.842	0.576
PD_1	0.910	f.p.	0.828		
PD_2	0.727	***	0.528		
PD_3	0.707	***	0.499		
PD_4	0.668	***	0.447		
Masculinity/Femininity (MF)				0.826	0.618
MF_1	0.942	f.p.	0.887		
MF_2	0696	***	0.484		
MF_3	0.695	***	0.483		
Individualism / Collectivism (IC)				0.831	0.624
IC_2	0.929	f.p.	0.863		
IC_3	0.698	***	0.487		
IC_4	0.723	***	0.523		
Language and Religion (LR)				0.810	0.598
LR_1	0.995	f.p.	0.990		
LR_2	0.630	***	0.397		
LR_3	0.639	***	0.409		

Moreover, to obtain acceptable discriminant validity, the square root of average variance extracted (AVE) for each construct should be greater than the correlation between the construct and the other constructs. Table 5.16 displays acceptable discriminant validity between each pair of constructs, where all AVE square roots are greater than the correlation between the constructs. These outcomes showed that the measurement model had a significant convergent validity.

Table 5.16 AVE square roots and inter-correlation

	CR	AVE	MSV	ASV	CP	RA	CPT	SC	CPX	TMS	RD	RS	LR	UA	PD	MF	IC
CP	0.827	0.620	0.033	0.008	0.788												
RA	0.855	0.547	0.017	0.006	0.086	0.740											
CPT	0.835	0.631	0.023	0.005	0.041	-0.038	0.794										
SC	0.841	0.641	0.028	0.007	0.011	0.049	0.111	0.801									
CPX	0.833	0.631	0.012	0.003	0.074	-0.018	0.061	0.105	0.794								
TMS	0.834	0.630	0.016	0.006	0.121	0.054	0.032	0.087	-0.007	0.794							
RD	0.811	0.594	0.017	0.005	0.002	0.131	0.125	0.071	-0.031	0.126	0.771						
RS	0.838	0.637	0.016	0.004	0.127	-0.018	0.009	-0.025	0.073	-0.043	0.073	0.798					
LR	0.810	0.598	0.012	0.004	0.017	-0.080	-0.026	0.099	-0.022	-0.015	-0.036	0.073	0.774				
UA	0.822	0.611	0.010	0.003	-0.064	0.072	0.027	0.039	0.042	0.101	-0.030	0.053	0.049	0.782			
PD	0.842	0.576	0.023	0.005	0.125	0.083	0.152	0.069	0.006	-0.015	0.020	0.042	0.034	0.047	0.759		
MF	0.826	0.618	0.033	0.005	0.183	0.052	0.021	-0.036	-0.024	0.069	-0.014	0.043	-0.108	0.039	-0.038	0.786	
IC	0.831	0.624	0.028	0.007	0.016	0.132	0.029	0.167	0.110	0.115	0.037	-0.038	0.066	0.061	0.028	0.019	0.790

5.3.6 The structural model

Testing the structural model was the next step, following validation of the established measurement model. This was done by testing the hypothesised conceptual model. To test the hypothesis, a structural model with all the 13 factors that were evaluated in the measurement model was developed. Subsequently, the hypothesised connections were framed between these constructs. The following sections discuss the structural model's outcomes. Figure 5.15 displays the structural model with the hypothesised relationships between all constructs.

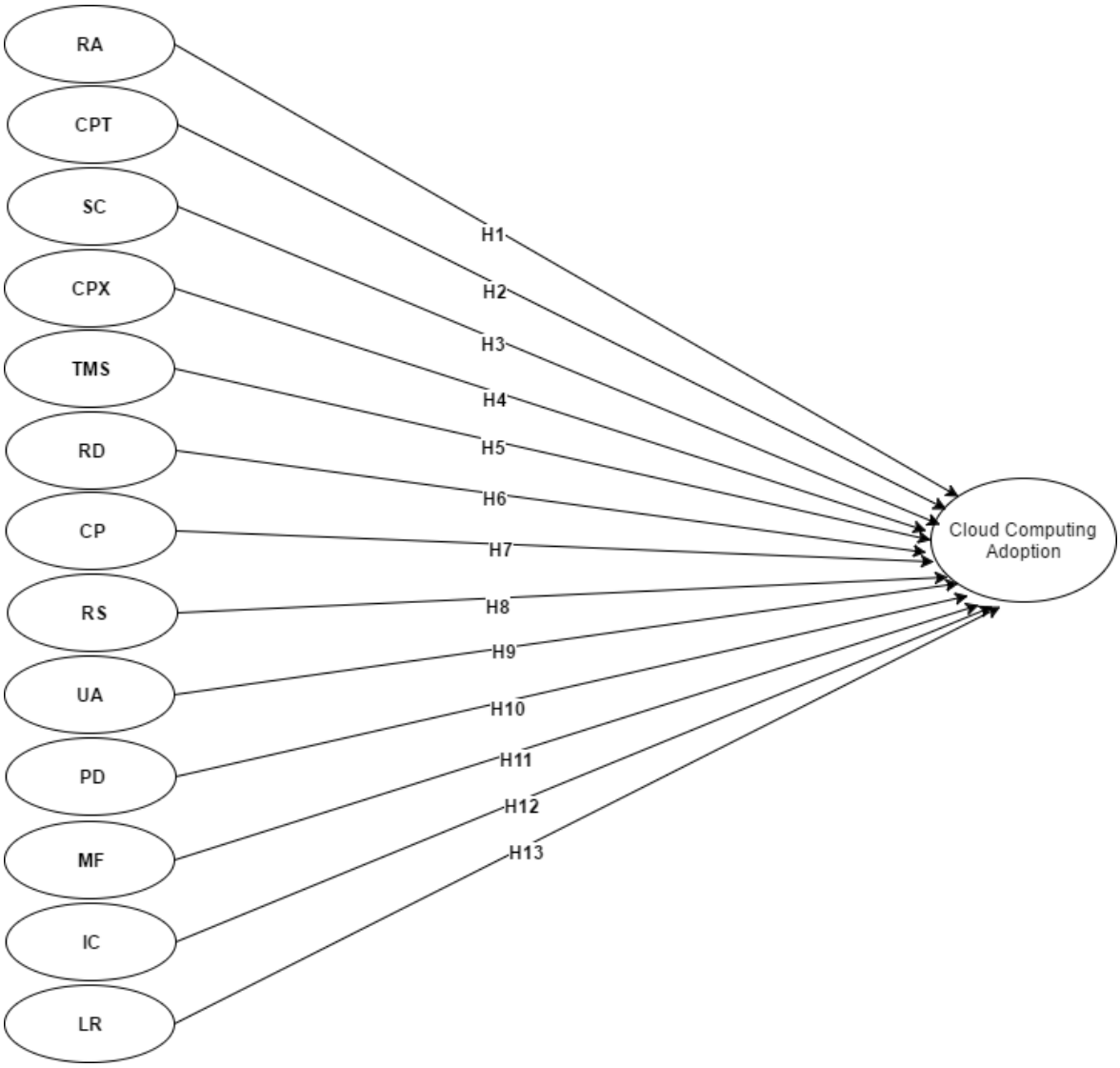

Figure 5.15 The structural model with the hypothesised relationships between all constructs

5.3.7 Assessing of the model fit

The fit statistic and indices for the structural model showed a good fit for all indices, as shown in Table 5.17. The results indicated that the fit indices (χ^2/df = 1.149; RMSEA = 0.019; GFI= 0.905; AGFI=0.894; CFI= 0.983; and TLI = 0.982) were acceptable, and a better overall fit of the proposed model; and that the hypothesised structural model provided a good fit to the data.

Table 5.17 Statistics for the structural model

Structural model	GFI	RMESA	SRMR	CFI	TLI	x2/df
Recommended Value	≥ 0.90	≤ 0.08	<0.08	≥ 0.90	>0.90	≤ 3.0
Revised Model	0.905	0.019	0.054	0.983	0.982	1.149

5.4 Testing the hypotheses

In order to make the evaluated population covariance matrix for the structural model, the parameter estimates were applied. There were 13 constructs recognised by 46 items in the model. To examine the structural model, the covariance matrix between the constructs was stratified. Hair et al. (2010) have stated that if the critical ratio (C.R./t-value) is higher than 1.96 for an estimate (regression weight), the parameter coefficient value is statistically significant at the 0.05 levels. The t-value was gained by dividing the regression weight estimate by the estimate of its standard error (S.E). Thirteen causal paths were examined in this study by using the path estimates and CR values. Table 5.18 shows that 11 hypothesised paths were statistically significant while two hypothesised paths were statistically not significant. Path coefficients for the proposed structural model are illustrated in Figure 5.16.

Table 5.18 Path coefficients for the proposed structural model

Path (Hypothesis)			Standardised path coefficient	t-value	Hypothesis testing result
RA	→	adop_int	0.189	6.971***	Supported
CPT	→	adop_int	0.195	7.375***	Supported
SC	→	adop_int	0.108	4.746***	Supported
CPX	→	adop_int	0.031	n.s	Not Supported
TMS	→	adop_int	0.168	5.825***	Supported
RD	→	adop_int	0.107	4.537***	Supported
RS	→	adop_int	0.201	7.105***	Supported
CP	→	adop_int	0.172	5.746***	Supported
LR	→	adop_int	-0.011	n.s	Not Supported
UA	→	adop_int	0.105	3.83***	Supported
PD	→	adop_int	0.191	7.923***	Supported
MF	→	adop_int	0.142	6.442***	Supported
IC	→	adop_int	0.098	4.461***	Supported

(***=significance at the 0.001, n.s= not significant)

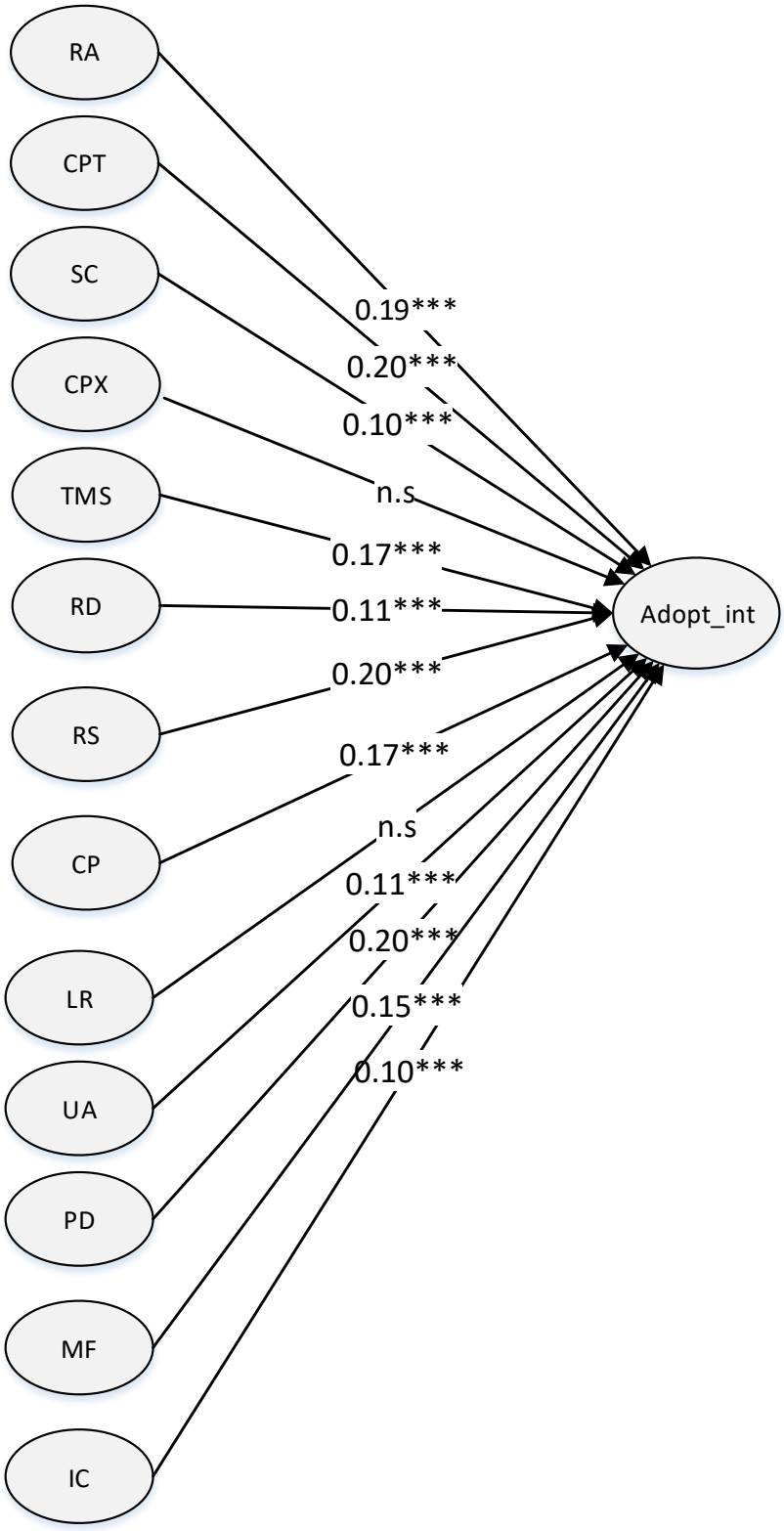

Figure 5.16 Path coefficients for the proposed structural model

5.5 Summary

This chapter presented the analysis techniques and the assessment results from the conceptual model developed in previous chapters. The research assessed the measurement model and determined its construct reliability and validity. CFA was employed to carry out this analysis by using *AMOS* 22 software. The overall measures of the measurement model were established by exceeding all the threshold values suggested from the literature. The assessment results also indicated that the measurement model possessed acceptable levels of fit, convergent validity, and discriminant validity. This was followed by identifying the significant paths and revealing the supported hypotheses as the second step to validate the model. This estimation showed that some relationships were supported in this context including: relative advantage, compatibility, security concerns, top management support, readiness, competitive pressure, regulatory support, uncertainty avoidance, power distance, masculinity and individualism, while others were not (complexity and language and religion). The quantitative analysis was used to test and verify the conceptual model that was refined by the qualitative analysis. This chapter clarified the main results (factors affected cloud computing adoption) needed to be discussed in next chapter in order to achieve the research objective (what factors influence the decisions related to cloud computing adoption in Arabian universirs). The next chapter discusses the conclusions that can be drawn from quantitative and qualitative analysis of the data.

Chapter 6

Discussion

This study used a mixed method sequential design that consisted of an initial exploratory phase, followed by an explanatory phase. The first phase was a qualitative study, which was then followed by a quantitative phase as described previously. The qualitative data were gathered and analysed as explained in Chapter 4, and then the quantitative data were gathered and analysed as shown in Chapter 5. The qualitative stage contributed to the refinement of the conceptual model and served as a basis for the following explanatory research stage. The quantitative research was for the testing of the model.

Chapter 2 presented a review of cloud computing as part of the wave of information and communication technology that is currently changing most aspects of human endeavour. It is easy to forget that even in developed nations, the ubiquity of digital devices for data storage, computation and communication is a development of only the last three decades, if we take the invention of the World Wide Web in 1989 as a beginning. Cloud computing as a digital storage and computing resource paradigm only really began in the early 21st century, and research into the adoption and effects of cloud technology on users is in its infancy. Therefore, the absence of research related to the adoption of cloud computing in the education sector of developing countries was not unexpected during the literature review. The research did indicate, however, that Saudi Arabia's rulers regard technology and education as important elements in the country's strategic plan for diversifying its economy. Cloud computing is an advanced, flexible and cost-effective way in which to introduce information technology widely into an education system, but has been little studied in this context. The current study was undertaken, therefore, to ascertain what effect Saudi organisation, the technology itself, that education environment, and Saudi culture would have on the uptake of the technology as the country seeks to realise its VISION 2030.

Chapter 3 covered the conceptual framework of this study. Qualitative research was subsequently conducted to determine construct relevance and a causal model was presented that incorporated the four key constructs in Chapter 4. Based on this framework, Chapter 5 was presented to explain how the data analysis revealed answers addressing the research goals..

6.1 Results of testing the research hypotheses

To investigate the critical determinants for adopting cloud computing in Saudi universities, a survey targeting senior management, IT managers and staff, and academics was used for data collection. An initial conceptual model, which was built on and extended the TOE theory via integration of cultural factors, was tested and validated using SEM based on the survey data. Positive relationships between relative advantages, compatibility, top management support, readiness, competitive pressure, regulatory support, masculinity and individualism and the adoption of cloud computing were identified. Moreover, negative relationships between cloud computing adoption and security concerns, uncertainty avoidance, and power distance were also identified. Complexity, language and religion were found to be insignificant in relation to the adoption of cloud computing.

As demonstrated by the data analysis, this empirical study supported all the hypotheses except two. Table 6.1 summarises the hypothesis testing for this study.

Table 6.1 Hypothesis testing results

Variable	Hypothesised influence on cloud computing adoption	Hypothesis testing result
relative advantage	positive	confirmed
compatibility	positive	confirmed
security concerns	negative	confirmed
complexity	negative	not confirmed
top management support	positive	confirmed
readiness	positive	confirmed
regulatory support	positive	confirmed
competitive pressure	positive	confirmed
power distance	negative	confirmed
uncertainty avoidance	negative	confirmed
masculine-feminie	positive	confirmed
individualism-communalism	positive	confirmed
language & religion	negative	not confirmed

The researcher examined the effects of technological factors (relative advantage, compatibility, security concerns, and complexity), organisational factors (top management support, and readiness), the environmental factors (competitive pressure, and regulatory support), and cultural factors (language and religion, uncertainty avoidance, power distance, masculinity, and individualism) on cloud computing adoption. The following section provides a discussion about each factor influencing cloud computing adoption in the theoretical framework.

6.1.1 Technology context

In this study, relative advantage dimensions included:

- reducing system administration
- keeping systems always up to date
- reducing hardware and software maintenance efforts
- reducing software cost
- accessing to data from everywhere
- flexibility of accessing computing resources as required.

H1 Relative advantages of cloud computing positively influence the intention to adopt cloud computing.

The quantitative analysis of the data found that relative advantage factors have high impact on cloud computing adoption with a significant positive influence ($\beta = 0.189$, $t= 6.971$, $p <0.001$). *Therefore, the hypothesis is accepted.*

Based on the outcomes of qualitative analysis, cost reduction was the main reason to adopt cloud computing. Cloud computing decreases the cost of IT infrastructure maintenance and reduces the number of staff required. Furthermore, Saudi universities tend to utilise cloud computing from outsource parties in order to concentrate on their own goals. Moreover, analysis also uncovered the fact that the universities would consider the adoption of cloud computing if the latter were flexible and easy to use. This factor is significant and will have a positive impact on the adoption of cloud computing in Saudi universities.

Relative advantage was discovered to be a significant factor of technology adoption in earlier adoption research in firms, including manufacturers associated with IT adoption, e-commerce, Internet-based ICT, and enterprise systems (Dwivedi et al., 2009; Ghobakhloo et al., 2011; Premkumar & Roberts, 1999; Sin Tan, Choy Chong, Lin, & Cyril Eze, 2009). However, relative advantage did not have a significant impact on the organisational adoption of an e-marketplace (Joo & Kim, 2004). In addition, (Yoon, 2009) revealed that none of the technological factors were found to play any role in organisational intent to adopt virtual worlds. When reviewing cloud computing adoption studies, it was found that relative advantage was a positive factor in the adoption of cloud computing by US industries (Tweel, 2012), along with Saudi universities (Tashkandi & Al-Jabri, 2015). Conversely, (Klug, 2014) did not find relative advantage has a significant effect on cloud computing adoption in colleges or universities.

Cloud computing appears to be adopted as a means for gaining benefits and advantages, such as reducing system administration, keeping systems up-to-date, reducing hardware and software maintenance, and accessing data from everywhere. Data analysis showed that Saudi universities realise the relative advantage of cloud computing, which has important practical implications for the future of cloud computing in Saudi universities, suggesting that universities are more willing to adopt cloud computing when relative advantage is recognised.

H2 Compatibility positively influences the intention to adopt cloud computing.

In this study, compatibility referred to compatibility with current university work, existing hardware and software, and the university's strategy. The quantitative analysis of the data found that compatibility had the greatest impact on the adoption of cloud computing in the context of technology, demonstrating a significant positive influence ($\beta = 0.195$, $t= 7.375$, $p <0.001$). *Therefore, the hypothesis is accepted.*

This is consistent with (Chebrolu, 2010; Espadanal & Oliveira, 2012), who also found that compatibility has a positive correlation with cloud computing adoption. In addition, (Cooper, Schindler, & Sun, 2006; Oliveira & Martins, 2010; Wang et al., 2010) found that compatibility was a significant factor in e-business and RFID adoption. While it was found to be a non-significant discriminator in (Low et al., 2011) and (Tashkandi & Al-Jabri, 2015), (Low et al., 2011) have pointed out that when technology is perceived as compatible with work systems, organisations are more inclined to consider adopting it.

Data analysis indicated that Saudi universities are more willing to adopt cloud computing because they perceive it as being consistent with their potential needs and their work context without the need to make huge changes to accommodate its use. The positive relationship indicates that high compatibility with cloud computing enables the staff and academics to avoid major changes in their jobs and work style. Universities should take initiatives to change existing processes to enhance the compatibility of cloud solutions and their existing infrastructure. Cloud computing should also be compatible with the universities' policies, IT development environment, and work needs (Lin & Chen, 2012).

H3 Security concerns negatively influence the intention to adopt cloud computing.

In this study, security concerns related to protection from unauthorised access, data loss, losing control, and intellectual property theft. The quantitative analysis of the data found that security concerns about the storage of data in the cloud had the greatest single negative influence in relation to the adoption of the technology ($\beta = 0.108$, $t = 4.746$, $p < 0.001$).

Therefore, the hypothesis is accepted.

Furthermore, the qualitative findings showed that this factor was considered to be an irritating issue, and, as a result, universities hesitate to move to cloud technology. The decision makers in the universities could decide not to adopt cloud computing because of the risk of data being exposed and compromised by third parties.

In this study, the participating IT managers declared that security concerns could be solved by advanced and up-to-date equipment and systems to control the security. On the other hand, it found that this factor was viewed differently according to the participant's type of responsibility. As an example, top managers considered security concerns to be a serious challenge and they rated it at the top of their list of priorities, while IT staff demonstrated a greater understanding and the flexibility to handle the challenge.

On the other hand, Alsanea (2015) noted that security concerns are seen differently in the Saudi context for both cultural and political reasons not part of Western contexts. The culture in Saudi Arabia impacts many aspects related to working with technology. Political factors have a direct impact on the handling of and dealing with security concerns. In the West, security concerns relating to cloud computing can be managed and dealt with by applying state-of-the-art techniques and tools to meet security standards. Saudi government organisations, including universities, are mainly controlled by the ruling authority, which has a strong tendency to be strict and involve themselves in university activities, which may influence technical decisions. Many technical initiatives have been delayed or cancelled for these reasons. So, any proposed solution in this matter should be first presented to the Saudi authorities in order to convince them to accept the solution.

The analysis identifies security concerns as one of the significant factors that negatively affects the adoption of cloud computing, and that this is one of the major challenges facing universities. The analysis, therefore, reflects and confirms those in the literature, for instance, research by (Alsanea, 2015; Dillon, Wu, & Chang,

2010; Zissis & Lekkas, 2012). However, this finding is inconsistent with (Yoon, 2009), who found that security concerns were not having a significantly negative effect on an organisation's intent to adopt virtual worlds.

Analysis of the data from this present study indicates that security concerns should be considered one of the major barriers to cloud computing adoption. Universities have no confidence in cloud computing, mostly because they are afraid that their data will be visible to others, and that their privacy will be compromised. In addition, they also would not like their data to be under someone else's control.

H4 Complexity negatively influences the intention to adopt cloud computing.

In this study, complexity refers to the complexity of needed skills, integration into the existing landscape, and the required mental effort to learn to use cloud computing. The quantitative analysis of the data found that complexity had the no impact on the adoption of cloud computing. ($\beta = 0.031$, $t= 1.194$); the complexity was non-significant. *Therefore, the hypothesis is not accepted.*

The results from the interview data analysis nevertheless revealed that more attention should be paid to this factor, specifically when the end users have a shallow idea about updated technologies. Furthermore, interview participants observed that user friendly services in cloud computing were an important issue.

The negative relationship between complexity and the adoption of cloud computing was found to be non-significant, which means that the complexity of cloud computing did not have a negative effect on the adoption process of Saudi universities. This was compatible with (Klug, 2014), who found that complexity did not have a negative effect on cloud adoption, a fact also observed in global colleges and universities. Furthermore, another study of cloud computing adoption revealed complexity was not found to be a significant factor (Low et al., 2011). On the other hand, (Tashkandi & Al-Jabri, 2015) did observe a negative relationship between complexity and the adoption of cloud computing by Saudi universities, and complexity was also found to be a negative factor in the intention to adopt cloud computing in small businesses in Arizona (Powelson, 2011).

One possible reason for the negative influences of complexity being non-significant in this study is the variety in the adopted cloud computing services and resources, which may not have required significant technical integration into existing systems, such as cloud-based email systems from known companies such as Google and Microsoft. In addition, most of the participants already had the skills needed to deal with day-

to-day ICT, and most of the survey participants used some cloud computing services through friendly user interfaces and did not have to carry the burden of transferring knowledge or setting up the systems. Moreover, the participants expected to receive intensive training before starting to use the new technology.

6.1.2 Organisational context

In this study, top management support refers to support for adoption, having a clear strategy, and offering training courses. The quantitative analysis of the data found that top management support has its greatest impact in the organisational context; it has a significant positive influence on cloud computing adoption ($\beta = 0.168$, $t = 5.825$, $p < 0.001$). *Therefore, the hypothesis is accepted.*

H5 Top management support positively influences the intention to adopt cloud computing.

In this study, top management support refers to support for adoption, having a clear strategy, and offering training courses. The quantitative analysis of the data found that top management support has its greatest impact in the organisational context; it has a significant positive influence on cloud computing adoption ($\beta = 0.168$, $t = 5.825$, $p < 0.001$). *Therefore, the hypothesis is accepted.*

This finding was compatible with other studies that found positive connections between the adoption of technology and top management support (Dong, Neufeld, & Higgins, 2009; Liao & Tseng, 2010; Xu & Quaddus, 2012). Moreover, (Chang et al., 2013) found a positive relationship between top management support and cloud computing adoption. However, (Yoon, 2009) found that top management support provided no significant explanation of organisational intent to adopt virtual worlds.

It is explicit from the findings that a positive attitude among top managers influenced the adoption of cloud computing in the context of this study. Managers must have a capacity for technology integration (Cho, 2006). The significance of top management support for the adoption of cloud computing highlights the importance of having a comprehensive perception of cloud computing among the leadership of the university. The more committed the leading figures in the university, the greater the support for cloud adoption and the chances of developing a clear strategy, and offering training courses for the cloud computing end users. Training employees enables them to understand the functional and technical perspectives of cloud computing. It makes them well educated, experienced, responsible, and knowledgeable for the effective use of cloud computing technologies, which become easier for them to use. Furthermore, they can appreciate the relevance of ICT in their job performance.

H6 Organisational readiness positively influences the intention to adopt cloud computing.

In this study, organisational readiness referred to the availability of necessary skills, convenient wireless Internet access, and Internet-enabled computers. The quantitative analysis of the data found that organisational readiness has a positive impact on the adoption of cloud computing in the organisational context. Organisational readiness has a significant positive influence on cloud computing adoption (β = 0.107, t= 4.537, p <0.001). This is consistent with previous studies (Hong & Zhu, 2006; Lumsden & Anabel, 2013; Oliveira & Martins, 2010; Yoon, 2009). *Therefore, the hypothesis is accepted.*

The findings from both the qualitative and quantitative analysis demonstrated that this factor had a significant positive effect on the adoption of cloud computing. The findings emphasised the importance of having an suitable ICT platform in advance of adopting cloud computing. The findings indicate that those universities with higher levels of organisational readiness for cloud computing are more likely to use cloud computing services.

Thus, top management needs to focus on technological resources, such as physical infrastructure and IT-educated staff. Moreover, top management has an effective role in motivating the employees by facilitating and developing the working environment. This could be done by providing the necessary resources, such as allocating time and updated equipment. In addition, it is critical that top managers realise the role of technology in improving organisational performance and overcoming perceived performance gaps (Gangwar et al., 2015).

6.1.3 Environmental context

H7 Competitive pressure from competitors positively influences the intention to adopt cloud computing.

In this study, competitive pressure includes the adoption of cloud computing by the majority of competitors, the intention to adopt cloud computing by the competitors, and recommendations by the government. Quantitative analysis of the data found that competitive pressure has a positive impact on the adoption of cloud computing in the environment in which the ICT is going to be used. Competitive pressure has a significant positive influence on cloud computing adoption (β = 0.172, t= 5.746, p <0.001). Prior studies have found that competitive pressure increases a firm's incentives to seek new technology innovations so as to maintain a competitive edge (Iacovou, Benbasat, & Dexter, 1995; Kamien & Schwartz, 1982). *Therefore, the hypothesis is accepted.*

The findings from the qualitative and quantitative analysis show that competitive pressures have a significant positive effect on the adoption of cloud computing. A significant and positive correlation between competitive pressure and cloud computing adoption indicates that when competitors implement cloud computing, other organisations feel pressure to do the same so as to maintain their competitiveness.

Moreover, the significance of competitive pressure to the adoption of cloud computing reveals that Saudi universities are prone to adopt cloud computing in order to maintain their competitive position. Moreover, the wish of the Saudi Ministry of Education to upgrade the education level, especially at universities, exerts considerable pressure on universities to adopt cloud computing.

H8 Regulatory support positively influences the intention to adopt cloud computing.

In this study, regulatory support referred to regulations to protect the users, laws regarding data ownership and responsibility, and budgetary sufficiency. The quantitative analysis of the data found that regulatory support has a positive impact on cloud computing adoption in the environment context. Regulatory support has a significant positive influence on cloud computing adoption ($\beta = 0.201$, $t= 7.105$, $p <0.001$). *Therefore, the hypothesis is accepted*.

This finding is consistent with preceding studies. Regulatory policy was a significant factor in both ERP and e-business adoption (Pan & Jang, 2008; Zhu, Kraemer, & Xu, 2006), and also in cloud computing adoption (Alsanea, 2015), even though it was not significant in the acceptance of Internet/e-business technologies between small and medium enterprises in Canada (Ifinedo, 2011).

The significance of regulatory support to the adoption of cloud computing reveals that the assistance from the Saudi government through the development of policies, programs, and budgetary provision has given rise to an educational renaissance that is potentially facilitative of the adoption process. It was noticed from the interview analysis that support from the government would help the organisations to overcome any financial limitations. However, the lack of identified policies and regulation have all slowed the progress and adoption of cloud computing in the education sector in Saudi Arabia.

6.1.4 Cultural context

H9 High uncertainty avoidance negatively influences the intention to adopt cloud computing.

Quantitative analysis of the data found that high uncertainty avoidance has a negative impact on cloud computing adoption, and the impact is significant ($\beta = 0.105$, $t= 3.83$, $p <0.001$). This is consistent with (Al-Sukkar, 2005; Erumban & De Jong, 2006; Hermeking, 2005; Zhao et al., 2014). *Therefore, the hypothesis is accepted.*

As is the case with power distance, societies with high uncertainty avoidance scores record lower adoption rates of technology than societies with low uncertainty avoidance scores. This is because people in countries with a high score for uncertainty avoidance are more risk unwilling and resistant to doing things for the first time. Adoption of any innovation that is proposed is likely to be influenced by uncertainty avoidance

> *…in cultures with low Uncertainty Avoidance, all innovations, not just interactive networks, will be looked upon more favourably than in cultures with high Uncertainty Avoidance.* (Maitland, 1998, p. 280)

Low uncertainty avoidance cultures generally experience faster rates of diffusion of new technologies (Maitland & Bauer, 2001).

Saudi Arabia scores 80 on this dimension and displays a preference for avoiding uncertainty, as confirmed by qualitative and quantitative analysis. The high UA score from Saudi universities suggest that the decision makers in the universities are not risk takers when dealing with IT projects. For some of them, new technologies are something ‘unknown’ and there are no particular results expected that they can rely on, so they may choose to avoid risks and avoid investing in these projects.

Those who are uncertainty avoidant prefer having formal rules and measured outcomes that assure positive results. In the IT world, where technologies change rapidly, the effects are unknown and the potential for unintended consequences are great; uncertainty is to be expected. So, managers may need to decrease the uncertainty attaching to ICT by, for example, clearly stating the advantages of the new technology and emphasising the adoption of new ideas.

H10 High power distance negatively influences the intention to adopt cloud computing.

The quantitative analysis of the data found that a high power distance has a negative impact on cloud computing adoption. Power distance has the greatest significant impact of all the factors ($\beta = 0.191$, $t= 7.923$, $p <0.001$). This is consistent with (Abdulrab, 2011; Al-Sukkar, 2005; Erumban & De Jong, 2006; Zhao, Scheruhn, & von Rosing, 2014). *Therefore, the hypothesis is accepted.*

The hypothesis of power distance is highly supported. The analyses point out that societies with a high power distance have a tendency to exhibit lower ICT adoption as compared to countries with a lower power distance. Moreover, it is anticipated that cultures with a high power distance will exhibit more restricted attitudes toward new ideas (Erumban & De Jong, 2006).

There is evidence that a larger power distance often results in a lack of communication and collaboration among individuals, whether in the same organisation or in different organisations (Abdulrab, 2011). Saudi Arabia scores high in this cultural aspect (score of 95/100), which means that people believe in the idea of hierarchical order in which everybody has a place, and which needs no additional justification, as indicated by the quantitative and qualitative analysis. So, it is recommended that managers try to minimise the power distance between them and their employees to increase ICT adoption chances.

Another implication of a high power distance index (PDI) in universities is the lack of technological knowledge and the end users' needs. It is reasonable to encourage an organisational culture within which employees can express their ideas freely, without considering their status difference. Otherwise, important ideas coming out at the bottom level may die-off without having a chance for expression or implementation (Erumban & De Jong, 2006).

Although it is not easy to change how people think of power distance in any culture, there are different methods that could contribute to improving the adoption and use of educational technologies in universities. One of them is to understand the negative effect of a large power distance between supervisors and subordinates, and find ways to lessen the impact.

The negative relationship between power distance and IT adoption and usage which was found in this study is similar to the findings of other studies that compared the PDI of different countries or cultures. For example, when (Hasan & Ditsa, 1999) studied the relationship between IT utilisation and culture, they found

that Australia, which is one of the world leaders in the use of new technology, had a lower PDI than countries in the Middle East, such as Egypt, Jordan, and Turkey. They also found that Turkey, which has greater IT adoption than Egypt and Jordan, had lower a PDI than those two countries.

Hofstede's original study in 1980 indicated that the Arab World region, which includes Egypt, Iraq, Kuwait, Saudi Arabia, the United Arab Emirates, Lebanon, and Libya had a PDI of 80, compared to a PDI of 40 for the United States. The US, which is a high-technology-adopting country, had a lower PDI than the Arab World in Hofstede's original study (Abdulrab, 2011).

H11 High masculinity positively influences the intention to adopt cloud computing.

The quantitative analysis of the data found that high levels of masculinity have a positive impact on cloud computing adoption, and exercised significant impact ($\beta = 0.142$, $t = 6.442$, $p < 0.001$). *Therefore, the hypothesis is accepted.*

The MAS index indicates the distribution of roles between genders in a culture. High MAS score cultures represent masculine cultures where social gender roles are distinguished: men have to be firm, strong, and concentrated on material success, and women are expected to be more modest, nurturing, and concerned with the quality of life. Low MAS score cultures represent feminine cultures where social gender roles can be mixed with both men and women encouraged to be modest, nurturing, and interested in the quality of life (Abdulrab, 2011).

According to studies (Gudykunst & Mody, 2002; Van Everdingen & Waarts, 2003), the MAS cultural dimension impacts IT adoption inasmuch as masculine cultures tend to be more IT adopting. On the other hand, this is inconsistent with (Erumban & De Jong, 2006), who reject any relationship between the masculinity dimension and ICT adoption.

Saudi Arabia scores 60 for this dimension and is thus a 'masculine' society. In masculine countries people 'live to work', managers are expected to be decisive and assertive, the emphasis is on equity, competition and performance and conflicts are resolved by fighting them out.

According to Hofstede (1991), organisations in masculine cultures give special importance to rewards and acknowledgement of performance, in addition to training and self-improvement. These are attributes popular to innovative organisations. Hofstede (2005) believed that religion is one of the factors that can predict a country's masculinity index. The issues related to the masculinity-femininity dimension are central to most

religions. In Hofstede's original study (1980) and other replicate studies (Hasan & Ditsa, 1999; Van Everdingen & Waarts, 2003), Islamic countries have always had higher MAS indexes than other countries. The MAS index for the Arab World region in Hofstede's study was the third highest MAS score for all countries and regions in his study (Hofstede, 1980). Saudi culture is also known for the differentiation and separation of sexes (Abdulrab, 2011).

H12 High individualism positively influences the intention to adopt cloud computing.

The quantitative analysis of the data found that high levels of individualism have a positive impact on cloud computing adoption, and exercised significant impact ($\beta = 0.098$, $t = 4.461$, $p < 0.001$). This is consistent with (Abdulrab, 2011; Zhao et al., 2014). *Therefore, the hypothesis is accepted.*

People in countries that emphasise individualism in their culture expect people to make their own choices and to look after themselves and their direct family only, while people in countries with a culture of collectivism belong more strongly to groups that take care of them in exchange for loyalty. Persons in individualistic countries have the ability to express their own views freely and are consequently more prepared to innovate and adopt new ideas (Erumban & De Jong, 2006).

Saudi Arabia, with a score of 25/100, is considered a collectivistic or communal society. Arab culture in general is known for being a collectivistic culture in which people tend to consider themselves as groups members , such as families or tribes, and generally think the group's needs are more important than the individuals needs. Within this tribal Arab culture, the group has priority over the individual. The value of the group comes first and the responsibility falls on the whole group instead of specific individuals. Saudi Arabia may possibly be one of the most collectivistic cultures among other Arab cultures, because of the strong tribal system that is still very apparent in Saudi culture.

According to (Van Everdingen & Waarts, 2003), individualism encourages IT adoption, whereas collectivism tends to slow the adoption of new technologies. As a result, it is usually easier to adopt new technologies in cultures with high individualism scores. Unlike employees in low individualism-score cultures, employees in highly individualistic cultures feel free to change and try new innovations and adopt new technologies.

H13 Language and religion negatively influence the intention to adopt cloud computing.

The quantitative analysis of the data found that language and religion have no impact on cloud computing adoption. Language and religion have a non significant impact (β = - 0.011, t = - 0.523). *Therefore, the hypothesis is rejected*.

Maitland and Bauer (2001) pointed out that English language ability is a cultural variable related specifically to Internet adoption. It has been observed that the ability to speak English will certainly impact the advantage ICT presents. Grazzi and Vergara (2012) note that language is one of the cultural aspects that may affect ICT adoption in developing countries where native languages are in use, while the language of the Internet and computer software is rarely translated into local languages. Grazzi and Vergara (2012) added that familiarity with the English language, which is commonly used in ICT, is generally low and extremely concentrated in well-educated and kindly rich societies in Saudi Arabia. In this study, language was not found to be a barrier, possibly because the participants in this study were well-educated people with a good knowledge of computers.

Regarding religion, the study found that religion had no significant impact on ICT adoption. This result aligns with that of (Tanasyuk & Avgerou, 2009). Tanasyuk and Avgerou found that the religious community of Athos recognise ICTs as useful for them in terms of data storage and time savings, and do not find ICT incompatible with their spiritual goals.

On the other hand, Kalliny and Hausman (2007) argue that some of the main religions, such as Islam and Christianity, can affect some innovation adoption strongly, and the effect can be moderated by the innovation type. They argue that the innovation producers can modify their product to suit the country's culture. They recommend that in societies where religion and government have the strongest authority (such as Saudi Arabia, Egypt and Lebanon), the innovation producer could approach the authorised people and receive their approval before introducing an innovation for the audience to adopt.

Moreover, Sanaktekin, Aslanbay, and Gorgulu (2013) found that religion has a significant effect on Internet consumption, and, as religiosity increases, Internet consumption decreases. Most religious people doubt and resist using the Internet. Campbell (2011) researched religion and the Internet within the Israeli context. The study showed that although the Internet is utilised, it is still regarded doubtfully. In addition, religious leaders actively try to restrict Internet usage in order to decrease its effect on religious and social norms.

6.2 Summary

This chapter explored the results of the quantitative and qualitative stages of the study and merged them to provide a comprehensive picture of the factors that have both long and short-lasting effects on cloud computing adoption. The chapter has summarised the technological, organisational, environmental, and cultural factors that affect Saudi universities when they consider adopting cloud computing. In terms of educational institutions, the managers of Saudi universities appear to realise the relative advantages of cloud computing, and are ready to adopt the technology with compatible infrastructure and clear senior management vision, in spite of some data security concerns. This research, however, has revealed genuine pitfalls that enthusiastic managers should consider when/if shifting to a cloud data storage and computer resources system.

Based on the research conducted with a small but representative sample of students and employees at PNU, higher education institutions of the quality of PNU are interested in cloud computing and ready to try it – if it is introduced in an orderly and supported way. While the enthusiasm of the study participants was evident, it was also clear that they would require training and the putting in place of structures, systems and processes, along with technicians, to convert the participants' enthusiasm for the cloud into something more sustainable. The analysis of the data, therefore, not only revealed the participants' readiness to try something new, but also their uncertainty about how it would be introduced and managed.

Culturally, the uptake of cloud computing requires that more attention be paid to clarifying the essence of the cloud, and training the staff in how to make the best of the cloud.

In the light of this discussion, the next chapter combines the answers to the questions and reconsiders the aims and objectives of this research. It also highlights the study's contribution to the body of knowledge. The study limitations and future work are also included.

Chapter 7

Conclusion and future work

This chapter provides an overview of the research, recounting the research questions and the answers the data analysis revealed. The chapter highlights the contributions of this study in the field of cloud computing adoption in Saudi universities. Lastly, it attends to the limitations of this study and gives recommendations for future research.

7.1 The purpose of the study

The research described in this thesis investigated the adoption of cloud computing in the developing country of Saudi Arabia, recognising that Saudi is not a small economy or lacking in governmental organisation, but that it is a developing country in terms of the strength of its civil society, diversity of it economy and goals for educational attainment in the countries institutions. Research studies conducted to identify the most influential technology adoption factors in developing countries and especially Saudi Arabia are very scarce. Therefore, this study sought to provide some insight into the nature of the problems involved in adopting a technology as advanced as cloud computing without having gone, as developed nations have, through various early manifestations of information and communication technology, such as the very beginning of the World Wide Web, networking, word processing and desktop computing – all precursors to the cloud.

7.1.2 The research problem

The study was designed to answer the following questions:

1 *What technological factors influence the decisions related to cloud computing in Saudi Arabian universities?*

2 *What organisational factors influence the decisions related to cloud computing in Saudi Arabian universities?*

3 *What environmental factors influence the decisions related to cloud computing in Saudi Arabian universities?*

4 *What cultural factors influence the decisions related to cloud computing in Saudi Arabian universities?*

The main goal of this study was to empirically identify the factors that may impact cloud computing adoption in Saudi universities. In order to do this, any current literature relating to cloud computing, technology adoption and to the uptake of technology in developing countries was interrogated. Little has

been reported in scholarly publications about Saudi education, so this study was an opportunity to contribute to the development of the country as they seek to meet the targets of the VISION 2030 strategic plan for modernising the kingdom's economy and educational environment.

From the literature, four categories of influence on systems attempting to make technological changes emerged, which were used to build the framework for the research: the nature of the technology itself, the nature of the organisation seeking to adopt the technology, the general environment of the potential technology adopter (support, skills, facilities) and the cultural features that operate on the activities of the individuals and the society's institutions. Aspects of all of these categories may be barriers to technology adoption.

7.1.2 Answering the questions

Many steps were taken in order to address the questions. The first step was to conduct a comprehensive literature review to identify the factors that could potentially affect the adoption of cloud computing generally and in Saudi Arabia specifically. The existing theories were reviewed and TOE theory was found to match most of the selected factors. TOE was extended with Hofstede's theory to cover the cultural aspect.

As a second step, the conceptual model was developed and the hypotheses were designed with 12 factors as declared in Chapter 3. The qualitative stage involved conducting interviews with key personnel at PNU to verify the conceptual model. One more factor was added to the conceptual model as presented in Chapter 4. The third step involved conducting the quantitative stage by distributing the survey to government universities throughout Saudi Arabia as discussed in Chapter 5. The quantitative results align with the qualitative findings. Both showed which factors encourage the uptake of cloud computing and which discourage it, and can be correlated with the categories in the questions.

Table 7.1 Summary of findings

Factors encouraging technology (cloud) adoption (TOE factor highlighted in bold italics)		**Factors inhibiting technology (cloud) adoption**	
relative advantage technological factors	*It is to the adopter's advantage relative to others to adopt the technology.*	***security concerns***	**Security concerns** differed from person to person, depending on their position and background. IT managers and staff understood that security issues could be solved by applying up-to-date software and protocols. Decision makers and principles should consult IT personnel before accepting or refusing to take steps towards implementing cloud computing
compatibility technological factors	*The new technology is compatible with earlier learning.*	***high power distance***	A **high power distance** society if hierarchical in nature, with members understanding where they are located in the power structure (pecking order). This phenomenon leads to the society being somewhat restricted and closed to new ideas and technologies. In order to overcome this negative factor, it is recommended that mangers try to minimise the power distance between them and their employees. Moreover, managers should also encourage their employees to talk and express their ideas and concerns freely so that managers can benefit from their new ideas. It is also recommended that everyone be made aware of the effect of large power distances in the working environment so that ways can be found to minimise such impacts.
top management support organisational factors	*The support of the senior management and leaders of the institution is critical.*	***high uncertainty avoidance***	People with **high uncertainty avoidance** mostly resist new technologies and are afraid to take risks, which means they will avoid adopting modern innovations. Managers may need to minimise the uncertainty associated with ICT by clearly stating the advantages of the new technology and emphasising the need to adopt new ideas.

Factors encouraging technology (cloud) adoption (TOE factor highlighted in bold italics)		Factors inhibiting technology (cloud) adoption
organisational readiness organisational factors	*The organisation must be prepared and open to a new technology.*	
competitive pressure environmental factors	*The organisation must maintain its competitiveness in the marketplace.*	
regulatory support environmental factors	*The new technology and its use must have rules and guidelines to assist users and technicians.*	
high individualism cultural factors	*Societies that value highly individual behaviour are more likely to support the uptake of new digital technologies.*	
high masculinity *Masculinity favours the adoption of new technology. Some societies have a masculine milieu.* **cultural factors**		

7.3 Contribution of the study to theory and practice

Cloud computing is being adopted in the fields of business, government, and education due to its attractive features and wide range of applications (Sultan, 2010). It has emerged as an attractive technology in the education community because it offers many features that educational organisations can utilise to enable their staff and students to do their work more effectively and efficiently (Miller, 2009) without the expense of purchasing and maintaining constantly changing suites of software.

The government of Saudi Arabia is attempting to update the country's educational systems by adopting the latest and best educational, technological practices (Weber, 2011). However, despite its attractiveness, many academic institutions in Saudi Arabia face major difficulties in adopting cloud computing. Cloud computing is a relatively new technology in the field of education worldwide, and scholarly studies into its impact on education and educational institutions are not yet common (Alkhater, Wills, & Walters, 2014). However, the cost benefits, range of features, stability and flexibility of the platform have led to its increasing popularity, in the education system of developed nations, where its impacts are increasingly being measured. In developing nations, such as Saudi Arabia, where the idea of using any digital technologies in education is relatively new, it is important to understand how an advanced digital platform like cloud computing would be received. Once the factors that would enable cloud computing are known, as well as the factors mitigating against it, the Ministry of Education will be able to formulate a set of principles to guide its systematic introduction into their school system. Therefore, this study makes an important theoretical and practical contribution.

7.3.1 Theoretical contribution

The majority of existing cloud computing research has been focused on cloud adoption in developed countries (Greengard, 2010; Hailu, 2012), but very little is known about the historical, societal, organisational and cultural factors that influence cloud computing adoption by educational organisations in developing countries (Van Everdingen & Waarts, 2003), all of which lack the same history of exposure to technology as educational institutions in developed nations. Therefore, this study focused on cultural factors that might influence the adoption of cloud computing in Saudi universities.

While existing studies have examined technology adoption in developing countries from an individual perspective using the *technology acceptance model* (TAM) (Susanto & Goodwin, 2010) and *unified theory of acceptance and use of technology model* (UTAUT) (Alzahrani & Goodwin, 2012), the area of technology

uptake at the institutional level using the technology-organization-environment (TOE) framework remains under-researched, particularly in university contexts (Borgman et al., 2013; Duan, 2012).

Other studies have explored the uptake of information and communication technologies (ICT) by organisations in developing countries. However, they have focused primarily on e-government and e-readiness without regarding the adoption of technology in the TOE framework (Abdalla, 2012; Alhujran, 2009; Altameem, 2007; Choudrie et al., 2012; Seng et al., 2010).

Thus, this study is significant for several reasons. From a theoretical perspective, it examines cloud technology adoption at the organisational level and in the context of developing countries, as well as the Saudi Arabian cultural and educational environment. It provides Saudi universities' with knowledge that can help to guide their managers as they go forward with plans to use digital technologies extensively in the updating of their educational facilities and programs. The findings from this study are significant because they add to the existing knowledge in the discipline of educational theory and technology adoption, highlighting the distinctive cultural context of Saudi Arabia, and foregrounding the serious challenges the country faces while attempting to change educational practices.

Furthermore, this study contributes to the existing literature in the field of cloud computing and technology adoption by (a) extending the TOE framework to the study of cloud computing adoption as a feature of educational organisations, (b) developing a validated conceptual model for inspecting the critical factors related to adopting cloud computing in Saudi universities.

The thorough literature review produced a selection of 13 factors that might influence cloud computing adoption while demonstrating the applicability and usefulness of the TOE framework to organise and examine data garnered through mixed methods research.

The lack of a theoretical model which could be used to identify the factors which have effects on the adoption of cloud computing and challenge the adoption intention and process in Saudi universities was identified. Therefore, a new conceptual model based on TOE was developed and tested and proved robust. Influencers associated with the technology itself, with the organisation, the teaching and learning environment and the cultural milieu were identified, which has not been seen before in studies into the uptake of technologies in developing countries. Considering the collected data through the frame of TOE, it was possible to appreciate more comprehensively the factors that influence the adoption of cloud computing in Saudi universities. The new model formed the theoretical basis of this study after being refined by

conducting and analysing interviews with key employees in the largest women's university in the world (PNU).

Furthermore, this research applied mixed methods research in the investigation of cloud computing. More specifically, the study combined qualitative and quantitative methods to fulfil the exploratory and explanatory research objectives. It has provided insight into how various procedures and strategies were adopted when formulating the research questions and collecting and analysing qualitative and quantitative data in order to achieve the research objectives. The research was, therefore, a perfect example of the applicability of a mixed-methods approach for obtaining a comprehensive understanding of the research phenomenon being studied, in this case the potential adoption of cloud computing in Saudi universities.

Therefore, the study makes an important theoretical contribution on the adoption of cloud computing in higher education in developing countries. It makes this contribution by building on past organisational adoption research, specifically the TOE framework, and extends it by integrating cultural factors in the context of developing countries, validated by both qualitative and quantitative research.

7.3.2 Implications for higher education institutions

Saudi Arabia is embarking on a new phase of its history as a nation (only founded in 1932), and, although wealthy by the standards of many developing nations, lacks the history and experience of the developed world in dealing with digital technologies. Cloud computing has been shown in this study to be largely acceptable to participants selected from one of Saudi's most advanced educational institutions when the right conditions are met. The study informs Saudi decision makers considering the introduction of digital technologies at universities. The findings can help decision makers formulate and devise specific policies and strategies for the effective adoption of technology by taking account of the cultural factors affecting or shaping the perspectives and decisions of decision makers in Saudi universities.

The Saudi Ministry of Education encourages innovation adoption and provides supported resources and efforts to enhance the education sector, and decision makers in the schools and universities should seriously consider adopting cloud computing in order to catch up with new technology and move forward educationally and economically more quickly than is currently occurring with more traditional technologies.

With a better understanding of critical issues in the adoption of cloud computing, universities can effectively manage their own cloud computing and further improve their productivity through better use of their available resources. Cloud computing is expected to deliver benefits by improving access to new

technologies and easier access to old ones, which are always being improved. The use of the cloud also results in relative advantages for the institution in terms of other institutions or organisations with which it may be competing. The use of cloud computing would allow universities can keep pace with the increased need for up-to-date resources while limiting cost and maintenance. In addition, institutions with modest infrastructure could provide high quality services by accessing the resources available on the cloud.

The results of the research demonstrated, however, that achieving these benefits meant that current systems and polices need changing to be more compatible with cloud computing if a shift to the cloud is to be achieved. The research results help educational institutions to establish their own guidelines for adopting cloud computing in terms of compatibility with their own capacities, systems and goals (university work, resources, strategy) and smoothly integrate new technological elements into existing systems. Although the findings of this study did not show complexity to be a significant factor for cloud adoption, it is still anticipated that decision makers will plan for the intensive training of their staff before introducing new technology in order to avoid staff dissatisfaction and disappointment due to frustration.

Since security is a concern, for example, senior management need to make decisions about how they want to secure their data, in terms of authority limits and data ownership. Consulting experts in the field is a priority before making agreements with service providers. Considering private cloud computing as a solution, for example, could be doable and convenient. Furthermore, it was noticed from the findings that the lack of identified rules and regulations are all slowing the adoption of cloud computing in the education sector in Saudi Arabia, and there would be some sense in privately hosting a cloud system within the organisation as this would eliminate regulation conflicts or lack of specific guidelines.

The clear implication is that managers should, themselves, have a comprehensive perception of cloud computing in order to develop modern strategies and come up with new ideas and comprehensive plans for introducing cloud computing and using it efficiently and effectively. This also requires a consistent focus on technological resources, such as physical infrastructure and IT-educated and experienced staff.

The results from the study clearly implied that there are cultural factors specific to Saudi Arabia that hinder the take-up of computer technologies, outside of mobile phones. Managers, for example, need to reduce the high power distance between themselves and employees, while, ideally, spreading awareness throughout the institution of the negative effect of large power distances in the working environment. These leaders also need to make a conscious effort to decrease the uncertainty related to adopted technology by demonstrating

through their own usage and by word of mouth the advantages of the new technology while emphasising the adoption of new ideas by new disciplines and the introduction of comprehensive technology and usage policies.

In addition, the fact that greater individualism encourages IT adoption, whereas collectivism tends to slow the adoption of new technologies, clearly implies that Arab culture collectivism hinders cloud computing uptake since individual initiative is not expected, but group decisions are. Consequently, managers should develop policies and new managerial methods in order to deal with individual employees and make the most of their insights and input.

Interestingly, the findings of this study showed that Saudi Arabia was a 'masculine' society. Organisations in masculine cultures tend to reward and acknowledge performance and self-improvement, indicating that with the right leadership, making greater use of ICT in innovative ways in Saudi Arabia would be rewarding for participants. The outcomes would depend on the way the introduction of computer technologies was approached.

The quantitative analysis of the data found that language and religion have no impact on cloud computing adoption. In this study, language was not found to be a barrier, possibly because the participants in this study were well-educated people with a good knowledge of computers.

7.4 Limitations and future research

This research has some limitations. This study does not distinguish between the adoption of cloud computing in Saudi regional contexts and Saudi cities. Universities located in small cities have specific characteristics different from those of universities in the main cities. Participating universities were located throughout Saudi Arabia. The reason why the interviews were not conducted via emails or phone calls is because the information that the researcher was seeking was sensitive and hence a face-to-face interview was needed.

Interviews were conducted with only one university, due to the complicated procedures required to arrange appointments with key employees in the universities, especially male staff due to cultural and religious laws. In addition, the participating universities were located all over Saudi Arabia. The low sample size of the qualitative method could decrease the reliability of the research.

Future research can address the above limitations by investigating the post adoption stage of cloud computing in Saudi universities, as well as by conducting a comparative study of the adoption of cloud

computing between the main and small cities. In addition, this study can be repeated in other countries to compare the significant factors. Furthermore, future studies could assess the implementation process and the impacts of cloud computing on university performance to gain a holistic understanding of cloud computing.

7.5 Summary

In this chapter, the study answered the research questions and the contributions of the study have been explained, as have the limitations and possible future research.

This research makes a unique theoretical contribution to the literature related to the adoption of cloud computing by universities in developing countries. Unlike past research that was based predominantly on developed countries, or, in the case of developing countries, has been explored primarily at the individual level of adoption, this research examines adoption at the organisational level in developing countries. It builds on an organisation level theory (TOE) as a basis to investigate cloud computing adoption factors and extends that theory with cultural factors in order to more holistically understand the key factors impacting the adoption of cloud computing in the cultural context of Saudi Arabia.

The research employed a qualitative method when developing the conceptual model and for initiating the survey instrument. A quantitative method was vital in testing the extended theory. The study uncovers key positive factors encouraging the adoption of cloud computing in Saudi universities, such as relative advantages, compatibility, top management support, organisational readiness and others. It also revealed negative factors and discussed how to lessen their impact on the adoption process, such as security concerns, high power distance and high uncertainty avoidance.

Saudi universities are willing to improve and develop in order to keep abreast of the country's development, which means adopting cloud computing in the future is highly likely. This study uncovers the key factors that are vital for cloud adoption and for reducing barriers, taking into account the cultural nuances of Saudi Arabia. Indeed, this research is critical as the Saudi Arabian higher education sector rapidly transforms itself in the digital age to meet the needs to an increasingly educated society.

References

A Vouk, M. (2008). Cloud computing–issues, research and implementations. *CIT. Journal of Computing and Information Technology, 16*(4), 235-246.

Aaker, D. A., Kumar, V., & Day, G. S. (2008). *Marketing research*. 12th edition. John Wiley & Sons, Inc.

Aaron, L. S., & Roche, C. M. (2012). Teaching, learning, and collaborating in the cloud: Applications of cloud computing for educators in post-secondary institutions. *Journal of Educational Technology Systems, 2*(40), 95-111.

Abdalla, S. (2012). *An e-government adoption framework for developing countries: A case study from Sudan.* PhD Thesis. Cranfield University: UK. Retrieved from http://dspace.lib.cranfield.ac.uk/handle/1826/7314.

Abdullah Alshwaier, A. Y., Ahmed Emam. (2012). A new trend for e-learning in KSA using educational clouds. *Advanced Computing: An International Journal (ACIJ), 3*(1), 81-97

Abdulrab, S. (2011). *The impact of culture on information technology adoption in Yemeni universities*. PhD Thesis. Robert Morris University. Moon Township, PA, USA. ProQuest Dissertations and Theses.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Al Alhareth, Y., McBride, N., Prior, M., Leigh, M., & Flick, C. (2013). *Saudi women and e-learning.* Paper presented at the 3rd International Conference on the Future of Education, 13-14 June, Florence, Italy.

Al Rawaf, H. S., & Simmons, C. (1991). The education of women in Saudi Arabia. *Comparative Education, 27*(3), 287-295.

Alamri, B. H., & Qureshi, M. R. J. (2015). Usability of cloud computing to improve higher education. *International Journal of Information Technology and Computer Science (IJITCS), 7*(9), 59-65.

Alamri, M. (2011). Higher education in Saudi Arabia. *Journal of Higher Education Theory and Practice, 11*(4), 88-91.

Albalawi, M. S. (2007). *Critical factors related to the implementation of web-based instruction by higher-education faculty at three universities in the Kingdom Of Saudi Arabia.* Unpublished doctoral dissertation. The University of West Florida, Florida, USA.

Aldraehim, M. S. A. (2013). *Cultural impact on e-service use in Saudi Arabia*. PhD thesis, Queensland University of Technology, Brisbane, Australia

Aldraehim, M. S., Edwards, S. L., Watson, J. A., & Chan, T. (2012). Cultural impact on e-service use in Saudi Arabia: The role of nepotism. *International Journal for Infonomics (IJI), 5*(3/4), 655-662.

Aldraehim, M. S., Edwards, S. L., Watson, J., & Chan, T. (2013). Cultural impact on e-service use in Saudi Arabia: The need for service oriented culture. In *Proceedings of the Nineteenth Americas Conference on Information Systems, Chicago, Illinois, August 15-17, 2013.*

Aldraehim, M., Edwards, S. L., & Watson, J. (2012). *Cultural impact on e-service use in Saudi Arabia: Results from focus groups.* Paper presented at the 2012 Ninth International Conference on Information Technology: New Generations (ITNG)

Aldraehim, M., Edwards, S. L., Watson, J. A., & Chan, T. (2013). Cultural impact on e-service use in Saudi Arabia: The need for interaction with other humans. *International Journal of Advanced Computer Science, 3*(2), 56-64

Aldraehim, M., Edwards, S. L., Watson, J., & Chan, T. (2012). *Cultural impact on e-service use in Saudi Arabia: Results from questionnaire.* Paper presented at the International Conference on Information Society (i-Society 2012). 230-236

Aleid, F., Rogerson, S., & Fairweather, B. (2009). *Factors affecting consumers' adoption of e-commerce in Saudi Arabia from a consumers' perspective.* Paper presented at the IADIS International Conference on e-Commerce. 11-18

Al-Gahtani, S. S., Hubona, G. S., & Wang, J. (2007). Information technology (IT) in Saudi Arabia: Culture and the acceptance and use of IT. *Information & Management, 44*(8), 681-691.

Alghamdi, I. A., Goodwin, R., & Rampersad, G. (2011a). E-government readiness assessment for government organizations in developing countries. *Computer and Information Science, 4*(3), 3-17

Alghamdi, I. A., Goodwin, R., & Rampersad, G. (2011b). *A suggested e-government framework for assessing organizational e-readiness in developing countries.* Paper presented at the International Conference on Informatics Engineering and Information Science.

Alghamdi, I. A., Goodwin, R., & Rampersad, G. (2011b). A suggested e-government framework for assessing organizational e-readiness in developing countries. *Informatics Engineering and Information Science,* 479-498.

Alghamdi, I. A., Goodwin, R., & Rampersad, G. (2013). Evaluation of organizational e-government readiness in the public sector. *International Journal of E-Services and Mobile Applications (IJESMA), 5*(2), 1-12.

Alghamdi, I., Goodwin, R., & Rampersad, G. (2014). Organizational e-government readiness: An investigation in Saudi Arabia. *International Journal of Business and Management, 9*(5), 14-24.

Alhammadi, A., Stanier, C., & Eardley, A. (2015). The determinants of cloud computing adoption in Saudi Arabia. *Computer Science & Information Technology*, 55-68.

Alharbi, S. T. (2012). Users' acceptance of cloud computing in Saudi Arabia: An extension of technology acceptance model. *International Journal of Cloud Applications and Computing (IJCAC), 2*(2), 1-11.

Alharbi, S. T. (2014). *Trust and acceptance of cloud computing: A revised UTAUT model.* Paper presented at the 2014 International Conference on Computational Science and Computational Intelligence (CSCI).

Alhujran, O. (2009). *Determinants of e-government services adoption in developing countries: A field survey and a case study.* School of Information Systems and Technology, Faculty of Informatics, University of Wollongong.

Aljenaa, E., Al-Anzi, F., & Alshayeji, M. (2011). Article No. 13. *Towards an efficient e-learning system based on cloud computing.* In the *Proceedings of the Second Kuwait Conference on e-Systems and e-Services.* (April 05-07, 2011). Kuwait City, Kuwait. Retrieved from the ACM (Association for Computing Machinery) Digital Library at http://dl.acm.org/citation.cfm?id=2107556.

Aljenaa, E., Al-Anzi, F., & Alshayeji, M. (2011). Towards an efficient e-learning system based on cloud computing. In the *Proceedings of the Second Kuwait Conference on e-Services and e-Systems.*

Alkhalout, G. (2016). *Forecast estimates Saudi Arabia's ICT spend to grow SAR 43.7 billon by 2020*. Retrieved from https://www.nexthink.com/saudi-arabia-cio-summit-2016/

Alkhater, N., Wills, G., & Walters, R. (2014). *Factors influencing an organisation's intention to adopt cloud computing in Saudi Arabia.* Paper presented at the Cloud Computing Technology and Science (CloudCom), 2014 IEEE 6th International Conference on Cloud Computing Technology and Science.

Al-Omar, A. M. (1998). *Job satisfaction among female and male academic department chairpersons in Saudi Arabian institutions of higher education*. Idaho: Dissertation Abstracts International, 4015A.

Alotaibi, M. B. (2014). Exploring users' attitudes and intentions toward the adoption of cloud computing in Saudi Arabia: An empirical investigation. *Journal of Computer Science, 10*(11), 2315-2329.

Alsanea, M. (2015). *Factors affecting the adoption of cloud computing in Saudi Arabia's government sector*. Doctoral thesis. Goldsmiths, University of London.

Alsharari, J. (2010). *The perceived training needs of female head teachers compared with the training needs of male head teachers in the government public schools in Saudi Arabia.* Doctoral dissertation. Retrieved from Durham E-theses Online, at http://etheses.dur.ac.uk/540.

Alshumaim, Y., & Alhassan, R. (2010). *Current availability and use of ICT among secondary EFL teachers in Saudi Arabia: Possibilities and reality.* Paper presented at the Global Learn Asia Pacific.

Alshuwaier, F., Alshwaier, A., & Areshey, A. (2012). *Applications of cloud computing in education.* Paper presented at the 8th International Conference on Computing and Networking Technology (ICCNT), 2012.

Alshwaier, A., Youssef, A., & Emam, A.(2012). A new trend for e-learning in KSA using educational clouds. *Advanced Computing, 3*(1), 81-97.

Al-Somali, S., & Baghabra, H. (2016). Investigating the determinants of IT professionals' intention to use cloud-based applications and solutions: An extension of the technology acceptance. *International Journal of Cloud Applications and Computing (IJCAC), 6*(3), 45-62.

Al-Sudairy, M. A., & Tang, N. (2000). Information technology in Saudi Arabia's supermarket chains. *International Journal of Retail & Distribution Management, 28*(8), 341-356.

Al-Sukkar, A. S. (2005). *The application of information systems in the Jordanian banking sector: a study of the acceptance of the internet.* University of Wollongong Thesis Collection, 419.

Altameem, T. A. (2007). *The critical factors of e-government adoption: An empirical study in the Saudi Arabia public sectors.* Brunel University.

Altshuler, A., & Zegans, M. (1990). Innovation and creativity: Comparisons between public management and private enterprise. *Cities, 7*(1), 16-24.

Al-Turki, S., & Tang, K. (1998). *Information technology environment in Saudi Arabia: A review of discussion papers in management and organisation studies.* University of Leicester, Leicester University Management Centre, UK.

Alzahrani, M., & Goodwin, R. D. (2012). Towards a UTAUT-based model for the study of e-government citizen acceptance in Saudi Arabia. *World Academy of Science, Engineering and Technology, (64)*, 8-14.

Al-Zarah, L. N. (2008). *An investigative study of the female initial teacher preparation programme in Saudi Arabia in an Islamic context: Perceptions of the key participants.* University of Durham, UK.

Alzharani, M. (2015). *An acceptance model for citizen adoption of web-based e-government services in developing countries: A field survey and a case study in Saudi Arabia.* Doctoral Thesis. Flinders University of South Australia, South Australia.

Al-Zoube, M., Abou El-Seoud, S., & Wyne, M. F. (2010). Cloud computing based e-learning system. *International Journal of Distance Education Technologies (IJDET), 8*(2), 58-71.

Amazon. (2011). *Summary of the Amazon EC2 and Amazon RDS service disruption in the US east region*. Retrieved 23 Feb. 2015, from https://aws.amazon.com/message/65648

Apache, U. (2011). Apache Software Foundation. Retrieved from http://java. apache. org.

Arbuckle, J. (2009). *Amos 18 user's guide. SPSS* Incorporated: Armonk, NY.

Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., & Stoica, I. (2010). A view of cloud computing. *Communications of the ACM, 53*(4), 50-58.

Babakus, E., & Mangold, W. G. (1992). Adapting the SERVQUAL scale to hospital services: An empirical investigation. *Health Services Research, 26*(6), 767.

Bagchi, K., Hart, P., & Peterson, M. F. (2004). National culture and information technology product adoption. *Journal of Global Information Technology Management, 7*(4), 29-46.

Baker, S. (2007). Google and the wisdom of clouds. *Business Week, Dec, 13.* Retrieved from www.businessweek.com/magaizne/content/07_52/ b4064048925836.htm.

Barney, J. B. (1986). Strategic factor markets: Expectations, luck, and business strategy. *Management Science, 32*(10), 1231-1241.

Baumgartner, H., & Homburg, C. (1996). Applications of structural equation modeling in marketing and consumer research: A review. *International Journal of Research in Marketing, 13*(2), 139-161.

Bellenger, D. N., Bernhardt, K. L., & Goldstucker, J. L. (2011). *Qualitative research in marketing*. Marketing Classics Press. Originally published 1976 by American Marketing Association.

Bernardi, L. (2011). A mixed-methods social networks study design for research on transnational families. *Journal of Marriage and Family, 73*(4), 788-803.

Bernius, S., & Krönung, J. (2012). *Fostering academic research by cloud computing-the users' perspective.* Paper presented at the European Conference on Information Systems (ECIS).

Bishop, M. (2003). What is computer security? *Security & Privacy, IEEE, 1*(1), 67-69.

Blaxter, L. (2010). *How to research*. 4th edition. McGraw-Hill Education: UK.

Bojanova, I., Zhang, J., & Voas, J. (2013). Cloud computing. *IT Professional, 15*(2), 12-14.

Bollen, K. A. (1989). *Structural equations with latent variables*. John Wiley & Sons.

Borgman, H. P., Bahli, B., Heier, H., & Schewski, F. (2013). Cloudrise: Exploring cloud computing adoption and governance with the TOE framework. In the *Proceedings of the 46th Hawaii International Conference on System Sciences* (HICSS 2013) (7-10 January 2013). Wailea, Hawaii, USA. (4425-4435). Institute of Electrical and Electronics Engineers (IEEE). Retrieved from the ACM (Association for Computing Machinery) Digital Library at http://dl.acm.org/citation.cfm?id=2471101&CFID=882367696&CFTOKEN=61176678.

Bose, R., & Luo, X. (2011). Integrative framework for assessing firms' potential to undertake green IT initiatives via virtualization–A theoretical perspective. *The Journal of Strategic Information Systems, 20*(1), 38-54.

Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and code development*. SAGE Publications, Inc.

Bradford, M., & Florin, J. (2003). Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems. *International Journal of Accounting Information Systems, 4*(3), 205-225.

Brian, O., Brunschwiler, T., Dill, H., Christ, H., Falsafi, B., Fischer, M., & Gutmann, R. (2013). *Cloud computing.* Swiss Academy of Engineering Sciences. Retrieved from www.satw.ch.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research.* 2nd ed. New York: Guilford Press.

Buller, A. (2016). *Saudi Arabia could warm to cloud computing, so long as regulation and connectivity keep pace.* Retrieved from http://www.computerweekly.com/

Burgess, J. (2015) *Is Saudi Arabia a developed country?* Quora. Retrieved from https://www.quora.com/Could-Saudi-Arabia-be-called-a-developed-country-Why-or-why-not.).

Business Monitor International. (2014). Catalogue of products & services. *Business Monitor International.* Retrieved from www.businessmonitor.com.

Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., & Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation Computer Systems, 25*(6), 599-616.

Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. 3rd edition, published 2016. Routledge.

Campbell, H. (2011). Religion and the internet in the Israeli Orthodox context. *Israel Affairs, 17*(3), 364-383.

Cappos, J., Beschastnikh, I., Krishnamurthy, A., & Anderson, T. (2009). Seattle: A platform for educational cloud computing. In the *Proceedings of the 40th ACM Technical Symposium on Computer Science Education, 04 March 2009, Chattanooga, USA*, 111-115.

Carlin, S., & Curran, K. (2013). Chapter 2: Cloud computing security. In *Pervasive and ubiquitous technology innovations for ambient intelligence environments*. IGI Global.

Carroll, M., Van Der Merwe, A., & Kotze, P. (2011). *Secure cloud computing: Benefits, risks and controls.* Paper presented at the 2011 Information Security South Africa (ISSA).

Cata, T. (2003). *Critical success factors for e-service: An exploratory study of web-based insurance business.* Doctoral dissertation. University of Nebraska, Lincoln.

CeArley, D., & Claunch, C. (2012). The top 10 strategic technology trends for 2013. *The Top 10*. Gartner, Inc.

Chanchary, F. H., & Islam, S. (2011). *E-government based on cloud computing with rational inference agent.* Paper presented at the 8th International Conference on High-capacity Optical Networks and Emerging Technologies (HONET), 2011.

Chang, B., Hai, P. H., Seo, D.-W., Lee, J.-H., & Yoon, S. H. (2013). *The determinant of adoption in cloud computing in Vietnam.* Paper presented at the International Conference on Computing, Management and Telecommunications (ComManTel), 2013.

Chang, L., Wang, P., & Wang, C. (2001). *Cross-cultural differences in international management using Kluckhohn-Strodtbeck framework*. *Journal of American Academy of Business, 2*, 20-27.

Chau, P. Y., & Tam, K. Y. (1997). Factors affecting the adoption of open systems: An exploratory study. *MIS Quarterly*, 1-24.

Chebrolu, S. B. (2010). *Assessing the relationships among cloud adoption, strategic alignment and information technology effectiveness.* ProQuest LLC.

Chen, W., Huang, L., & Lu, X. (2005). The B2B adoption in retail firms in China: An empirical study. Paper presented at the Services Systems and Services Management, 2005. In the *Proceedings of ICSSSM'05. 2005 International Conference on Services Systems and Services Management, 2005*, (2), 1502-1505.

Chieochan, O., Lindley, D., & Dunn, T. (2002). The adoption of information technology: A foundation of e-commerce development in Thai culture. In *E-commerce and cultural values*, 17-50.

Chin, W. W., & Newsted, P. R. (1999). Structural equation modeling analysis with small samples using partial least squares. Chapter 12 in: Statistical strategies for small sample research. SAGE Publication. *International Educational and Professional Publisher*. London New Delhi.

Cho, V. (2006). Factors in the adoption of third-party B2B portals in the textile industry. *The Journal of Computer Information Systems, 46*(3), 18.

Choudrie, J., Umeoji, E., & Forson, C. (2012). *Diffusion of e-government in Nigeria: A qualitative study of culture and gender*. UH Business School Working Papers, University of Hertfordshire, 33 .

Choudrie, J., Umeoji, E., & Forson, C. (2012). *Diffusion of e-government in Nigeria: A qualitative study of culture and gender*. UH Business School Working Papers. University of Hertfordshire, 33 .

Chow, R., Golle, P., Jakobsson, M., Shi, E., Staddon, J., Masuoka, R., & Molina, J. (2009). Controlling data in the cloud: Outsourcing computation without outsourcing control. In the *Proceedings of the 2009 ACM Workshop on Cloud Computing Security, Chicago, USA*, 85-89.

Chronicle of Higher Education (The). (2017). *Academic destinations_ Saudi Arabia*. Retrieved from http://www.chronicle.com/academicDestination/Saudi-Arabia/50/.

Churchill, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research, 16*(1), 64-73.

Communications and Information Technology Commission (CITC). (2015). *ICT Report: ICT Investments in the Kingdom of Saudi Arabia* (pp. 31). Retrieved from http://www.citc.gov.sa/en/reportsandstudies/Reports/Documents/ICTInvestments_EN.pdf.

Communications and Information Technology Commission (CITC). (2016). *Saudi Arabia's telecom regulator proposes regulating cloud computing*. Retrieved from http://www.citc.gov.sa/en/mediacenter/pressreleases/Pages/20160724001.aspx.

Cook, R. D., & Weisberg, S. (1982). *Residuals and influence in regression.* New York: Chapman and Hall. Retrieved from the University of Minnesota Digital Conservancy, http://hdl.handle.net/11299/37076.

Cooper, D. R., Schindler, P. S., & Sun, J. (2006). *Business research methods* 9. McGraw-Hill: New York.

Council, U. S.-S. A. B. (2015). Saudi Arabia's 2015 budget maintains strong spending, diversification initiatives.

Crabtree, B. F., & Miller, W. L. (1999). *Doing qualitative research*: Sage Publications.

Creeger, M. (2009). Cloud computing: An overview. *ACM Queue, 7*(5), 2.

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research*. Sage Publications, Inc.

Cruz, D. (2007). Application of data screening procedures in stress research. *The New School Psychology Bulletin, 5*(2), 41-45.

Dadzie, K. Q., Lee, E., & Dadzie, E. W. (2000). Assessing logistics technology adoption time with event history analysis. *The International Journal of Logistics Management, 11*(1), 47-60.

Damanpour, F., & Schneider, M. (2006). Phases of the adoption of innovation in organizations: Effects of environment, organization and top Managers 1. *British Journal of Management, 17*(3), 215-236.

Darmawan, I. G. N. (2001). Adoption and implementation of information technology in Bali's local government: A comparison between single level path analyses using *PLSPATH* 3.01 and *AMOS* 4 and multilevel path analyses using *MPLUS* 2.01. *International Education Journal, 2*(4), 100-125.

Dasgupta, S., Agarwal, D., Ioannidis, A., & Gopalakrishnan, S. (1999). Determinants of information technology adoption: An extension of existing models to firms in a developing country. *Journal of Global Information Management (JGIM), 7*(3), 30-40.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319-340.

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies, 38*(3), 475-487.

Davison, R., & Martinsons, M. (2003). Guest editorial cultural issues and IT management: Past and present. *Engineering Management, IEEE Transactions on, 50*(1), 3-7.

Denzin, N. K. (1978). *Sociological methods: A sourcebook*: McGraw-Hill Companies.

Dickinson, E. (2015). Dell to partner up with Middle East firms to build cloud services. *Gulf Business.* Retrieved from http://gulfbusiness.com/dell-to-partner-up-with-middle-east-firms-to-build-cloud-services/

Dillon, T., Wu, C., & Chang, E. (2010). *Cloud computing: Issues and challenges.* Paper presented at the 24th IEEE International Conference on Advanced Information Networking and Applications (AINA), 2010.

Doelitzscher, F., Sulistio, A., Reich, C., Kuijs, H., & Wolf, D. (2011). Private cloud for collaboration and e-learning services: From IaaS to SaaS. *Computing, 91*(1), 23-42.

Dong, L., Neufeld, D., & Higgins, C. (2009). Top management support of enterprise systems implementations. *Journal of Information Technology*, *24*(1), 55-80.

Dong, Zheng, Q., Yang, J., Li, H., & Qiao, M. (2009). An e-learning ecosystem based on cloud computing infrastructure. In the *Proceedings of the Ninth IEEE International Conference on Advanced Learning Technologies, 2009.*

Duan, S. X. (2012). *An integrated solution to the adoption of electronic market in Australian small and medium sized enterprises.* RMIT University. Melbourne, Australia.

Dwivedi, Y. K., Papazafeiropoulo, A., Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs' adoption of enterprise systems. *Journal of Enterprise Information Management*, *22*(1/2), 10-24.

Edberg, D., Grupe, F. H., & Kuechler, W. (2001). Practical issues in global IT management. *Information Systems Management, 18*(1), 34-46.

Mundial, B. (2000). *Higher education in developing countries: Peril and promise*. World Bank, Washington, D, C.

El-Sofany, H. F., Al-Otaibi, K. F., & Alsanea, M. S. (2012). Data exchange model of patient records in the Kingdom of Saudi Arabia using cloud computing. *International Journal of Innovation, Management and Technology, 3*(5), 580.

Eman, A.-T., & Mohammad, H. (2014). The impact of cloud computing on Saudi organizations: The case of a telecom company. *International Journal of Computing Academic Research*, *3*(I), 126-130

Erumban, A. A., & De Jong, S. B. (2006). Cross-country differences in ICT adoption: A consequence of culture? *Journal of World Business, 41*(4), 302-314.

Espadanal, M., & Oliveira, T. (2012). Cloud computing adoption by firms. In the *Proceedings of the Mediterranean Conference on Information Systems, MCIS.*

Evers, V., & Day, D. (1997). *The role of culture in interface acceptance.* Paper presented at the Human-Computer Interaction INTERACT'97.

Fichman, R. G. (1992). *Information technology diffusion: A review of empirical research.* Paper presented at the ICIS.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research.* Addison-Wesley: MA.

Fleming, S. T. (2003). The leapfrog effect: Information needs for developing nations. *Managing Globally with Information Technology*, 127-139.

Fox, A., Griffith, R., Joseph, A., Katz, R., Konwinski, A., Lee, G., & Stoica, I. (2009). *Above the clouds: A Berkeley view of cloud computing.* Dept. Electrical Eng. and Comput. Sciences, University of California, Berkeley, Rep. UCB/EECS, 28, 13.

Fox-Wasylyshyn, S. M., & El-Masri, M. M. (2005). Handling missing data in self-report measures. *Research in Nursing & Health, 28*(6), 488-495.

Furht, B., Escalante, A. (2010). *Handbook of cloud computing*. Springer Science US, eBook.

Gangwar, H., Date, H., & Ramaswamy, R. (2015). Understanding determinants of cloud computing adoption using an integrated TAM-TOE model. *Journal of Enterprise Information Management, 28*(1), 107-130.

Gefen, D., Straub, D., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. *Communications of the Association for Information Systems, 4*(1), 7.

Geissler, M. (2006). *Aligning technology with culture: Connecting information and communication technology adoption to cultural dimensions*. ProQuest.

George, D., & Mallery, M. (2003). *Using SPSS for Windows step by step: A simple guide and reference.* Allyn & Bacon: Boston, MA.

Ghafour. (2009). Saudi education 'passing through a historic phase'. *Arab News.*

Ghauri, P. N., & Gronhaug, K. (2005). *Research methods in business studies: A practical guide*: Pearson Education.

Ghobakhloo, M., Arias-Aranda, D., & Benitez-Amado, J. (2011). Adoption of e-commerce applications in SMEs. *Industrial Management & Data Systems, 111*(8), 1238-1269.

Gloor, P. (2012). *Making the e-business transformation.* Springer Science & Business Media.

Google for Education. *G suit*. Retrieved Feb, 2017, from https://gsuite.google.com/

Grandon, E. E., & Pearson, J. M. (2004). Electronic commerce adoption: An empirical study of small and medium US businesses. *Information & Management, 42*(1), 197-216.

Gray, T. (2010). A tale of two clouds. *EDUCAUSE Quarterly, 33*(2), n2.

Grazzi, M., & Vergara, S. (2012). ICT in developing countries: Are language barriers relevant? Evidence from Paraguay. *Information Economics and Policy, 24*(2), 161-171.

Greengard, S. (2010). Cloud computing and developing nations. *Communications of the ACM, 53*(5), 18-20.

Greenhalgh, T., Glenn, R., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. *Milbank Quarterly, 82*(4), 581-629.

Gudykunst, W. B., & Mody, B. (2002). *Handbook of international and intercultural communication*. SAGE.

Hackney, R., Xu, H., & Ranchhod, A. (2006). Evaluating web services: Towards a framework for emergent contexts. *European Journal of Operational Research, 173*(3), 1161-1174.

Hailu, A. (2012). *Factors influencing cloud-computing technology adoption in developing countries.* Capella University, USA.

Hair, J., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Pearson.

Hall, E. T. (1973). *The silent language*: Anchor.

Hamad, H. (2014). *Antecedents of business-to-business e-commerce adoption and its effect on competitive advantage in manufacturing small and medium-sized enterprises: A comparative study of United States of America and Egypt.* Plymouth University, England.

Hamad, H. (2014). *Antecedents of business-to-business e-commerce adoption and its effect on competitive advantage in manufacturing small and medium-sized enterprises: A comparative study of United States of America and Egypt.* Plymouth University.

Hamod, D. (2009). Saudi Arabia's King Abdullah inaugurates 21st century research university. *US-Arab Tradeline, XVII*.

Han, Y. (2013). On the clouds: A new way of computing. *Information Technology and Libraries, 29*(2), 87-92.

Hasan, H., & Ditsa, G. (1999). The impact of culture on the adoption of IT: An interpretive study. *Journal of Global Information Management (JGIM), 7*(1), 5-15.

Hassan, H., Tretiakov, A., & Whiddett, D. (2010). *Extent of adoption as opposed to adoption: Case of e-procurement*. ACIS 2010 Proceedings. 12. http://aisel.aisnet.org/acis2010/12

Henderson, D., Sheetz, S. D., & Trinkle, B. S. (2012). The determinants of inter-organizational and internal in-house adoption of XBRL: A structural equation model. *International Journal of Accounting Information Systems, 13*(2), 109-140.

Henry, G. T. (1990). *Practical sampling,* (21). SAGE.

Hermeking, M. (2005). Culture and internet consumption: Contributions from cross-cultural marketing and advertising research. *Journal of Computer-Mediated Communication, 11*(1), 192-216.

Hill, C. E., Loch, K. D., Straub, D. W., & El-Sheshai, K. (1998). A qualitative assessment of Arab culture and information technology transfer. *Journal of Global Information Management,* (6), 29-38.

Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations*. SAGE.

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online Readings in Psychology and Culture, 2*(1), 8.

Hofstede, G. H., & Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations.* Sage.

Hofstede, G., & Bond, M. H. (1988). The Confucius connection: From cultural roots to economic growth. *Organizational Dynamics, 16*(4), 5-21.

Hofstede, G., Hofstede, G. J., & Minkov, M. (1991). *Cultures and organizations: Software of the mind.* McGraw-Hill. Retrieved from https://doi.org/10.1016/0147-1767(92)90033-Q.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and organizations: Software of the mind: Intercultural cooperation and its importance for survival*. McGraw-Hill Education: USA.

Hong, W., & Zhu, K. (2006). Migrating to internet-based e-commerce: Factors affecting e-commerce adoption and migration at the firm level. *Information & Management, 43*(2), 204-221.

Hox, J. (2010). *Multilevel analysis: Techniques and applications*. Routledge.

Hunt, S. D., Sparkman Jr, R. D., & Wilcox, J. B. (1982). The pretest in survey research: Issues and preliminary findings. *Journal of Marketing Research*, 269-273.

Hwa Chung, S., & Snyder, C. A. (2000). ERP adoption: A technological evolution approach. *International Journal of Agile Management Systems, 2*(1), 24-32.

Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Quarterly*, 465-485.

IBM. IBM Cloud Academy. Retrieved Feb 22, 2015 from http://www.ibm.com/solutions/education/cloudacademy/us/en/cloudacademy_3.html

Ibrahim, M. S., Salleh, N., & Misra, S. (2015). *Empirical studies of cloud computing in education: A systematic literature review.* Paper presented at the International Conference on Computational Science and Its Applications (ICCSA) 2015, 725-737.

IDC. (2014). Saudi Arabia cloud, hosted, managed, and outsourced services market 2012 analysis and 2013–2017 forecast. *PR Newswire* (Jun 30, 2014).

Ifinedo, P. (2011). Internet/e-business technologies acceptance in Canada's SMEs: An exploratory investigation. *Internet Research, 21*(3), 255-281.

Ihlsoon, C., & YoungGul, K. (2002). Critical factors for assimilation of object-oriented programming languages. *Journal of Management Information Systems, 18*(3), 125-156.

InformationAge. (2011). *Universities to share £12m cloud services in England*. Retrieved 15 Dec, 2014. Retrieved from http://www.information-age.com/channels/itservices/news/1599748/universities-to-share-125m-cloud-services.thtml.

International Business Machines Corporation (IBM). *IBM Cloud Academy*. Retrieved Feb 22, 2015, from http://www.ibm.com/solutions/education/cloudacademy/us/en/cloudacademy_3.html.

International Data Corporation (IDC). (2014). Saudi Arabia cloud, hosted, managed, and outsourced services market 2012 analysis and 2013–2017 forecast. *PR Newswire* (Jun 30, 2014).

International Trade Administration (ITA). (2016). *2016 Top markets report: Cloud computing*. US Department of Commerce, International Trade Administration, Industry & Analysis (I&A).

Ives, B., & Jarvenpaa, S. L. (1991). Applications of global information technology: Key issues for management. *MIS Quarterly*, 33-49.

Jamjoom, F. B., & Kelly, P. (2013). Higher education for women in the Kingdom of Saudi Arabia *Higher Education in Saudi Arabia*. Springer, 117-125.

Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of Management Information Systems,* 29-64.

Jelonek, D., & Wysłocka, E. (2014). Barriers to the development of cloud computing adoption and usage in SMEs in Poland. *Advances in Information Science and Applications*, (1), 128-133.

Jeon, B. N., Han, K. S., & Lee, M. J. (2006). Determining factors for the adoption of e-business: The case of SMEs in Korea. *Applied Economics, 38*(16), 1905-1916.

Jia, J. (2009). *Electronic commerce and internationalisation in New Zealand SMEs.* Auckland University of Technology.

Jick, T. D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly, 24*(4), 602-611.

Johns, S. K., Smith, M., & Norman, C. S. (2002). *How culture affects the use of information technology*. Paper presented at the Accounting Forum, *(27)*1, 84-109. Retrieved from SSRN: https://ssrn.com/abstract=376504.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14-26.

Joo, Y.-B., & Kim, Y.-G. (2004). Determinants of corporate adoption of e-marketplace: An innovation theory perspective. *Journal of Purchasing and Supply Management, 10*(2), 89-101.

Kalliny, M., & Hausman, A. (2007). The impact of cultural and religious values on consumer's adoption of innovation. *Academy of Marketing Studies Journal, 11*(1), 125.

Kamien, M. I., & Schwartz, N. L. (1982). *Market structure and innovation*. Cambridge University Press.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly,* 183-213.

Kaufman, L. M. (2009). Data security in the world of cloud computing. *Security & Privacy, IEEE, 7*(4), 61-64.

Kaur, R. S., Sawtantar. (2015). Exploring the benefits of cloud computing paradigm in education sector. *International Journal of Computer Applications, 115*(7), 1-3.

Kendall, J. D., Tung, L. L., Chua, K. H., Ng, C. H. D., & Tan, S. M. (2001). Receptivity of Singapore's SMEs to electronic commerce adoption. *The Journal of Strategic Information Systems, 10*(3), 223-242.

Khalil, I., Khreishah, A., & Azeem, M. (2014). Cloud computing security: A survey. *Directory of Open Access Journals*, *3*(1), 1-35.

King, N., & Horrocks, C. (2010). *Interviews in qualitative research*: Sage.

Kinnear, T. C., Taylor, J. R., Johnson, L., & Armstrong, R. (1993). *Australian marketing research.* Roseville: McGraw-Hill.

Kline, B. (2005). *Principles and practice of structural equation modeling*. New York: Guilford Press.

Klug, W. E. (2014). *The determinants of cloud computing adoption by colleges and universities*. ProQuest Dissertations & Theses, Publication no. 3617041. Northcentral University, USA. Retrieved from http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:pqdiss&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&rft_dat=xri:pqdiss:3617041

Koufteros, X. A. (1999). Testing a model of pull production: A paradigm for manufacturing research using structural equation modeling. *Journal of Operations Management, 17*(4), 467-488.

Kovačić, Z. J. (2005). The impact of national culture on worldwide e-government readiness. *Informing Science Journal,* (8), 143-158.

Kshetri, N. (2010). Cloud computing in developing economies. *IEEE Computer, 43*(10), 47-55.

Kuan, K. K., & Chau, P. Y. (2001). A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework. *Information & Management, 38*(8), 507-521.

Kutbi, A. I. (2015). *How undergraduate female students in the Kingdom of Saudi Arabia perceive social media as a learning tool: An exploratory study*. Electronic Theses and Dissertations. Paper 5290. University of Windsor

Kwon, T. H., & Zmud, R. W. (1987). *Unifying the fragmented models of information systems implementation.* Paper presented at the Critical Issues in Information Systems Research. 227-251.

Laisheng, X., & Zhengxia, W. (2011). *Cloud computing: A new business paradigm for e-learning.* Paper presented at the Third International Conference on Measuring Technology and Mechatronics Automation (ICMTMA), 2011.

Lakshminarayanan, R., Kumar, B., & Raju, M. (2013). *Cloud computing benefits for educational institutions*. Second International Conference of the Omani Society for Educational Technology.

Laverty, A. (2011). *The cloud and Africa–Indicators for growth of cloud computing. The African File on WordPress.com*. Retrieved from http://theafricanfile.com/ict/the-cloud-and-africa-indicators-for-growth-of-cloud-computing/

Law, M. (2011). *Cloud computing basics*. Hillcrest Media Group, Inc. Minneapolis.

Lazarus, W., & Mora, F. (2000). Online content for low-income and underserved Americans: The digital divide's new frontier: A strategic audit of activities and opportunities. A Publication of the Children's Partnership.

Leavitt, N. (2009). Is cloud computing really ready for prime time? *Computer* (1), 15-20.

Lee, M. K., & Cheung, C. M. (2004). Internet retailing adoption by small-to-medium sized enterprises (SMEs): A multiple-case study. *Information Systems Frontiers, 6*(4), 385-397.

Lee, O.-K. D., Wang, M. W., Lim, K. H., & Peng, Z. J. (2009). Knowledge management systems diffusion in Chinese enterprises: A multistage approach using the technology-organization-environment framework. *Journal of Global Information Management, 17*(1), 70.

Leidner, D. E., & Kayworth, T. (2006). Review: A review of culture in information systems research: toward a theory of information technology culture conflict. *MIS Quarterly, 30*(2), 357-399.

Li, P., & Toderick, L. W. (2010). Cloud in cloud: Approaches and implementations. In the *Proceedings of the 2010 ACM Conference on Information Technology Education*. ACM: New York, 105-110.

Liao, C.-H., & Tseng, P.-S. (2010). Influential factors of Voip adoption of top 500 export-import enterprises in Taiwan. *Contemporary Management Research, 6*(1).

Lin, A., & Chen, N.-C. (2012). Cloud computing as an innovation: Perception, attitude, and adoption. *International Journal of Information Management, 32*(6), 533-540.

Linthicum, D. S. (2009). *Cloud computing and SOA convergence in your enterprise: A step-by-step guide*. Pearson Education, Boston, USA.

Lippert, S. K., & Govindarajulu, C. (2006). Technological, organizational, and environmental antecedents to web services adoption. *Communications of the IIMA, 6*(1), 14.

Lohr, S. (2007). Google and IBM join in 'cloud computing' research. *New York Times, 8*.

Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data Systems, 111*(7), 1006-1023.

Lubbe, S. (2003). The development of a case study methodology in the information technology (IT) field: A step by step approach. *Ubiquity, 4*(2).

Lumsden, J., & Anabel, G. (2013). *Understanding the determinants of cloud computing adoption within the UK.* Paper presented at the European, Mediterranean & Middle Eastern Conference on Information Systems, Windsor, United Kingdom.

MacDaniel, C., & Gates, R. (1991). *Contemporary marketing research*. St. Paul: West Publishing Company.

Mahmood, Z. (2011). *Cloud computing: Characteristics and deployment approaches.* Paper presented at the IEEE 11th International Conference on Computer and Information Technology (CIT), 2011.

Maitland, C. F., & Bauer, J. M. (2001). National level culture and global diffusion: The case of the Internet. In *Culture, technology, communication: Towards an intercultural global village*, 87-128.

Marston, S., Li, Z., Bandyopadhyay, S., Zhang, J., & Ghalsasi, A. (2011). Cloud computing—The business perspective. *Decision Support Systems, 51*(1), 176-189.

McCoy, S., Galletta, D. F., & King, W. R. (2007). Applying TAM across cultures: The need for caution. *European Journal of Information Systems, 16*(1), 81-90.

MCIT, M. o. C. a. I. T. (2016). ICT Development Stages. 2016

Mehrtens, J., Cragg, P. B., & Mills, A. M. (2001). A model of Internet adoption by SMEs. *Information & Management, 39*(3), 165-176.

Mell, P., & Grance, T. (2011). *The NIST definition of cloud computing, 15*. Gaithersburg: National Institute of Standards and Technology.

Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Review: Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly, 28*(2), 283-322.

Mengash, S. A. (2001). *An exploration of the consequences of two alternatives on women's needs for higher education in Saudi Arabia: A women's independent university and a women's open university*. University of Wisconsin, Madison.

Mezghani, K., & Ayadi, F. (2016). Factors explaining IS managers attitudes toward cloud computing adoption. *International Journal of Technology and Human Interaction (IJTHI), 12*(1), 1-20.

Microsoft. (2015). *Office in Education*. Retrieved from: http://products.office.com/en-us/student/office-in-education.

Microsoft. (2015). *State University of New York moves to Microsoft's cloud.* Retrieved 28 Feb, 2015, from http://www.microsoft.com/enus/news/press/2010/dec10/12-21sunypr.aspx.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis.* Thousand Oaks, CA.: SAGE.

Miller, M. (2009). *Cloud computing: Web- based applications that change the way you work and collaborate online*. USA: Que.

Miller, M. (2009). *Cloud computing: Web- based applications that change the way you work and collaborate online*. USA: Que.

Ministry of Communications and Information Technology (MCIT) (2016). ICT development stages. MCIT website. Retrieved from www.mcit.gov.sa.

Ministry of Higher Education (MOHE). (2010, last modified 4 Aug 2010). *Saudi Arabia – Kingdom of Humanity*. Retrieved 5 Feb, 2013, from http://www.mohe.gov.sa.

Ministry of Higher Education (MOHE). (2016). *About the Kingdom*. Retrieved from https://www.mohe.gov.sa/en/studyinside/aboutKSA/Pages/default.aspx.

Ministry of Higher Education in Saudi Arabia. (2013). *The current situation of higher education in Saudi Arabia.*

Muinde, F. N. (2009). *Investigation of factors affecting the adoption of information and communication technologies for communication of research output in research institutions in Kenya.* Doctoral thesis, Victoria university of Willington, New Zealand. URI: http://hdl.handle.net/10063/1417

Muthén, B., Kaplan, D., & Hollis, M. (1987). On structural equation modeling with data that are not missing completely at random. *Psychometrika, 52*(3), 431-462.

Neuman, W. L., & Neuman, W. L. (2006). *Social research methods: Qualitative and quantitative approaches.* (6th edition). Pearson.

Nkhoma, M., Dang, D., & De Souza-Daw, A. (2013). Contributing factors of cloud computing adoption: A technology-organisation-environment framework approach. In the *Proceedings of the European Conference on Information Management & Evaluation*.

Nui Polatoglu, V., & Ekin, S. (2001). An empirical investigation of the Turkish consumers' acceptance of Internet banking services. *International Journal of Bank Marketing, 19*(4), 156-165.

Oates, B. J. (2005). *Researching information systems and computing.* Sage.

OECD. (2003). The e-government imperative: Main findings. *OECD Observer*.

Ogigău-Neamţiu, F. (2012). Cloud computing security issues. *Journal of Defense Resources Management*, (02).

Ograph, B., & Morgens, R. (2008). Cloud computing. *Communications of the ACM, 51*(7).

Ojo, A., Janowski, T., Estevez, E., & Khan, I. K. (2007). *Human capacity development for e-government.* UN University International Institute for Software Technology, Macau, UNU-IIST Report (362).

Oliveira, T., & Martins, M. F. (2010). Understanding e-business adoption across industries in European countries. *Industrial Management & Data Systems, 110*(9), 1337-1354.

Oliveira, T., & Martins, M. F. (2011). Literature review of information technology adoption models at firm level. *The Electronic Journal Information Systems Evaluation, 14*(1), 110-121.

Oliveira, T., Thomas, M., & Espadanal, M. (2014). Assessing the determinants of cloud computing adoption: An analysis of the manufacturing and services sectors. *Information & Management, 51*(5), 497-510.

Organisation for Economic Co-operation and Development (OECD) (2003). The e-government imperative: Main findings. *OECD Observer*.

Oxley, J. E., & Yeung, B. (2001). E-commerce readiness: institutional environment and international competitiveness. *Journal of International Business Studies*, 705-723.

Pallant, J. (2007). *SPSS survival manual: A step by step guide to data analysis using SPSS for Windows (Version 15)*. Allen & Unwin: Crows Nest, NSW.

Pan, M., & Jang, W. (2008). Determinants of the adoption of enterprise resource planning within the technology-organization-environment framework: Taiwan's communications. *Journal of Computer Information Systems, 48*(3), 94.

Pardeshi, V. H. (2014). Cloud computing for higher education institutes: architecture, strategy and recommendations for effective adaptation. *Procedia Economics and Finance*, *11*, 589-599.

Patton, M. Q. (1990). *Qualitative evaluation and research methods*. SAGE Publications, Inc.

Perry, J. T., & Schneider, G. P. (2000). *New perspectives on e-commerce: Introductory course*. Technology Ptr.

Phillips, E., & Pugh, D. (2010). *How to get a PhD: A handbook for students and their supervisors*. McGraw-Hill Education (UK).

Pinsonneault, A., & Kraemer, K. L. (1993). Survey research methodology in management information systems: An assessment. *Journal of Management Information Systems*, 75-105.

Pocatilu, P., Alecu, F., & Vetrici, M. (2009). Using cloud computing for E-learning systems. In the *Proceedings of the 8th WSEAS international conference on data networks, communications, computers, Baltimore, MD, USA*, 54-59.

Powelson, S. E. (2011). *An examination of small businesses' propensity to adopt cloud-computing innovation.* PhD thesis, Walden University. Minnesota, USA. Retrieved from http://scholarworks.waldenu.edu/dissertations

Premkumar, G. (2003). A meta-analysis of research on information technology implementation in small business. *Journal of Organizational Computing and Electronic Commerce*, *13*(2), 91-121.

Premkumar, G., & Ramamurthy, K. (1995). The role of interorganizational and organizational factors on the decision mode for adoption of interorganizational systems*. *Decision Sciences*, *26*(3), 303-336.

Premkumar, G., & Roberts, M. (1999). Adoption of new information technologies in rural small businesses. *Omega*, *27*(4), 467-484.

Princess Nourah Bint Abdulrahman University (PNU). (2015). Introduction to the University. Retrieved 6-6, 2015, from http://www.pnu.edu.sa/en/University/

Princess Nourah Bint Abdulrahman University (PNU). (2016). Smart suitcase. Retrieved 8-12, 2016, from http://www.pnu.edu.sa/en/departments/itc/sc/Pages/index.html.

Princess Nourah Bint Abdulrahman University (PNU). (2016). Vision, mission and objectives. Retrieved 2016. Retrieved from http://www.pnu.edu.sa/en/University/Pages/Mission.aspx.

Pugesek, B. H., Tomer, A., & Von Eye, A. (2003). *Structural equation modeling: Applications in ecological and evolutionary biology*: Cambridge University Press.

Ramgovind, S., Eloff, M. M., & Smith, E. (2010). *The management of security in cloud computing.* Paper presented at the Information Security for South Africa (ISSA), 2010.

Rampersad, G. (2008). *Management of innovation networks in technology transfer*. The University of Adelaide.

Ranganathan, C., & Balaji, S. (2007). Critical capabilities for offshore outsourcing of information systems. *MIS Quarterly Executive*, *6*(3), 147-164. http://www.infoworld.com/article/3041078/security/the-dirty-dozen-12-cloud-security-threats.html.

Rashid, F. (2016). The dirty dozen: 12 cloud security threats. *InforWorld*.

Regalado, A. (2011). Who coined 'cloud computing'? *Technology Review, 31*. Retrieved from https://www.technologyreview.com/s/425970/who-coined-cloud-computing/

Rena, R. (2010). Emerging trends of higher education in developing countries. *Analele Stiintifice ale Universitatii" Alexandru Ioan Cuza" din Iasi-Stiinte Economice, 2010*, 301-316.

University Of Dammam (2015). *Strategic planning resources.* Retrieved 2016 from: http://www.uod.edu.sa/en/about-us/strategic-planning-resources

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

Rogers Everett, M. (1995). *Diffusion of innovations.* The Free Press, New York.

Roseman, I. J., Dhawan, N., Rettek, S. I., Naidu, R., & Thapa, K. (1995). Cultural differences and cross-cultural similarities in appraisals and emotional responses. *Journal of Cross-Cultural Psychology, 26*(1), 23-48.

Rosli, K., Yeow, P. H., & Siew, E.-G. (2012). Factors influencing audit technology acceptance by audit firms: A new I-TOE adoption framework. *Journal of Accounting and Auditing: Research & Practice, 2012*, 1-11.

Rosli, K., Yeow, P. H., & Siew, E.-G. (2012). Factors influencing audit technology acceptance by audit firms: A new I-TOE adoption framework. *Journal of Accounting and Auditing: Research & Practice, 2012*, 1-11.

Ross, V. W. (2010). *Factors influencing the adoption of cloud computing by decision making managers.* Capella University. Minneapolis, Minnesota.

Rossi, B. (2011). *Universities to share £12.m cloud services in England*. Retrieved 15 Dec, 2014, from http://www.information-age.com/channels/itservices/news/1599748/universities-to-share-125m-cloud-services.thtml.

Sabherwal, R., Jeyaraj, A., & Chowa, C. (2006). Information system success: Individual and organizational determinants. *Management Science, 52*(12), 1849-1864.

Sachdev, S. B., & Verma, H. V. (2004). Relative importance of service quality dimensions: A multisectoral study. *Journal of Services Research, 4*(1), 93.

Salam, A. (2012). Traditional Networks vs The Cloud. Salam, A. (2012). Traditional Networks vs The Cloud. [online] cloudtweaks.com. Retrieved 2017 from https://cloudtweaks.com/2012/07/traditional-networks-vs-the-cloud/

Sanaktekin, O. H., Aslanbay, Y., & Gorgulu, V. (2013). The effects of religiosity on internet consumption: A study on a Muslim country. *Information Communication & Society, 16*(10), 1553-1573.

Sapsford, R., & Jupp, V. (2006). *Data collection and analysis*. Sage.

Sarin, S., Sego, T., & Chanvarasuth, N. (2003). Strategic use of bundling for reducing consumers' perceived risk associated with the purchase of new high-tech products. *Journal of Marketing Theory and Practice*, 71-83.

Saunders, M., Lewis, P., & Thornhill A.(2009). *Research methods for business students*. Prentice Hall: England.

Schneiderman, R. (2011). For cloud computing, the sky is the limit [Special Reports]. *Signal Processing Magazine, IEEE, 28*(1), 15-144.

Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modelling* (2nd ed.). Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

Scupola, A. (2003). The adoption of Internet commerce by SMEs in the south of Italy: An environmental, technological and organizational perspective. *Journal of Global Information Technology Management, 6*(1), 52-71.

Scupola, A. (2003). The adoption of Internet commerce by SMEs in the south of Italy: An environmental, technological and organizational perspective. *Journal of Global Information Technology Management, 6*(1), 52-71.

Sekaran, U. (2006). *Research methods for business: A skill building approach*. John Wiley & Sons.

Selznick, P. (1948). Foundations of the theory of organization. *American Sociological Review*, 25-35.

Seng, W. M., Jackson, S., & Philip, G. (2010). Cultural issues in developing e-government in Malaysia. *Behaviour & Information Technology, 29*(4), 423-432.

SEU. (2012). Definition of the university and its foundation. *Saudi Electronic University*. Retrieved 8 Feb, 2013, from http://seu.edu.sa.

Shapiro, R., & Rohde, G. (2000). Falling through the net: Toward digital inclusion: A report on Americans' access to technology tools. *Washington, DC: US Department of Commerce*.

Sharif, M. H. M., Davidson, R., & Troshani, I. (2013). Exploring social media adoption in Australian local government organizations. In the *Proceeding os the International Conference on Information Resources Management (Conf-IRM) 2013.*

Sheard, R. (2010). Innovating in the cloud: Exploring cloud computing to solve IT challenges. *EDUCAUSE Quarterly, 33*(2).

Shetty, A. (2015). *Saudi ICT Spending*. IDC Research, Inc. Retrieved from: https://www.idc.com/getdoc.jsp?containerId=prCEMA40822415

Shore, B. (2001). Information sharing in global supply chain systems. *Journal of Global Information Technology Management, 4*(3), 27-50.

Shore, B., & Venkatachalam, A. (1996). Role of national culture in the transfer of information technology. *The Journal of Strategic Information Systems, 5*(1), 19-35.

Sieber, S. D. (1973). The integration of fieldwork and survey methods. *American Journal of Sociology*, 1335-1359.

Sila, I. (2013). Factors affecting the adoption of B2B e-commerce technologies. *Electronic Commerce Research, 13*(2), 199-236.

Sin Tan, K., Choy Chong, S., Lin, B., & Cyril Eze, U. (2009). Internet-based ICT adoption: Evidence from Malaysian SMEs. *Industrial Management & Data Systems, 109*(2), 224-244.

Slowikowski, S., & Jarratt, D. G. (1997). The impact of culture on the adoption of high technology products. *Marketing Intelligence & Planning, 15*(2), 97-105.

Spector, P. E. (1992). *Summated rating scale construction: An introduction.* Vol. 82 of the Quantitative Applications in the Social Sciences Series. SAGE Publications.

Srivastava, S. C., & Teo, T. S. (2010). E-government, e-business, and national economic performance. *Communications of the Association for Information Systems, 26*(1), 14.

Central Department of Statistics and Information in Saudi Arabia (CDSI). (2015). Statistical sector. Retrieved from www.cdsi.gov.sa.

Steenkamp, J.-B. E., & Baumgartner, H. (2000). On the use of structural equation models for marketing modeling. *International Journal of Research in Marketing, 17*(2), 195-202.

Straub, D. (1994). The effect of culture on IT diffusion: E-mail and fax in Japan and the US. *Information Systems Research, 5*(1), 23-47.

Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *The Communications of the Association for Information Systems, 13*(1), 63.

Straub, D., Keil, M., & Brenner, W. (1997). Testing the technology acceptance model across cultures: A three country study. *Information & Management, 33*(1), 1-11.

Straub, D., Loch, K., & Hill, C. (2003). Transfer of information technology to the Arab world: A test of cultural influence modeling. *Advanced Topics in Global Information Management,* (2), 141-172.

Strickland, J. (Producer). (2008, April 8). *How cloud computing works*. Retrieved from from http://computer.howstuffworks.com.

Sultan, N. (2010). Cloud computing for education: A new dawn? *International Journal of Information Management, 2*(30), 109-116.

Suraya, R. M. Y. (2003). *Internet diffusion and e-business opportunities amongst Malaysian travel agencies.* Paper presented at the CITA.

Susanto, T. D., & Goodwin, R. (2010). Factors influencing citizen adoption of SMS-based e-government services. *Electronic Journal of E-government, 8*(1), 55-71.

Symonds, M. (2012). Cloud ERP meets manufacturing. *Quality, 51*(4), 40.

Tabachnick, B., & Fidell, L. (2001). *Using multivariate statistics*. Allyn and Bacon: Boston Massachusetts.

Talalay, M., & Farrands, C. (1997). *Technology, culture, and competitiveness: Change and the world political economy,* (1). Psychology Press.

Tanasyuk, P., & Avgerou, C. (2009). *ICT and religious tradition: The case of Mount Athos*. Paper presented at the IFIP WG9.4 Conference, Dubai, UAE. http://eprints.lse.ac.uk/35560/

Tashkandi, A., & Al-Jabri, I. (2015). Cloud computing adoption by higher education institutions in Saudi Arabia: Analysis based on TOE. In the *Proceedings of the International Conference on Cloud Computing* (ICCC), 2015.

Task Force on Higher Education and Society. (2000). *Higher education in developing countries: Peril and promise*. Washington DC: World Bank. Retrieved from http://documents.worldbank.org/curated/en/345111467989458740/Higher-education-in-developing-countries-peril-and-promise.

Teddlie, C., & Tashakkori, A. (2003). Major issues and controversies in the use of mixed methods in the social and behvioral sciences. *Handbook of mixed methods in social & behavioral research,* 3-50.

Teo, T. S., Lin, S., & Lai, K.-h. (2009). Adopters and non-adopters of e-procurement in Singapore: An empirical study. *Omega, 37*(5), 972-987.

Thatcher, S. M., Foster, W., & Zhu, L. (2006). B2B e-commerce adoption decisions in Taiwan: The interaction of cultural and other institutional factors. *Electronic Commerce Research and Applications, 5*(2), 92-104.

Thomas, F., Haddon, L., Gilligan, R., Heinzmann, P., & de Gournay, C. (2005). Cultural factors shaping the experience of ICTs: An exploratory review. *International Collaborative Research. Crosscultural Differences and Cultures of Research, COST, Brussels*, 13-15.

TOP500.org. (2016). *Top 10 sites for November 2016*. Retrieved from https://www.top500.org/lists/2016/11/

Tornatzky, L. G., & Fleischer, M. (1990). *Processes of technological innovation.* Lexington Books: Lexington, MA.

TradingEconomics. (2016). *Saudi Arabia retirement age*. Retrieved April 2016, from http://www.tradingeconomics.com/saudi-arabia/retirement-age-men

Tricker, R. I. (1988). Information resource management—A cross-cultural perspective. *Information & Management, 15*(1), 37-46.

Troshani, I., Rampersad, G. C., & Plewa, C. (2011). Adopting innovation management software in university innovation commercialization. *Journal of Computer Information Systems, 52*(2), 83-92.

Troshani, I., Rampersad, G., & Wickramasinghe, N. (2013). Managing SaaS risk in higher education organisations: A case study. *International Journal of E-Business Research (IJEBR), 9*(2), 8-23.

Truong, H.-L., Pham, T.-V., Thoai, N., & Dustdar, S. (2012). Cloud computing for education and research in developing countries. In *Cloud computing for education and research*, 78-94.

Truong, H.-L., Pham, T.-V., Thoai, N., & Dustdar, S. (2012). Cloud computing for education and research in developing countries. In L. Chao, *Cloud computing for teaching and learning: strategies for design and implementation*, 64-80.

Twati, J. M. (2006). *Societal and organisational culture and the adoption of management information systems in Arab countries.* Griffith Business School Brisbane, Australia.

Tweel, A. (2012). *Examining the relationship between technological, organizational, and environmental factors and cloud computing adoption.* Northcentral University.

United Nations, (2014). World Economic Situation and Prospects 2014. Department of Econmics and Social Affairs. Retrieved from http://www.un.org/en/development/desa/policy/wesp/wesp_current/2014wesp_country_classification.pdf

US-Saudi Arabian Business Council. (2015). *Saudi Arabia's 2015 budget maintains strong spending, diversification initiatives.* Retrieved from https://www.us-sabc.org/custom/news/details.cfm?id=1645.

Van Everdingen, Y. M., & Waarts, E. (2003). The effect of national culture on the adoption of innovations. *Marketing Letters, 14*(3), 217-232.

Vatanasakdakul, S., Tibben, W., & Cooper, J. (2004). *What prevent B2B eCommerce adoption in developing countries?: A socio-cultural perspective*. Paper presented at the 17th Bled eCommerce Conference on eGlobal.

Veiga, J. F., Floyd, S., & Dechant, K. (2001). Towards modelling the effects of national culture on IT implementation and acceptance. *Journal of Information Technology, 16*(3), 145-158.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.

Vishwakarma, A. K., & Narayanan, A. (2012). *E-learning as a service: A new era for academic cloud approach.* Paper presented at the 2012 1st International Conference on Recent Advances in Information Technology (RAIT).

Voas, J., & Zhang, J. (2009, April). Cloud computing: New wine or just a new bottle? *IT Professional on the Web IEEE,* 15-17.

Vogt, W. P. (2006). *Quantitative research methods for professionals in education and other fields*. Allyn & Bacon: New York. Instrument Validation Study.

Voorsluys, W., Broberg, J., & Buyya, R. (2011). Introduction to cloud computing. In *Cloud computing: Principles and paradigms*, 1-44.

Walia, R. (2012, September 24). Saudi Arabia's investment in education largest in the Gulf. *Saudi Gazette*.

Wang, T., & Lai, Y. (2014). Examining the adoption of KMS in organizations from an integrated perspective of technology, individual, and organization. *Computers in Human Behavior, 38*, 55-67.

Wang, Y.-M., Wang, Y.-S., & Yang, Y.-F. (2010). Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting and Social Change, 77*(5), 803-815.

Wargin, J., & Dobiéy, D. (2001). E-business and change–Managing the change in the digital economy. *Journal of Change Management, 2*(1), 72-82.

Waring, T., & Wainwright, D. (2008). *Innovative developments in the use of template analysis: Two comparative case studies from the field.* Paper presented at the 7th European Conference on Research Methodology for Business and Management Studies.

Weaver, D. (2013). *Six advantages of cloud computing in education.* Retrieved from http://www. pearsonschoolsystems. com/blog.

Weber, A. S. (2011). Cloud computing in education in the Middle East and North Africa (MENA) region: Can barriers be overcome? *eLearning and Software for Education(eLSE) Journal*, 2011, (1).

Weerakkody, V. (Ed.). (2009). Handbook of Research on ICT-Enabled Transformational Government: A Global Perspective: A Global Perspective. IGI GlobalWengraf, T. (2001). *Qualitative research interviewing: Biographic narrative and semi-structured methods.* SAGE.

White, E., McMillan, L., Brenton, F., Featherston, E. and Hubbard, P. (2011). Denial-of-Service Attacks and the Cloud. [online] Cloudcomputing.sys-con.com. Retrieved from: http://cloudcomputing.sys-con.com/node/1747821 [Accessed 1 Oct. 2017].

Wimmer, R., & Dominick, J. (1994). *An introduction to mass media research.* California: Wadsworth.

Wu, J., Shen, Q., Wang, T., Zhu, J., & Zhang, J. (2011). Recent advances in cloud security. *Journal of Computers, 6*(10), 2156-2163.

Woodford, C. (2017). *Cloud computing*. [online] explainthatstuff.com. Available at: http://www.explainthatstuff.com/cloud-computing-introduction.html [Accessed 1 Oct. 2017].

Xu, J., & Quaddus, M. (2012). Examining a model of knowledge management systems adoption and diffusion: A partial least square approach. *Knowledge-Based Systems, 27*, 18-28.

Yamin, M., & Al Makrami, A. A. (2015). Cloud computing in SMEs: Case of Saudi Arabia. *Our Major Indexing at International Level, 4852*, 853.

Yamin, M., & Al Makrami, A. A. (2015). Cloud computing in SMEs: Case of Saudi Arabia. *Our Major Indexing at International Level, 4852*, 853.

Yang, J., & Chen, Z. (2010). *Cloud computing research and security issues.* Paper presented at the 2010 International Conference on Computational Intelligence and Software Engineering (CiSE).

Yee-Loong Chong, A., & Ooi, K.-B. (2008). Adoption of interorganizational system standards in supply chains: An empirical analysis of RosettaNet standards. *Industrial Management & Data Systems, 108*(4), 529-547.

Yesser, e.-G. P. (2016). Government cloud computing. Retrieved from http://www.yesser.gov.sa/en/BuildingBlocks/Pages/GCloud_Computing.aspx

Yesser. (2012). The e-Government Second Action Plan.

Yesser. (2016). *Government cloud computing.* Retrieved from http://www.yesser.gov.sa/en/BuildingBlocks/Pages/GCloud_Computing.aspx

Yoon, T. (2009). *An empirical investigation of factors affecting organizational adoption of virtual worlds.* Florida State University. USA

Zeineldin, Y. (2014). Gulf cloud computing market poised to grow sevenfold. *Gulf News.*

Zhang, Q., Cheng, L., & Boutaba, R. (2010). Cloud computing: State-of-the-art and research challenges. *Journal of Internet Services and Applications, 1*(1), 7-18.

Zhao, F., Scheruhn, H.-J., & von Rosing, M. (2014). The impact of culture differences on cloud computing adoption. *Human-computer interaction. Applications and services*. Springer, 776-785.

Zhu, K., & Kraemer, K. L. (2002). E-commerce metrics for net-enhanced organizations: Assessing the value of e-commerce to firm performance in the manufacturing sector. *Information Systems Research, 13*(3), 275-295.

Zhu, K., Kraemer, K. L., & Xu, S. (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. *Management Science, 52*(10), 1557-1576.

Zikmund, W., & Babin, B. (2006). *Exploring marketing research*. Cengage Learning.

Zissis, D., & Lekkas, D. (2012). Addressing cloud computing security issues. *Future Generation Computer Systems, 28*(3), 583-592.

Zoho. (2015). *More than 7 million users work online with Zoho*. Retrieved 20 Feb, 2015, from http://www.zoho.com.

Appendices

Appendix A

Information Sheet (English Version)

INFORMATION SHEET

Title: 'Factors Affecting the Adoption of Cloud Computing in Saudi Universities'

Investigators:

Mrs Faten Karim

School of Computer Science, Engineering and Mathematics

Flinders University

Ph: +61 434 519 476

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Description of the study:

This study is part of the project entitled '*Factors Affecting the Adoption of Cloud Computing in Saudi Universities*'. This project will investigate the critical factors and barriers of cloud computing adoption at Saudi universities. The project will use a variety of research methods (qualitative and quantitative). This project is supported by the Flinders University School of Computer Science, Engineering and Mathematics.

Purpose of the study:

This project aims to uncover the barriers that hinder cloud computing adoption at Saudi universities, with respect to the unique cultural needs, whilst at the same time meeting global standards. It is expected that the outcome of the research will help decision makers at Saudi universities to recognize the serious barriers and overcome them to upgrade the universities to the modern technological level.

What will I be asked to do?

You are invited to attend a one-on-one interview with a researcher and to complete a survey. Other participants are invited to complete the survey only.

In the interview the participant will be asked a few questions about the current use of Information Technology (IT), the expected benefits of cloud computing, and the main barriers that prevent successful cloud computing adoption at the university. The interview will take about 30 minutes and survey will be of 15-20 minutes. Notes will be taking during the interview to help with looking at the results. The notes will typed-up and stored as a computer file and then destroyed once the results have been finalised.

Completing the questionnaire and attending the interview are voluntary and the participants have the right to refuse participation in this study.

What benefit will I gain from being involved in this study?

The sharing of your experiences will improve cloud computing adoption at Saudi universities. We are very keen to identify barriers and obstacles so they are overcome. The outcomes of the study will guide planning an efficient frame work for adopting cloud computing and lead to future significant research.

Will I be identifiable by being involved in this study?

We do not need your name and you will be anonymous. Any identifying information will be removed and the typed-up file stored on a password protected computer that only the coordinator (Mrs Faten Karim) will have access to. Your comments will not be linked directly to you.

Are there any risks or discomforts if I am involved?

The researcher does not believe there are any risks for you if you choose to participate in this research.

How do I agree to participate?

Participation is voluntary. You may answer 'no comment' or refuse to answer any questions and you are free to withdraw at any time without effect or consequences. A consent form accompanies this information sheet. If you agree to participate please read and sign the form.

How will I receive feedback?

Outcomes from the project will be summarised and given to you by the investigator if you would like to see them.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

Appendix B

Information Sheet (Arabic Version)

ورقة معلومات

عنوان البحث ' العوامل المؤثرة في تبني الحوسبة السحابية في الجامعات السعودية'

الباحث:

السيدة / فاتن خالد كريم

طالبة دكتوراه تخصص علوم الحاسب

كلية علوم الحاسب والهندسة والرياضيات

جامعة فلندرز بأستراليا

صندوق بريد ٢١٠٠ , اداليد ,٥٠٠١ , جنوب استراليا

+هاتف :٦١٨ ٨٢٠١٢٢٩٧

البريد الالكتروني: faten.karim@flinders.edu.au

وصف الدراسة:

هذه الدراسة هي جزء من دراسة بعنوان ' العوامل المؤثرة في تبني الحوسبة السحابية في الجامعات السعودية '. و تسعى هذه الدراسة لمعرفة الواقع الحالي بالنسبة لتقنية المعلومات في الجامعات السعودية، و العوامل المهمة و العوائق التي تؤثر على قرارا تبني الحوسبة السحابية فيها ، ومن ثم دراسة و تحليل اثر هذه العوامل والعلاقة بينها. الدراسة سوف تستخدم مجموعة متنوعة من أساليب البحث (النوعية والكمية). هذه الدراسة تتم بدعم من جامعة فلندرز مدرسة علوم الحاسوب والهندسة والرياضيات.

الغرض من هذه الدراسة:

تهدف هذه الدراسة لكشف المعوقات التي تؤثر على اعتماد الحوسبة السحابية في الجامعات السعودية، واقتراح اطار عملي لتسهيل عملية تبني هذه التقنية وفق المعايير العالمية مع الاخذ في الاعتبار ثقافة المجتمع العربي المسلم. ومن المتوقع أن نتائج البحث ستساعد صناع القرار في الجامعات السعودية وغيرها من الجامعات العربية للتعرف على الحواجز المهمة لتطبيق هذه التقنية و محاولة التغلب عليها لرفع مستوى الجامعات إلى المستوى التكنولوجي الحديث.

ماهو المطلوب؟

أنت مدعو لحضور مقابلة مع طالب دكتوراه أو لإكمال الاستبيان.

في المقابلة سوف يطلب منك الاجابة على بعض الأسئلة حول الاستخدامات الحالية في تكنولوجيا المعلومات (IT)، والفوائد المتوقعة من الحوسبة السحابية، والعقبات الرئيسية التي تحول دون نجاح اعتماد الحوسبة السحابية في الجامعة. سوف تستغرق المقابلة حوالي 30 دقيقة. سيتم خلالها تدوين الملاحظات للمساعدة في استخراج النتائج. سيتم تخزين الملاحظات كملف كمبيوتر ثم سيتم اتلافه في حال الانتهاء من النتائج.

في الاستبيان سوف يطلب منك تعبئة الاستبيان حيث تكون اجابتك دقيقة ومعبرة عن رايك. الاستبانة مكونة من ثلاث اجزاء. الجزء الاول منها يتعقلق بالمعلومات الشخصية للمشارك و الاستخدام الحالي للبرامج، والجزء الثاني هو مقياس لاهم الميزات المستفادة من الحوسبة السحابية، اما الجزء الثالث فهو مقياس للعوامل المعيقة لاعتماد او تبني الحوسبة السحابية في الجامعة. من الممكن ان تستغرق تعبئة الاستبيان من 15 دقيقة.

وفي الختام أود التَأكيد على أن تعبئة هذة الإستبانة اختيارية ولك الحق بعدم تعبئتها ,كما لك الحق في عدم الإجابة على أي سؤال لا تود الإجابةَ عليه .وفي حال رغبتك المشاركة بِهذه الدراسة، فإن بيانات هذة الاستبانة ستكون سرية.

ما الفائدة من الإنضمام لهذه الدراسة؟

الإستفادة من الخبرات سيساعد على تحديد وتصنيف العوائق التي تؤثر على تبني الحوسبة السحابية بالجامعة .وهذا بدوره سوف يساعد في تطوير خارطة طريق لمساعدة صناع القرار في الجامعات لتحقيق هذا التحول. ايضا نتائج هذه الدراسة تشجع لعمل ابحاث مستقبلية في نفس المجال.

هل سيتم التعريف بهويتي في هذه الدراسة؟

لايوجد حاجة للتعريف بهويتك وسوف تكون البيانات مجهولة المصدر وفي حال الانتهاء من النتائج سيتم التخلص من نتائج المقابلة..

هل هناك أي مخاطر أو مضايقات نتيجة الإنضمام للدراسة؟

سوف يكون التركيز في هذا البحث على البيانات بشكل عام وجماعي لذلك فإن اي بحث منشور من هذه الدراسة سيتم اخفاء هوية المشارك فيه وسيتم الإحتفاظ بالمعلومات التي قدمتها في هذا الإستبيان او المقابلة بشكل يحافظ على الخصوصية وسيتم التخلص منها عند انتهاء الدراسة.

الموافقة على المشاركة؟

يوجد نموذج مرفق مع ورقة المعلومات هذه ,فإذا كنت موافق على المشاركة في الإجابة على الأسئلة يرجى التوقيع على النموذج ,وأنت حر في رفض الإجابة على اي سِؤال و الإنسحاب في اي وقت.

كيف يمكنني تلقي ردود الفعل؟

سيتم تلخيص نتائج البحث و بالإمكان الاطلاع على النتائج إذا رغبت في ذلك من خلال التواصل مع الباحث بواسطة البريد الإلكتروني.

شكر اً على وقتك ومساعدتك ونأمل بأن تقبل دعوتنا للمشاركة.

Appendix C

English Version of the Interview Questions

CONSENT FORM FOR PARTICIPATION IN RESEARCH

(By interview)

I.....

Being over the age of 18 years hereby consent to participate as requested in the interview for the research project on '**Factors Affecting the Adoption of Cloud Computing in Saudi Universities'**

I have read the information provided.

Details of procedures and any risks have been explained to my satisfaction.

I am aware that I should retain a copy of the Information Sheet and Consent Form for future reference.

I understand that:

I may not directly benefit from taking part in this research.
I am free to withdraw from the project at any time and am free to decline to answer particular questions.
While the information gained in this study will be published as explained, I will not be identified, and individual information will remain confidential.
Whether I participate or not, or withdraw after participating, will have no effect on any treatment or service that is being provided to me.
I may withdraw at any time from the session or the research without disadvantage

6. I have had the opportunity to discuss taking part in this research with a family member or friend.

Participant's signature……Date……...

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name…Faten Karim**…….…….....**

Researcher's signature……..Date……

Name:

Job:

Qualification:

Interview questions

What is the current situation regarding information and communication technology (ICT) in the university (for teaching and learning/management/ maintenance)?

What are the university's polices or strategies regarding ICT?

From the perspective that the university is growing and the demands for information technology (IT) are increasing does the university outsource any IT services (how & why)?

What do you personally think about Cloud Computing?

What might be the technological factors that affect the adoption of Cloud Computing in the university?

What might be the organisational factors factors that affect the adoption of Cloud Computing in the university?

What might be the environmental factors that affect the adoption of Cloud Computing in the university?

What might be the cultural factors that affect the adoption of Cloud Computing in the university?

Is there anything you would like to add?

Appendix D

Survey Questionnaire (English Version)

PART 1: about you (demographics and current activities)

Name of your university: *****

Please select your age group *

- Between 20 - 29
- Between 30-39
- Between 40-49
- 50 or over

Please select your gender *

- Female
- Male

What is your highest qualification: *

- Doctorate
- Master degree
- Bachelor
- High School
- Diploma

Which position do you hold at the university: *

- Top Management
- Dean/Department head
- IT Manger/Staff
- Management staff
- Academic
- Other

Your experience: *

- Less than 3 years
- 3-5 years
- 6-8 years
- 9-10 years
- More than 10 years

Please rate the challenges facing the university's IT activities?

	Very important	Important	Moderately important	Low importance
Concerns about data security				
Inadequate IT staff levels				
Inadequate IT systems				
Inadequate end-user skills				
Insufficient training for IT staff				
Insufficient training for end users				
Inadequate Internet access				

In your opinion, are there any more challenges that were not mentioned?

If you are an IT staff, please answer the following question:

Are the following computer applications in use at the university?

	Never	Rarely	Some times	Often	Always
Content management					
Email					
Office productivity (such as word processing)					
Programming/software development					
Social networking/Web 2.0 (such as Facebook)					
SMS/text messaging (such as SMS Cloud)					
Telephone and voice services/VoIP					
Web conferencing (such as Skype)					

PART 2: Cloud computing adoption

What is your university's intention about cloud computing adoption?

- Has no intention
- Will adopt within 12 months
- Already adopted
- I don't know

Section1: Technology context

Please indicate how much you agree or disagree with each of the following statements

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
The use of cloud computing reduces system administration					
By using cloud computing, the information technology system is always up to date.					
Cloud computing reduces hardware and software maintenance efforts.					
Costs of purchasing software for every personal computer are reduced.					
Cloud computing involves access to data from anywhere.					
Cloud computing leads to ease of upscale or downscale of computing resources as required					
The use of cloud computing is fully compatible with current university work					
The use of cloud computing will be compatible with existing hardware and software in the university					
Cloud computing adoption is consistent with the university's strategy					
The skills needed to adopt cloud computing are too complex for employees of the university					
Integrating cloud computing into existing system landscape is difficult					
The use of cloud computing requires a lot of mental effort					
By using cloud computing sensitive data is protected from unauthorized persons					
By using cloud computing there are worries about data loss.					
Data will be controlled by the service provider					
Intellectual property rights could be stolen					

Section 2: Organisational context

Please indicate how much you agree or disagree with each of the following statements

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
The university's management supports the adoption of cloud computing.					
Top management in the university has a clear strategy towards IT					
Top management in the university offers training courses to use IT					
There are necessary skills within the university's staff to implement cloud computing					
There is limited and inconvenient wireless Internet access on campus.					
There are limited Internet enabled computers available on campus.					

Section 3: Environmental context

Please indicate how much you agree or disagree with each of the following statements

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Many large universities are currently adopting cloud computing					
Many large universities will be adopting cloud computing in the near future					
Cloud computing is recommended by the government					
The regulations that exist are sufficient to protect the users from risks associated with cloud computing					
There are no laws regarding ownership and responsibility for customer data.					
Budgeting for the availability of technology in the education sector is limited.					

Section 4: Cultural context

Please indicate how much you agree or disagree with each of the following statements

Please choose the appropriate response for each item:

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Language problems in using technology is considered as a barrier in adopting cloud computing.					
Some services in cloud computing don't support Arabic languages.					
Possibility to find an inappropriate websites (advertising) with content inappropriate to the Islamic context considered as a barrier in adopting cloud computing					
Lack of laws to organize and keep Islamic boundaries while using cloud					
It is important to have job requirements and instructions spelled out in detail so that people always know what they are expected to do					
People should avoid making changes when their outcomes are uncertain					
Order and structure are very important in a work environment					
Managers expect workers to closely follow instructions and procedures					
Managers should make most decisions without consulting subordinates					
Employees should not question their manager's decisions.					
Decision making power should stay with top management and not be delegated to lower level employees					
Managers should not delegate important tasks to employees					
Men usually solve problems with logical analysis; women usually solve problems with intuition					
Solving organisational problems usually requires an active forcible approach which is typical of men					
It is preferable to have a man in a high level position rather than a woman.					
Individual rewards are not as important as group welfare					
Group success is more important than individual success					
Being accepted by the members of your work group is very important					
Employees should pursue their goals after considering the welfare of the group					

Final Comments

Please feel free to add any additional information

Thank you very much for taking the time to fill out this survey!

Faten Karim

Appendix E

Skewness and Kurtosis Tests

Skewness and Kurtosis for all the items

	N	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
RA_1	421	1.006	.110	.119	-.509	.237
RA_2	421	1.158	-.019	.119	-.787	.237
RA_3	421	1.069	-.119	.119	-.611	.237
RA_4	421	1.102	.028	.119	-.687	.237
RA_5	421	1.107	-.009	.119	-.744	.237
RA_6	421	1.110	-.078	.119	-.675	.237
CPT_1	421	1.079	-.047	.119	-.833	.237
CPT_2	421	1.158	-.048	.119	-.649	.237
CPT_3	421	1.182	-.056	.119	-.748	.237
CPX_1	421	1.095	.061	.119	-.791	.237
CPX_2	421	1.147	-.059	.119	-.731	.237
CPX_3	421	1.162	-.075	.119	-.787	.237
SC_1	421	1.066	-.069	.119	-.631	.237
SC_2	421	1.157	-.139	.119	-.684	.237
SC_4	421	1.141	-.098	.119	-.707	.237
SC_3	421	1.038	-.217	.119	-.472	.237
TMS_1	421	1.052	-.119	.119	-.624	.237
TMS_2	421	1.138	-.223	.119	-.604	.237
TMS_3	421	1.130	-.216	.119	-.566	.237
RD_1	421	1.022	-.200	.119	-.715	.237
RD_2	421	1.102	-.065	.119	-.740	.237
RD_3	421	1.112	-.192	.119	-.638	.237
CP_1	421	1.055	-.201	.119	-.552	.237
CP_2	421	1.155	-.029	.119	-.790	.237

CP_3	421	1.126	-.157	.119	-.676	.237
RS_1	421	1.055	-.024	.119	-.680	.237
RS_2	421	1.154	-.171	.119	-.736	.237
RS_3	421	1.141	-.036	.119	-.783	.237
LR_1	421	1.014	.016	.119	-.884	.237
LR_2	421	1.111	-.184	.119	-.537	.237
LR_3	421	1.121	-.080	.119	-.752	.237
LR_4	421	.991	-.019	.119	-.742	.237
UA_2	421	.961	-.132	.119	-.547	.237
UA_1	421	1.005	-.023	.119	-.743	.237
UA_3	421	1.087	-.184	.119	-.542	.237
UA_4	421	1.139	-.204	.119	-.649	.237
PD_1	421	1.044	-.019	.119	-.751	.237
PD_2	421	1.148	-.117	.119	-.733	.237
PD_3	421	1.169	-.115	.119	-.766	.237
PD_4	421	1.080	-.144	.119	-.602	.237
MF_2	421	1.051	-.017	.119	-.731	.237
MF_1	421	1.093	-.129	.119	-.722	.237
MF_3	421	1.135	-.114	.119	-.670	.237
MF_4	421	1.114	.085	.119	-.770	.237
IC_1	421	1.059	-.070	.119	-.665	.237
IC_2	421	1.050	.005	.119	-.755	.237
IC_3	421	1.115	-.053	.119	-.699	.237
IC_4	421	1.171	-.086	.119	-.741	.237
Valid N (listwise)	421					

Reliability Statistics of RA

Cronbach's Alpha	N of Items
.773	6

Item-Total Statistics of RA

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
RA_1	15.42	13.358	.784	.674
RA_2	15.53	13.607	.607	.715
RA_3	15.51	14.179	.598	.719
RA_4	15.53	14.159	.574	.724
RA_5	15.37	18.552	.038	.850
RA_6	15.50	13.855	.611	.715

Reliability Statistics of CPT

Cronbach's Alpha	N of Items
.826	3

Item-Total Statistics of CPT

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CPT_1	6.22	4.162	.764	.684
CPT_2	6.30	4.306	.633	.810
CPT_3	6.30	4.125	.660	.785

Reliability Statistics of SC

Cronbach's Alpha	N of Items
.650	4

Item-Total Statistics of SC

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SC_1	9.60	5.112	.668	.409
SC_2	9.67	4.942	.620	.433
SC_4	9.69	5.218	.565	.479
SC_3	9.56	8.518	-.021	.835

Reliability Statistics of CPX

Cronbach's Alpha	N of Items
.822	3

Item-Total Statistics of CPX

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CPX_1	6.15	3.966	.775	.655
CPX_2	6.22	4.274	.623	.807
CPX_3	6.27	4.173	.637	.794

Reliability Statistics of TMS

Cronbach's Alpha	N of Items
.824	3

Item-Total Statistics of TMS

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TMS_1	6.42	3.882	.767	.675
TMS_2	6.41	3.937	.650	.789
TMS_3	6.48	4.031	.631	.808

Reliability Statistics of RD

Cronbach's Alpha	N of Items
.801	3

Item-Total Statistics of RD

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
RD_1	6.72	3.616	.731	.644
RD_2	6.93	3.676	.618	.759
RD_3	6.88	3.703	.598	.780

Reliability Statistics of CP

Cronbach's Alpha	N of Items
.815	3

Item-Total Statistics of CP

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CP_1	6.34	3.864	.762	.654
CP_2	6.47	3.888	.641	.775
CP_3	6.40	4.103	.607	.807

Reliability Statistics of RS

Cronbach's Alpha	N of Items
.823	3

Item-Total Statistics of RS

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
RS_1	6.31	3.915	.784	.655
RS_2	6.36	4.054	.627	.810
RS_3	6.42	4.077	.635	.801

Reliability Statistics of LR

Cronbach's Alpha	N of Items
.620	4

Item-Total Statistics of LR

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
LR_1	10.00	4.571	.650	.360
LR_2	10.18	4.785	.494	.476
LR_3	10.17	4.588	.536	.439
LR_4	9.99	7.395	.008	.786

Reliability Statistics of UA

Cronbach's Alpha	N of Items
.604	4

Item-Total Statistics of UA

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
UA_1	9.84	4.317	.657	.318
UA_2	9.75	7.545	-.075	.806
UA_3	9.96	4.532	.510	.430
UA_4	9.94	4.161	.562	.377

Reliability Statistics of PD

Cronbach's Alpha	N of Items
.835	4

Item-Total Statistics of PD

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PD_1	9.59	7.610	.787	.741
PD_2	9.67	7.771	.647	.801
PD_3	9.72	7.773	.627	.810
PD_4	9.67	8.245	.615	.813

Reliability Statistics of MF

Cronbach's Alpha	N of Items
.816	3

Item-Total Statistics of MF

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MF_1	6.42	3.749	.761	.651
MF_3	6.49	4.027	.625	.791
MF_4	6.56	4.109	.623	.792

Reliability Statistics of IC

Cronbach's Alpha	N of Items
.653	4

Item-Total Statistics of IC

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
IC_1	9.55	8.191	.029	.819
IC_2	9.49	5.146	.680	.411
IC_3	9.54	5.277	.579	.478
IC_4	9.54	5.202	.546	.500

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
RA_1	155.07	160.940	.214	.698
RA_2	155.02	162.274	.157	.701
RA_3	155.00	160.305	.223	.698
RA_4	155.02	160.911	.201	.699
RA_5	155.02	165.409	.028	.708
RA_6	154.98	160.178	.224	.698
CPT_1	155.03	158.225	.296	.694

CPT_2	155.09	159.621	.254	.696
CPT_3	155.10	159.747	.221	.698
CPX_1	155.05	160.035	.223	.698
CPX_2	154.85	159.602	.259	.696
CPX_3	155.05	160.126	.224	.698
SC_1	154.98	161.342	.183	.700
SC_2	154.95	161.967	.163	.701
SC_4	154.98	161.814	.163	.701
SC_3	154.95	166.637	-.011	.710
TMS_1	154.99	160.419	.221	.698
TMS_2	155.00	161.171	.217	.698
TMS_3	154.95	161.767	.165	.701
RD_1	154.68	161.438	.190	.699
RD_2	154.65	160.881	.215	.698
RD_3	154.67	160.358	.249	.697
CP_1	154.96	159.277	.264	.696
CP_2	154.95	160.002	.231	.697
CP_3	154.97	161.147	.202	.699
RS_1	154.99	161.705	.172	.700
RS_2	154.63	161.844	.197	.699
RS_3	154.75	161.986	.207	.699
LR_1	154.77	160.899	.214	.698
LR_2	154.80	159.759	.248	.696
LR_3	154.78	162.037	.164	.701
LR_4	154.77	165.568	.034	.707
UA_2	154.81	166.664	-.007	.709
UA_1	154.90	163.649	.108	.704
UA_3	154.87	163.569	.100	.704
UA_4	154.93	162.874	.135	.702
PD_1	154.93	160.047	.238	.697

PD_2	154.89	160.323	.240	.697
PD_3	154.91	157.141	.355	.691
PD_4	154.94	162.163	.156	.701
MF_2	154.92	168.066	-.064	.713
MF_1	154.90	161.505	.170	.701
MF_3	154.93	159.543	.244	.697
MF_4	154.97	161.747	.168	.701
IC_1	155.07	167.040	-.027	.711
IC_2	155.01	160.583	.216	.698
IC_3	154.99	159.648	.262	.696
IC_4	155.07	159.616	.254	.696