AN INTELLIGENT CITIZEN-CENTRIC ORIENTED MODEL FOR EGOVERNANCE: A UAE CASE STUDY

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A thesis submitted in partial fulfilment of the requirements of Liverpool John Moores University for the degree of Doctor of Philosophy

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DECLARATION

I, Mohamed Alloghani, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm this has been indicated in the thesis.

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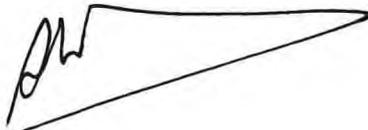
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ABSTRACT

Tremendous advancements in information and communication technology, coupled with the usability of smart mobile devices, have brought enormous growth in the appeal of high-quality government services. This appeal has, in turn, encouraged governments to deploy services to citizens using electronic channels. Worldwide, governments have recognized the need to deliver better-integrated services to the public to meet their expectations. Therefore, the transition from the conventional modes of delivering government services to an electronic format involves substantial considerations in the operational aspects of services delivery and drastic changes in existing core business systems across governmental public institutions. The concepts of eGovernance and smart services have emerged as new ways to deliver such services to meet citizens' demands by developing tools and setting practical standards for services delivery. These tools comprise process reengineering and the setting of guidelines, establishment of policies, delegating of authority, and continued monitoring of performance and control. From a research perspective, there is a need to identify the several factors that constitute online and mobile services delivery in the UAE and measure the adoption of these services by the public. Extant literature includes very few studies that evaluate the delivery of online and mobile services in the context of eGovernance. This study highlights these gaps in the field and conducted research in the UAE to address them.

The major aim of this research is to develop and validate a citizen-centric oriented model, which examines factors that affect people's acceptance of eGovernance services within governmental public sector organizations such as health and education. This research adopted mixed methods for data collection, including a quantitative survey and qualitative semi-structured interviews.

To test the proposed model, the research adopted structural equation modelling (SEM), which is a powerful tool that considers a confirmatory approach rather than an exploratory approach with regard to the data analysis. Second, the validated and evaluated model was used as a roadmap for eGovernance services adoption and implementation, in which new initiatives can be evaluated. Third, this research provides an intelligent system for evaluating eGovernance implementation across government entities. The proposed novel system features an intelligent login module as a service that enables users to access multiple public government services using secured unified entry access (UEA) through a single account. The users are only required to log in once to access many eGovernance services. In addition, the proposed system applied the model view controller (MVC), which is an exceedingly secure model, to leverage the system's quality, efficiency, security, flexibility and reusability. The system applied a collaborative filtering technique to improve the delivery of eGovernance services, measuring entities' performance and ranking government organizations. Finally, this research provides recommendations for future works, including the validation of the developed model in other countries, consideration of G2B and G2E digital services and approaches to solving world systems' technical challenges pertinent to big data, data sparsity, cold start and scalability.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ADT	Android Development Tool
AI	Artificial Intelligence
APP	Application
BI	Business Intelligence
CF	Collaborative Filtering
Chatbots	A program that simulates conversation with human users
C-TAM-TPB	Combined Technology acceptance and Theory of Planned Behaviour
DOI	Diffusion of Innovation Theory
eDirham	Electronic Dirham
eGovernance	Electronic Governance
eHealth	Electronic Health
eServices	Electronic Services
G2B	Government to Business
G2C	Government to Citizen
G2E	Government to Employees
G2G	Government to Government
GCC	Gulf Cooperation Council
GSP	Government Service Provider
GUI	Graphical User Interface
ICT	Information and Communication Technology
IDE	Integrated Development Environment
MADLC	Mobile Application Development Lifecycle
MGov	Smart Government
mHealth	Mobile Health
ML	Machine Learning
MM	Motivational Model
MPCU	Model of PC Utilization
mServices	Mobile Services
NLP	Natural Language Processing
PC	Personal Computer
PEOU	Perceived Ease of Use
PLS	Partial Least Square
PU	Perceived Usefulness
RUP	Rational Unified Process
SAML	Security Assertion Markup Language
SCT	Social cognitive theory
SDK	Software Development Kit
SDLC	Software Development Lifecycle
SEM	Structure Equation Modelling
SPSS	Statistical Package for Social Sciences
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour

TRA	Theory of Reasoned Action
UEA	Unified Entry Access
UML	Unified Modelling Language
UP	Unified Process
UTAUT	Unified Theory of Acceptance and Use of Technology

Chapter 1 INTRODUCTION

1.1 Overview

eGovernment refers to the practical usage by government organizations of information technologies such as the internet, telecommunications, networks and mobile computing, which have the ability to build and transform relationships with public citizens, private companies, businesses and other government organizations [1]. eGovernance "is the public sector's use of information and communication technologies with the aim of improving information and services delivery, encouraging citizen participation in the decision-making process and making government more accountable, transparent and effective" and involves new ways of organizing and delivering services and information, different styles of leadership, novel ways of accessing and delivering services, and new ways of involving and listening to citizens' needs and requests [2], [3]. eGovernance considers citizens' participation and involvement in the decision-making processes and reduces the internal processes of operations and administrative load, improves response time, and promotes more efficient and effective government processes and procedures, thereby allowing citizens greater access to services and ultimately contributing value to the economy [4]. In this research, eGovernance is defined as the government's use of information and communication technologies with the objective to provide enhanced, sustainable and high-quality information access and services to citizens electronically, transparently, effectively, and efficiently while making government services more citizen-oriented [5].

This research work focusses on the development and validation of a model of adoption and intention to use eGovernance services. Health and education will be used as a case study to validate the proposed model. This research is the first to propose a novel model based on a combination of multiple theories, such as the unified theory of acceptance and use of technology (UTAUT), with external constructs, namely, perceived security, perceived enjoyment, perceived trustworthiness, personal innovativeness, data privacy, social influence, technology anxiety, resistance to change, self-efficacy, facilitating conditions, and constructs measured for quality including the system, services and information.

Most eGovernance models have limited application to a specific area of interest. Therefore, many critical aspects should be considered, namely, the diversity of the government's developed online and mobile systems, the status of technological infrastructure, and cultural, economic and political conditions. As an example, in the United Arab Emirates (UAE), most government entities depend on outsourced ICT consultancy companies and highly skilled personnel to operate eGovernance implementation projects [6]. In fact, most of these businesses, along with project teams at the respective government entities, neither consider nor understand the cultural, social, economic, political and behavioural aspects of the region. Consequently, these facts increase the chances of delays and failures of eGovernance services project implementation. It is essential that government entities and concerned officials, as well as the decision makers who participate in implementing eGovernance services projects, know and are fully aware of the barriers, challenges and opportunities supporting or obstructing the adoption of eGovernance services. Moreover, they need to understand the critical factors that impact citizens' acceptance and intention to use eGovernance service systems so that they develop systems that are acceptable, useful and compliant with citizens' actual needs.

External independent constructs were deemed to be variables of choice to be incorporated into the model for testing and validation. The research methodology used in this study is the mixed-method approach, which includes quantitative (numeric) and qualitative (text) data. The quantitative method incorporated a large-scale survey questionnaire for generalizing the results, validating the model and confirming the proposed hypotheses. The qualitative method was conducted through semi-structured interviews to elaborate on the collected quantitative data findings.

1.2   Problem Statement

The increased number of citizens' demands for meaningful participation in the decision-making process requires launching new innovative eGovernance to enable people to take part in decisions that impact their life [6], [7]. An increasing concern that many governments may encounter usage divide, users' accessibility to services, lack of usability features and the primary intention to use by users. The usability challenges, lack of planning and mutual coordination between governments' public organizations are showstoppers for effective implementation of eGovernance in UAE. Furthermore, no strategic master plans that guide public government entities to assess, qualify, prioritize and implement efficient eGovernance services. There are very few studies that

studied eGovernance adoption in UAE and no study established the reasons that underline the citizens' uptake, decision and acceptance towards adoption of eGovernance services particularly in healthcare and education domains. A study by [7] suggested that eGovernance implementations are delayed, not completed on time, failed or did not accomplish their goals, particularly in the developing world. The empirical studies about eGovernance services adoption and usage in UAE require more work and consequently this thesis is addressing a theoretical gap. Addressing these challenges is vital to propose a practical model that identifies all factors that impact users' adoption of eGovernance services in health and education [7].

1.3   Research Aims and Objectives

The major aim of this research work is to develop and validate a citizen-centric oriented model, which examines factors that affect people's acceptance of eGovernance services within government public sector organizations such as health and education. The research will be concluded with a new acceptance model that addresses the factors which impact the peoples' acceptance of eGovernance Systems and services. To meet the desired aims of this research, the following objectives are formulated and are as shown in the proposed research map (Figure 1-1).

- To develop a novel eGovernance acceptance model for the education and the health sectors.
- To assess, validate and evaluate the acceptance of the proposed technology acceptance model.
- To apply the proposed model as a roadmap for eGovernance services' adoption and implementations where new initiatives can be evaluated.
- To develop an intelligent system that help decision makers in evaluating and monitoring performance of eGovernance implementations.
- To develop a system that provide highest level of security including enterprise architecture.
- To apply collaborative filtering for improving the delivery of eGovernance services, measuring entities' performance and ranking as perceived by citizens.
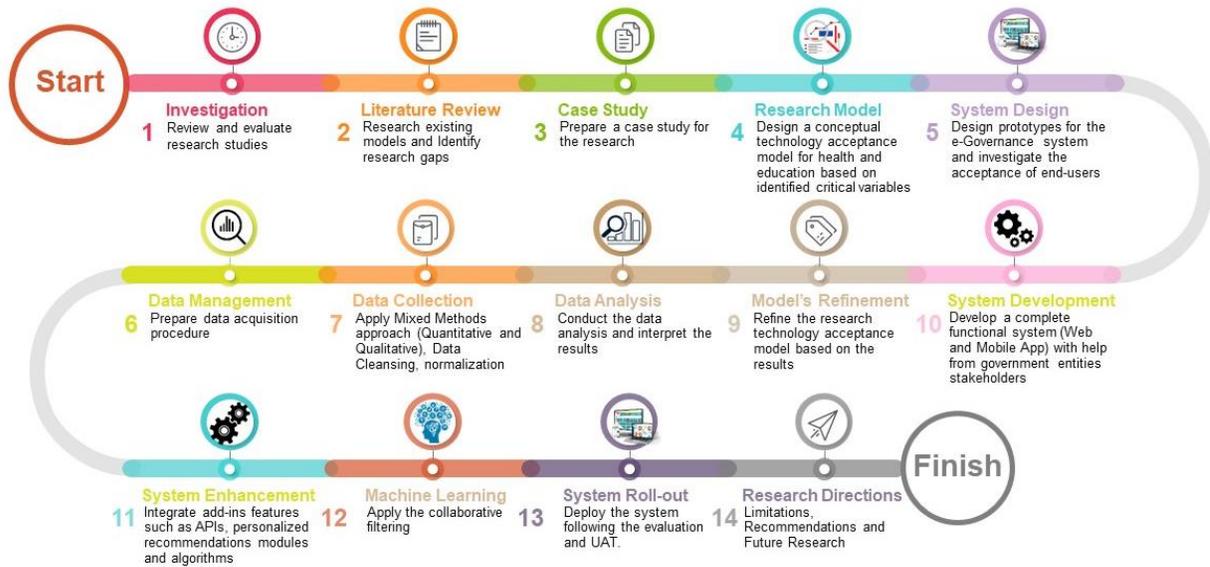
Figure 1-1 The Research Map

1.4 Motivation of the Research

Numerous governments worldwide still use old fashioned paper-based systems with traditional styles of delivering services to the community. There are persistent challenges pertinent to the services delivery and digitization. For instance, in developing countries such government services entail the public's physical presence at service counters to access certain services. In addition, making appointments with physicians require patients to make phone calls, send emails and typically attend at healthcare centres. The first motivation of this research is to help decision makers who are involved in the eGovernance projects to deal with the highlighted challenges and opportunities by identifying the type of challenge, determining associated risks, mitigate it and responding accordingly. If governments do not have strategic plans for the identified risks, this may lead to failure of eGovernance projects. Consequently, to mitigate the risks and have a proper implementation and adoption of eGovernance survives, a technology model has to be developed and implemented. Another motivation of this research is to help governments to focus on the creation and adoption of digital services though eGovernance implementations by using the proposed intelligent system, which is a unified platform designed to properly manage, administer, monitor and control the performance of eGovernance among the government institutions in UAE.

1.5   Research contributions

The proposed acceptance model in this research work is very useful for various countries, that are implementing eGovernance services in the electronic or mobile format to identify the most prominent factors that hinder the publics' acceptance, adoption and intention to use eGovernance services. The proposed model is novel and includes many unknown and unexplored dimensions that affect the users' uptake of eGovernance services across the public sectors. The proposed acceptance model is considered as a measurement model for eGovernance implementations where project managers, officials and decision makers become aware of these factors prior to the implementation. Additionally, it can be applied to systems of assessment measurement to support government organizations to evaluate, prioritize and implement services based on the acceptance model and being evaluated through a specialized, tailored eGovernance assessment system.

The research work presented in this thesis has provided the following novel contributions:

1. An integrated and extended model with inclusion of external variables. The novelty of this aspect is related to the provisioning of contributions to knowledge where both theories are tested for their predictive values towards the use of eGovernance services. Those derived variables from the literature will be used as an extension to the new model. Furthermore, this study is the first to present a model that uses UTAUT with derived external variables that will be tested for its validity of adoption in a different sector of the government such as education and health. This provides more insights to researchers to understand better and determine the critical variables that may impact the adoption of eGovernance services.
2. Newly collected data will provide a contribution to knowledge by enabling the research community to determine the factors that affect the adoption and intention to use eGovernance services in health and education. This study helps in bridging the existing gap of identifying the factors that affect the acceptance and adoption of eGovernance services in real world applications for example health and education which could be extended to other fields. The collected data will also help the research community to understand the users' characteristics.
3. Newly developed adoption model to support decision makers in evaluating future initiatives of eGovernance services in health and education which can be adopted by other sectors.
4. Newly developed novel application templates facilitating the adoption of new initiatives in areas of interest and contributing to practice because it will enable other stakeholders in the e-

Governance services fields to realize its advantages and hence implement applications that satisfy the actual needs of citizens.

5. Developing an automated and predictive system that applies machine learning from the e-Governance services perspective is a new idea.

6. The aspects provided by the proposed system includes a development of intelligent web and mobile systems that will significantly help government organizations to meet government strategies and facilitate the success of the implementation pertinent to e-Governance services initiatives.

1.6   Structure of the Thesis

This thesis is organised in six chapters, each chapter addressing a different element of the study.

Chapter 1: This chapter introduces the research problem along with the aims and objectives of this study. It also identifies the motivation of the research and describes the structure of this thesis.

Chapter 2: This chapter draws the reviews from the literature to investigate recent studies that target the definitions eGovernance and eGovernment, eGovernance service types and stages of eGovernance with emphasis on deep investigation of the eGovernance, highlights the benefits of eGovernance, shows the role of ICT as an enabler in eGovernance and how governments can leverage the ICTs to deliver information and services to citizens.

Chapter 3: This chapter provides a deep literature review on the essence of eGovernance to the contemporary society. We review and discuss the implementation of eGovernance worldwide, outline the level of services around the world for the improvement of eGovernance innovations. This chapter also covers a review of the well-known models. It also presents the research methodology and highlights applied model for implementation of the mixed-methods approach.

Chapter 4: This chapter presents application of the PLS-SEM technique, data collection methods and analysis of the results obtained through the mixed method approaches. This chapter shows the applicability of the proposed model for the prediction of the intention to use online/mobile Government education and health services.

Chapter 5: This chapter introduces the proposed intelligent web and mobile systems. This chapter also discusses the benefits of the proposed systems, web system and mobile application, the impacts of eGovernance, social Impact, economic Impact, eGovernance system architecture, model view controller architecture, eGovernance network architecture, deployment environments, development environment, staging and production environments, application platforms, the security and privacy procedures that have been followed in the design stages.

Chapter 6: This chapter concludes this study, where we provide the limitations of the research and recommendations for future work.

Chapter 2 THE eGOVERNANCE

2.1   Introduction

"*Information Technology, and the ability to use it and adapt it, is a critical factor in generating and accessing wealth, power, and knowledge in our time*"[8]. Communication technology has been evolving over the past decades, and the world is changing due to the utilization of the Internet [9]. The use of technology and data collected from these technologies has influenced many aspects of life especially the ways in which citizens, governments and business interact with each other. The dissemination of broadband networks, the Internet and mobile technologies shows how pervasive they have become. It is indeed storage/communication technology, which is considered as one of the building blocks for today's digital economies and modernized society [10]. From the government perspective, the adoption of eGovernment has become a mandatorily required task. The eGovernment streamlines activities, operations as well as information and services of government. The main goal of eGovernment is to offer a robust and increased portfolio of public utilities to the people in a cost-effective and efficient manner [11]. The continued progress in the Information and Communication Technology has promoted and helped the eGovernance solutions by improving the levels of responsiveness, transparency, accountability, quality and efficiency of government services [12]. The citizens are increasingly requiring and expecting a high level of provided services as much as most of the government entities. The development of eGovernance applications has evolved, and many countries have moved into electronic delivery of services to fulfil citizen's needs. On the other hand, this transition from the conventional way of services delivery to electronic services delivery involves substantial considerations and changes in the existing systems across the government's public organization such as education, health, transportation, security, industry and more. A recognition of changes in process and procedures shall sustain and motivate the implementation of eGovernance initiatives. There are an enormous number of eGovernance system solutions that have been developed and found insufficient to help a government employee to carry out and perform certain tasks and activities. The citizens encounter some difficulties from technical perspectives on how to use the developed government's systems and services as they were not part of the systems' development cycle from the initial stages and were compelled to use the existing applications to carry out electronic transactions [13]. The eGovernance provides greater participation of citizens, business and interest groups into the

governance system that is in place. For example, this can be remarkably observed by the decision makers using the Internet to get views from their public in a successful way or dissemination of social and government organizations' opinions which conflict with the political ruling authority. The eGovernance's innovation and sustainability has been a crucial focus for the government's public sectors, with the international and local governments aware of the rewarding possibilities of using advancement in information system development to improve the access to information, data enquiry, data exchange, data transactions, and provision of electronic services and to establish citizens' adoption of eGovernment systems [14-16].

Accordingly, this research study carries out the investigations on users' adoption, acceptance and continuance intention to use eGovernance systems from the services level domain and services quality through the proposed model that will be tested and validated for its applicability on various government sectors namely health and education. UAE will be used as a case study to demonstrate the usefulness of the proposed model that will be generalized and intended to be used for many countries that consider using such delivery services of eGovernance.

eGovernance has been considered as an innovation meant to provide motivation for the economic development across the world. The developing countries are greatly exercising efforts to run eGovernance projects as they are evidenced to improve governments' services delivery to the public. In the same context, some of the developed countries such as the U.S.A, UK, Republic of Korea, Denmark and Singapore have already made successful stories on complete services transition whereas most developing countries are still experiencing and facing unsuccessful and failed eGovernance projects [17].

2.2   eGovernance and eGovernment

There is no consensus definition of the term eGovernance as many research studies have introduced terminology of their genuine understanding of the subject. However, there are some of the well-known organizations such as UNESCO where they defined it [3] with something like "*eGovernance is the public sector's use of information and communication technologies with the aim of improving information and service delivery, encouraging citizen's participation in the decision-making process and making government more accountable, transparent and efficient. eGovernance involves new styles of leadership, new ways of debating and deciding policy and*

investment, new ways of accessing education, new ways of listening to citizens and new ways of organizing and delivering information and services. e-Governance is generally considered as a wider concept than e-Government since it can bring about a change in the way citizens relate to governments and each other. e-Governance can bring new notions of citizenship, both concerning Citizens' needs and responsibilities. Its objective is to engage, enable and empower the citizen".

According to [18], the term Governance means the description of the links between the government and its related operational environment including the social, political, economic, cultural and administration. The application of electronic connections outlines the interaction between the citizens, business, government entities as well as the internal interaction of government operations to enhance the government's common functions and business. According to [19], eDemocracy is a subset of eGovernance, and it builds on it. The eGovernance concentrates on the innovations and actions facilitated by the ICT along with upper levels of the democratic intent.

Several studies [17-20] have suggested that one of the major advantages of eGovernance is enhancing the operational and administrative efficiency and applying the Information, and Communication Technology across the government's agencies which will result in great reduction of costs, errors and saving time as well as better quality of service. In another study [21], eGovernance makes empowerment to citizens through enabling them to access information and/or formulate an efficient government management. Benefits of the eGovernment can be summarised as increased accountability, anticorruption, improved transparency, cost reductions, efficiency gains, increased capacity of government, improving the quality of decision-making, network and community creation, and more revenue growth and promoting the use of ICT in all sectors. As observed by [21, 22], the eGovernance is considered as the technology that facilitates the interaction and transformation between the government and public. In a similar vein, [23] states that eGovernance is the assurance of making use of technology for enormous ends including effective services and better democracy. According to [24] and [25], who considered eGovernance as a mediator that represents the relationship between the citizens and government.

The [26] defines eGovernment as the use of technology to offer superior services to employees, citizen and business. In [27] argues that eGovernment not only provides superior services but also provides government information through the digital means such as the internet.

According to [28], eGovernment contributes to delivering and sharing of services to business and citizens to eliminate the real corruption, reduction of costs and time, strengthening transparency and accountability. In [29], showed the eGovernment from a different perspective where he defined it as a significant movement towards establishing changes required to increase the accountability, efficiency and effectiveness of the public sector. The Global Business and Electronic Commerce [30] developed their definition of eGovernment where it refers to a state in which legislative, administrative and judicial entities transform their external and internal activities, operations and make use of networked systems effectively to provide better quality regarding public services. According to [36], eGovernment is defined as the nonstop of continuous optimization carried out on the services delivery, public participation and governance by making over external and internal relationships with the use of technology, media and the internet. On the other hand, the Working Group on eGovernment has provided another definition in which eGovernment is considered as the use of Information and Communication Technology (ICT) to support government effectively and efficiently, providing accessibility to government services, allowing the public to access information and making government more accountable. Service delivery through channels such as telephone, internet, self-service, inter-communication systems, wireless devices and other means of smart communications.

Even though people can support their lives, government services are quite essential to them. Levi noted in his work [31] that nearly every person in a nation requires some services from the government. However, the government may not be capable of carrying on its duties as expected due to several reasons. Some reasons may be technological whereas others may be due to poor leadership, financial hardship or slow innovation. In response to the people's needs, eGovernance plays a vital role in easing the availability of eServices to the people through various platforms including the internet. Apart from the citizens, businesses, various entities, and interest groups look towards the eGovernance services for assistance in various areas. Precisely, the technology connects government to citizens; government to government; government to professionals as well as government to business entities.

2.2.1 The role of eGovernance

Technology is changing the world and eGovernance is part of the technologies that are changing the world. For instance, the mass digital migration is enormous in the modern world from

mobile phone applications to personal computers that boost eGovernance's implementation. Accessing government services in most countries becomes relatively easier with the passage of time with the new technological opportunities that show up regularly. Nearly 77% of people around the world own mobile phones whereas a notable number of people can access computers in both developed and developing nations [32]. The accessibility to computerised accessories creates a chance for citizens to utilize eGovernance programs. Access to information is crucial not only for the corporate fraternity but for ordinary citizens who are in constant need of government services. eGovernance influences the employment of millions of people across the globe. Governments have a mandatory obligation to serve their people and satisfy some needs as defined in various documents that govern government operation. According to [33] who asserted that eGovernance is a subject of technology rather a political tool. The fact that eGovernance does not face political challenges remains inescapable. The citizens of a country have a right to receive government services and they may complain to the point of prosecuting the government in the case of its failure to perform its duties effectively. The role of the government is not merely to serve its people but to do so effectively in an appropriate manner that leaves the citizens satisfied adequately. Citizens' satisfaction through eGovernance may take place through various ways. Firstly, it may take place through creating employment to the unemployed populace as mentioned earlier in this paragraph. Secondly, it may take place through timesaving and efficiency improvement. Manual ways of service delivery by governments prove to cost governments heavily through wastage of time, money and other resources.

Presumably, the implementation of eGovernance propels the achievement of the millennium goals. Some of the millennium goals include eliminating poverty from the society, enhancing efficiency in organizations' operations globally, and improving technology to the best level possible. Consequently, eGovernance promotes technological development, poverty eradication, and efficiency improvement [34, 35]. The eGovernance makes it possible for people to access governmental services without having to join long queues and waste time. When people save time by utilizing eGovernance technology, they may use it to develop economies in one way or another. Development of economies courtesy of technology assists in achieving the millennium goals. Using the saved time and energy for production minimizes poverty amongst people. Poverty reduction or eradication is one of the basic objectives of governments.

Concerning eGovernance, many countries in the western world and other parts of the world have success stories. Most of the stories praise eGovernance and recommend it for their further development. Internet accessibility is increasing rapidly in many nations that have poor technologies and network coverage. The implementation of eGovernance has special requirements such as a reliable network, adequate electricity, and some literacy amongst the users. Without the mentioned necessities, a country may hardly succeed in achieving its governance goals. Efforts to implement eGovernance without the necessities may lead to waste of resources or potential failure. Governments have key considerations to put in place before eGovernance implementation. Governments focus on serving millions or billions of people who expect good services from them. Even so, successful delivery of services to a huge population calls for keenness, innovation, and commitment by governments. Suggestively, eGovernance is one of the technologies that make this possible. Ineffective plans and implementation may make countries fail in embracing eGovernance. Governments are reforming to become more useful to their people. That is, governments are considering the use of ICT in making governments more productive in terms of service delivery to people. The re-engineering process is evident in most countries and already accomplished in some countries [36]. Citizens need positive outcomes from effective systems. To some extent, citizens associate governance with democracy. That is, they call for a democratic governance that eliminates amoral acts in government services such as corruption so that the population becomes active participants in government services as well as beneficiaries of the same. The reformation of government through technology will no longer become an option soon given the direction that the world is taking as far as technology and eGovernance is concerned.

Apparently, eGovernance is hugely connected to the development of computer technology, communication technologies, and networking of computers. The implementation of eGovernance takes place through predetermined procedures [37]. eGovernance has special stages known as phases that countries ought to follow in implementing the technological strategy. The four phases of eGovernance include computerization, networking, online presence, and online interactivity. Computerization is the first phase of eGovernance implementation. The government ought to own some computers and program them accordingly to serve different needs of the people in relation to eGovernance [38]. Literacy is key in promoting an electronic governance, which determines how the computers are used. In the computerization phase, using computers begins with processing of words before data processing takes place. Thereafter, the launch of the networking phase

commences where the interconnection of specific government units occurs through a hub, which stimulates information sharing, and data flow among various bodies of the government. The third phase in eGovernance implementation is online presence, which involves internet connectivity alignment and ensuring the presence of the web. Many countries admit that achieving reliable internet connection is a major challenge in making eGovernance possible [39]. For instance, when the Indian government was transforming to eGovernance, it had challenges with implementing this phase due to poor networks in areas hence the services could not be delivered exhaustively and fairly to the citizens, so the government decided to maintain its websites and enhance internet connectivity throughout the country, which was not easy to achieve fully. Fundamentally, the web-pages contain key details regarding organizational structure, publications, reports, individual details, vision statements, and goals of numerous government entities [40]. Ultimately, online interactivity starts. The phase is characterized with opening of communication systems among public institutions, the civil society institutions, and the citizens. This stage focuses on minimising the level of personal interface with government institutions through provision of downloadable acts, forms, rules, and instructions amongst other essential documents. Further exploration of this phase leads to online submission of forms and digital running of services by government institutions to their people. After the implementation of the final phase, citizen-government transactions are put in the eGovernance mode hence become more accessible for the citizens and relatively executable for the institutions.

2.3   Definitions of eGovernance

eGovernance refers to the involvement of ICT in the delivery of governmental services with the aim of achieving more effectiveness, efficiency, and citizen satisfaction [41]. The technology is becoming popular throughout many countries in the world to improve the quality of services to the interest groups such as the citizens amongst others. Furthermore, the type of governance under discussion enables efficient storage of information, simple exchange of information, retrieval of information by individuals, groups, organizations, businesses and other governments [42]. Accuracy of service delivery is also part of eGovernance. ICT plays a vital role in the making of eGovernance and all that it entails. Importantly, the technology also assists governments in the right decision-making.

Another applicable definition of eGovernance is putting together internet connectivity and computerizations to serve the technological interests of the public. According to [43], the expectations that citizens have towards the government is relatively high and delivery may be difficult. In response to the bulk need for government services, the paradigm of governance must change. The program enhances accountability and transparency of the government officials and responsible authorities. Internet connectivity and computerization creates a specific source in which citizens can find services conveniently in their own time regardless of the mass population to be served at a given time.

Elaborately, eGovernance is a potential technological way in which governments utilize technology to handle the public effectively through execution of its obligations to pose a positive impact in the lives of the involved persons [44]. The mentioned process happens through provision of services and information to the public using computer resources and human resources. Governments are eliminating traditional methods of governance and introducing eGovernance as the modern way of managing the public. Through eGovernance, there has been a huge difference between the old governments and the modern governments in the way they operate and deliver services to their people. However, it is important to note that the implementation of eGovernance can be challenging for many countries due to the huge finances that are required in the process. The world shares nearly the same perspective on the positive impacts of eGovernance to the contemporary global community. eGovernance developers such as computer specialists advocate for communal development through identification of the local needs and international needs of the people with respect to their country [45]. eGovernance works together with other technologies to ease service delivery and make things simple for the government. According to the definition of eGovernance, it concentrates on enhancing sustainability through specific programs. Reliable researches in both developing and developed nations have revealed that eGovernance requires a keen follow up to make it successful rather than leading to failure.

Nearly every government project may need the application of eGovernance programs easing delivery to people. Government projects undergo poor technical designs, lack of trust among the stakeholders, and emergence of corruption [46]. The relevance of eGovernance shows up when the mentioned negative impacts are eliminated if not mitigated in one way or another. For data management, the study suggests the utilization of Service Oriented Architecture (SOA). SOA is

another technological innovation that relates to eGovernance to help in integration of services, enhancement of reusability, and facilitation of interoperability amongst eGovernance operational systems. Many times, confusion arises in the differentiation of eGovernance from eGovernment. eGovernance can also be defined as a dynamic process that enhances interaction between consumers, public administrations, and the government. In this perspective, eGovernance, through ICT, helps the minority to access services as fairly as the well-to-do community [47]. Different social classes often vary in terms of how they access government services as well as information. The only way that makes this possible is through institutional arrangements and creation of a fair platform where every person can get their right served effectively. On the other hand, eGovernment is merely the provision of government services by use of ICT especially to the public-sector organizations rather than to the citizens directly as in the case of eGovernance. eGovernment is a subordinate of eGovernment. Both technologies are essential to the members of the society over time.

2.3.1 Definition of eGovernance from our perspective

eGovernance can be defined as public's use of information and communication technology to steer, monitor, direct and control the performance of government institutions for a long-term. This requires substantial changes in decision-making process, business process re-engineering, setting strategic business goals that should be based on global best-practices and aligned with governments' national goals and agendas. The eGovernance platforms should provide specific instructions to users to ensure adherence to the law, avoid conflict, and enhance smooth delivery of government services.

2.4   eGovernance Services Types

As mentioned earlier, the eGovernance facilitates the interactions and relationships between different stakeholders such as government and public. Such interactions include the Government to citizen (G2C), which is an interface that is created by the government and the citizens allowing them to take all the benefits offered as public services. In this category, the government provides its services and communicates them directly to the public; such services include but are not limited to, health, education, transportation, employment and government transfer programs. While, with the Government to Government (G2G) services the government

restructures the internal governmental process and procedures and transforms into a connected entity by developing an integrated back-office to serve the citizen's needs. This kind of interface expands the availability of the public services as well as improving the quality of services rendered. The Government to Business Enterprises (G2B) includes the provision of services while it aids the business community. The services and goods providers can seamlessly interact with a government which can reduce cost considerably and allow the provision of more transparency at all levels. The Government to Employee (G2E) is where the government provides employees with required training, data access to support them in doing their day-to-day tasks and assists in improving the organizational accountability and maximizing the limited resources as well as enhancing the services provided to citizens [48].
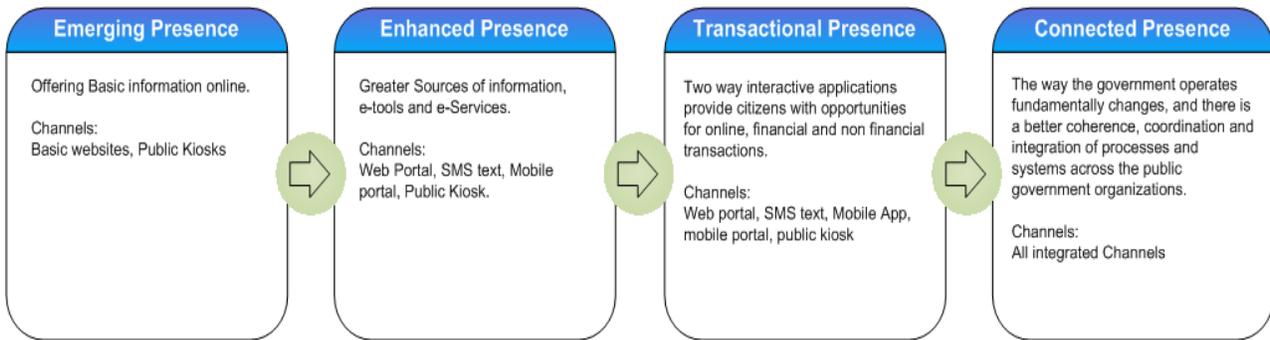
Figure 2-1 UN Model of e-Governance Development [7]

Figure 2-1 illustrates the stages of eGovernance implementation. In the emerging presence, the governments provide basic websites with static content. In the following phase of enhanced presence, governments establish an enhanced presence by providing eServices, emerging portal, interaction with users like enabling them to email and download forms. The transactional phase has the two-way interactive applications that facilitate to citizens performing online transactional services such as finance and payments. In the connected phase where most of the channels are integrated, being fully networked internally/ externally with all entities of government and having a one front-end channel for citizens' access [49]. In the same context, other studies [50-52] draw on the same concept of eGovernance stages' development cycle.

2.5   Chapter summary

In this chapter, we have reviewed and understood the definitions eGovernance and eGovernment, eGovernance services types and stages of eGovernance. Types of eGovernance applications include G2G, G2C, G2B, and G2E. In general, it can be noted that the implementation of eGovernance in countries minimizes corruption to a certain level and encourages transparency in offering government service. This deep investigation of the eGovernance helps to highlight the benefits of eGovernance, show the role of ICT as an enabler in eGovernance and how governments can leverage the advancement of ICTs to deliver information and services to citizens. Furthermore, the review produced various definitions perceived by scholarly sources in different countries. Notably, the chapter illustrated key differences between eGovernment and eGovernance. The eGovernance's influence on the community is more positive than negative. In addition, the literature review puts forward the eGovernance implementation process from the computerization stage to online interactivity.

Chapter 3 LITERATURE REVIEW

3.1 Introduction

The contemporary world is hardly comparable to the world of about a century ago. The technological progress of the present world has emerged as the years have come and gone. Some technologies and innovations are highly helpful to the nation and its people. According to Rodrigo [32], the interconnectedness among people is one of the major aims of technologists and innovators around the globe. Moreover, computer science contributes hugely into the development of both developing and developed nations in numerous ways. A potential prediction holds that the world is more likely than unlikely to become a better place for human survival compared to human harm courtesy of the upgrading of technology and innovations that are taking place today. Nonetheless, some repercussions come along with the innovations and technologies that emerge day-in-day-out. More specifically, electronic governance (eGovernance) is one of the fundamental contributors of effective service delivery to people in several countries that embrace it. Governance is not a simple issue or task for many countries hence it may need some technologies to boost its execution [53, 54]. In addition, governance can be relatively complex given the scope and the components. For this reason, eGovernance is a special tool of the modern era that simplifies governance for various governments that prefer employing it for the sake of improving accessibility of services to the involved parties, in this case, the citizens and non-citizens of a country. In a public-sector context, governance deals with institutional arrangements and coordination of programs to ease service accessibility to various people [55]. Factors such as Information and Communication Technology (ICT) come into place when analysing eGovernance since it involves communication and interaction. In every country, citizens have their interests to which they give much priority and they mind how they run in their country. However, it is important to note that eGovernance propels the potential implementation of public services in the most convenient and effective way possible for the sake of the growth of a country and improvement of the lives of the people. Notably, the electronic medium in conjunction with the government authorities work together in ensuring the development of a workable eGovernance. Intricately, the eGovernance attempts to perfect the relationship between the government and its people through facilitation of transparency and ease of serving the people. One point of view holds that eGovernance is an asset to the countries that implement it with various objectives to achieve for the individuals and the country as a whole [31].

Information accessibility, effective communication, and government relations to various individuals and authorities mark the major general objective of eGovernance. eGovernance is a potential technology of the present day that improves the relationship between governments and their people by simplifying governmental processes, improving connection among people, and enhancing interconnectedness between various technological systems with an aim of bettering lives and creating a conducive environment for the government to govern its people more effectively.

3.1.1 The eGovernance Impacts

According to [56], existing studies pay limited attention to considering the effects of government stakeholders on the overall eGovernance project's success. The previous and existing research focused on providers rather than receivers, in other words research focused on the supply side not the citizens side [57]. This gap was attributed to a lack of attention to considering citizens' participation and engagement in eGovernance strategic policies [58]. According to [59] there is the need for a well-developed eGovernance impact assessment model to turn government inputs into effective outcomes.

This research presents novel citizen-centric eGovernance performance measurement systems along with a technology acceptance model to transform eGovernance digital services to the highest quality and to realise citizens' demands, support policy recommendations for paramount government performance and achieve key values namely accountability, transparency, citizen participation, quality of services, citizen engagement, services excellence and innovation. The proposed systems provide opportunities for government in terms of evaluation, monitoring and reporting. These are components implemented at different levels as part of the eGovernance process model. The evaluation component measures implementation of plans against key performance indicators and checks overall entities' compliance with system models' criteria. The monitoring focuses on tracking all participating government organizations on the implementation of eGovernance strategic plans [57].

3.1.2 The Governance Impacts

The impacts of eGovernance include different spheres such as governance, social and economic [56]. From the governance perspective, impacts include the following:

- Better openness, accountability, responsibility, transparency and efficiency.
- Enhanced cooperation and collaboration between government entities.
- Cross government entities' boundaries and prevent working-in-silos direction.
- Reduce inequality and satisfy basic human needs especially in poor countries.
- Improve communications and outreach of public relations.
- Enable public participation in decision-making process.
- Unify the regulatory and policy models.
- Streamline government's business procedures.
- Redefine government roles and obligations.
- Achieve elevation and compliance of citizens' rights.
- Enhance capacity of collaborations at national and international levels.
- Facilitate effective diffusion of e-Governance and decentralize entities' processes.
- Decentralization shifts central government agencies' authority to the local government, which helps for more rapid delivery of services and better decision-making process.
- Establish a partnership with non-government entities as well as organizations from the private sector.
- Streamline communications and exchange of data across public organizations.

3.1.3 The Social Impacts

The eGovernance defines a set of strategic objectives, vision and national policies that draw beneficial values affecting the overall governance dimension [59]. From the social perspective, numerous benefits/impacts include:

- Improve social security and welfare.
- Involvement of citizens in decision-making.
- Better access to health and education services.
- Increase quality of health and education services.
- Change traditional services delivery format into a well-developed citizens'-centric model.
- Reduce the digital divide and increase ICT literacy.
- Provide online and smart services to citizens and businesses on a 24/7 basis.
- Provide comfort and ease of citizens' lives interacting with government.
- Availing open-data published by diverse government entities to community.

3.1.4 The Economic Impacts

On the economic side, the impact includes establishing successful rapid economic growth; sustain growth of country, development of cost-effective delivery of services, reduce operational cost for business services, increase planning capacity for integrated automation and digitization of services, enhance revenue collection, reduce transactional expenditures, consolidation of internal and external services and better financial management [59].

3.2 eGovernance around the World

eGovernance is not fully adopted by all countries around the world. While some countries are yet to adopt it, others continue to develop it. The awareness of eGovernance continues to grow with the passage of time. The expectation that citizens have towards the government today is quite different from the expectations of previous generations [54]. Today, people expect governments to be more responsible and responsive to the needs of the people. The modern world can go as far as ranking the governance of different countries as opposed to the past. With the high expectations that people have, eGovernance personnel have crucial roles to play to ensure the fulfilment of government promises through adequate delivery of services. Political leaders look forwards to achieve effective and good governance, which can be possible through the formulation and adoption of eGovernance. Corruption is a global problem that nearly all countries around the world suffer from. eGovernance, as mentioned earlier in the thesis, helps in controlling corruption by enabling transparency.

Governments around the world have objectives to achieve probably at the end of every year. Effective delivery is part of achieving the overall objectives of a country. The modern global environment uses special tools with the support of the advancement in ICT to transform the world even in terms of governance [60, 61]. The relationship between the government and its people and businesses greatly determines its growth. Certainly, eGovernance improves the relationship between a country and its people hence making the world a better place for humans and acts as a linking factor between humans and their habitat. Precisely, eGovernance simplifies the functioning of the government through enabling the achievement of five major features summarised as "SMART." The five features that make up "SMART" include Simplicity, Morality, Accountability, Responsiveness, and Transparency. Simplicity means an understandable process that many citizens will understand with a little or no education. Literacy is key in understanding and being a beneficiary of eGovernance not only in one's country but around the world. In this context, Morality means involving ethical acts that are harmless to the people in any given way. Accountability means being responsible for one's negative or positive acts. eGovernance enables retrieval of information hence any misconduct by a worker or a citizen in the process of service delivery may be captured and the right persons get either punished or rewarded where applicable [62, 63]. Responsiveness is the reaction of the involved persons to their professional environment.

Ultimately, transparency refers to a professional quality of being true in actions and performance. eGovernance effectiveness varies from developing to developed nations around the world.

The world views eGovernance as a tool for achieving sustainable development. Development is an endless process across the globe. eGovernance is part of technological development that eases delivery of services by the government to its citizens [64], [65, 66]. Developed nations are viewed as 'developed' due to the effective adoption of eGovernance to serve citizens in the county. However, governments of developing nations strain to enhance effective eGovernance as part of achieving sustainable development through improving in technology and service delivery. There have been an increased number of countries that use eGovernance in provision of public services for one good reason; to ease the access of public service to the people as way of benefiting from sustainable development. The progress in eGovernance development and adoption has been extensive in the last decade and many countries embrace and practise governance today. Nevertheless, countries are at different stages of eGovernance implementation and development.

Today, many governments around the world are heightening the level of service in public institutions through ensuring that they are transparent, inclusive, accountable, and effective. For many years, people have been losing trust in government institutions and finding alternative private institutions to provide them with the same services [67]. Unfortunately, the government especially in the developing countries can only provide some services and not all. Nearly 50% of countries in the developing world have no private alternative programs and many people must rely on the government [43]. However, some services can only be provided by the government irrespective of the situation. When the government is burdened with excessive duties, it may give poor services that are unsatisfactory due to inability to manage the masses effectively. eGovernance is taking the world to another level where governments only need to adopt some specific technologies as well as work closely with technologists to ensure provision of services to whoever needs them. Questions directed to the government are reducing hugely in the modern world courtesy of eGovernance that enables governments to provide information to the public for scrutiny. Usually, people provide suggestions to government based on the nature of information that they perceive through the digital sources [62, 63]. Nearly all countries across the globe are embracing innovation and technology in relation to eGovernance.
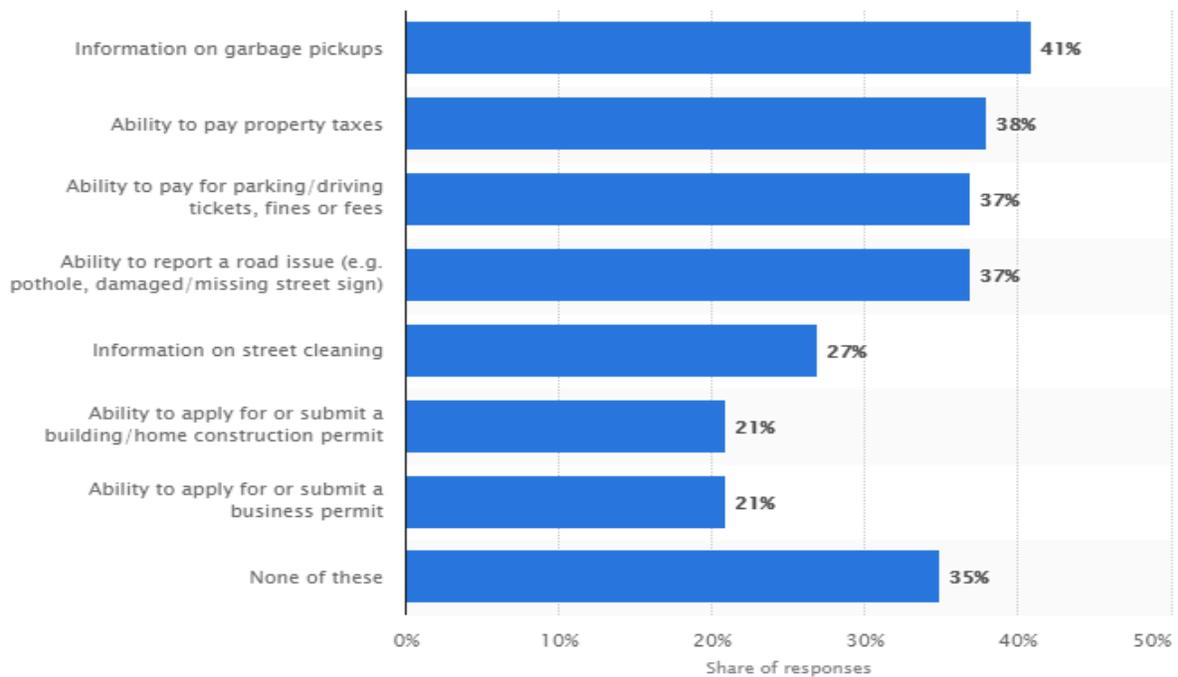
Figure 3-1 American citizens' awareness on e-governance services

Figure 3-1 shows statistical data showing how much aware the U.S citizens are regarding the provision of online services by their local governments. The data reveals that people are never equally aware of the digital technologies provided by the government. That is, the familiarity of people to government digital technologies differs from one a region to another and from an individual to another. The data above is subject to a sample of U.S citizens who were revealed to be aware of some eGovernance services and unaware of others apart from mobile phones. Many people amounting to 41% of U.S citizens were aware of accessing information concerning garbage pickups through eGovernance technological services [65, 66]. The main reason why awareness of digital technologies concerning accessibility of garbage pickups was high is that it affects many Americans. Garbage collection and disposal is always an ongoing process and many households require these services even as they continue with their lives. On the other hand, awareness concerning digital technologies related to making tax, fees, and fine payments amounted to 37%, which is below average. While the services are available in developed nations, a good number of people are unaware or unwilling to utilize the services accordingly. Only 27% of Americans had similar awareness on information about street cleaning.

The majority of people who had information are young people and people whose jobs are related to one eGovernance technology or another. While it is expected that people are aware of

digital technologies relating to application or submission of business permits, that was not the case according to the above statistical data. Only 21% of American citizens were aware of government technologies related to business permits. Nearly 35% of Americans were either unaware or unconcerned about the e-governance services provided by both the local and the Federal government. 35% is a big number to disregard eGovernance services provided by local governments [62, 63]. The large percentage of unawareness may only mean that the residents can access the services elsewhere through other means, or they don't value the programs for various reasons known to them.

3.2.1 Developed Countries

The calibre of eGovernance in developed countries is quite high compared to that of the developing nations. Technology is more advanced in developed countries hence the expectation of government delivery to its people is even higher. Given that the majority of citizens in developed nations have acquired average education, they can utilize eGovernance programs more effectively hence the need to implement it in a wider scale if not throughout the country [60]. Every country that wants to adopt eGovernance in its governance practice may need to consider an eGovernance Plan (NeGP). NeGP establishes institutional models within which the citizens and other interested parties will receive services on demand and at their convenience. The plan also comprises of the relevant expertise as well as experience that provide professional and technical support to the nation. In developed countries, the planners are mostly found within the borders of a nation as opposed to developing nations that are likely to suffer the shortage of expertise and import advanced labour.

eGovernance grows rapidly in developed nations since the citizens and governments adapt to the technology relatively faster. Today, the United States of America and some of the Western countries have adopted eGovernance to a notable level nearly 100%. For instance, in Estonia eGovernance adoption is one of the success stories in Europe especially in the last decade. Estonia had put the necessary resources to commence the implementation throughout its territory. More specifically, Tallinn Technology took over the initiative to spread e-governance education throughout the region to the people suggesting ICT solutions to the problems facing the area's governance. The ICT solutions ought to be at the government level, that is, they should not be either too simple or complex for the government to handle. The interoperability between various

faculties such as economics, public management, and law is worth consideration. Estonia has been more consistent with the requirements of the implementation of eGovernance that enables it to realize its eGovernance goals overtime [41]. Since the implementation of eGovernance in Estonia, the citizens, government administrations, and business entities have found it more helpful and its demand has gone even higher. The citizens in developed countries who have tested the benefits that come along with eGovernance know its significance and tend to need it even more. The need and significance of eGovernance is increasing tremendously in the developed world.

The impacts of eGovernance in developed countries are enormous compared to in developing countries. The more the countries explore eGovernance, the more benefits they derive from it. The speed of service delivery in developed countries is relatively higher and the citizens enjoy speedier communication and interaction to their government through phones and the internet. In turn, this reduces the time taken to deliver services and improves overall effectiveness of government response to the needs of its people. Even though the implementation of eGovernance is relatively expensive, it reduces the cost of government services to the citizens and other interest groups [37]. The cost reduction of government services in developed nations is even more due to extensive adoption of advanced technology. eGovernance minimizes the use of stationery and encourages the use of software to pursue various activities, which enables the developed nations to save even more because of observance of efficiency. eGovernance enables governments from the developed nations to save heavily as they minimize on government expenditure. The level of corruption and other malicious acts within government institutions reduces hugely in developed countries leading to a wide transparency in governance by the managers and other governing professionals. When information becomes available from the internet, ways to practise the amoral acts are blocked. However, this may only be possible if the government has created a public domain platform that allows the public to access information. Many developed nations succeed in this hence, experience good governance from their government considering other factors are constant.

Notably, eGovernance in developed countries has promoted the growth of eServices and eDemocracy alongside enhancing cyber security. eServices are tangible outcomes of the governments that practise eGovernance to manage the interaction between citizens and the state effectively. eGovernance enables governments to develop eServices for their people as in the case

of Estonia and other developed parts of the world [53, 54]. On the other hand, eDemocracy is the due attention that the government gives to each citizen, organization, or person of interest especially through e-services. Governments can go as far as providing advice to companies, institutions, or business entities on how to ensure civic engagement, transparency, or accountability. The existence of eServices causes the need for cyber security. Cybercrime is a common issue of the developed world more than in the developing world. The use of national cyberspace to deliver eServices may expose some users to danger of cyber bullies. National cyberspace is a modern subject of technology that requires adequate protection and ethical adherence from an individual to a national level as well as international level. The safety of eGovernance contributes to its effectiveness [67, 68]. In terms of security in e-governance programs, developed countries undergo numerous problems of enhancing a secure and trustworthy digital development. Even so, this may be also a problem for the developing nations.

Large use of internet in the Western world propels and widens the use of e-governance by thousands of millions of people. eGovernance utilization is widespread in the US and the European region. The benefits of eGovernance to the citizens in developed nations encourage them to participate in the political processes. Apart from encouraging the citizens, it enables the citizens to participate in the political processes. eGovernance in the developed nations plays a major role in their success by engaging the public and improving the coordination between the government and its people. When the government can control and serve its people effectively, it achieves most of its goals and objectives [69]. For example, the Obama Care program to Americans has been productive especially through eGovernance as it engages the society for the wellbeing of the people. The Healthcare.gov is another example of an eGovernance tool of the US. Irrespective of being helpful for some few months, Health.gov failed. The failure of the website is attached to many political issues. Health.gov provided a platform for Americans to purchase insurance services for healthcare insurance providers. The eGovernance may also fail even in developed nations due to various factors. The future of the developed countries is promising with the continuous implementation of eGovernance [69].

Which online services have you used in the past 3 months?*
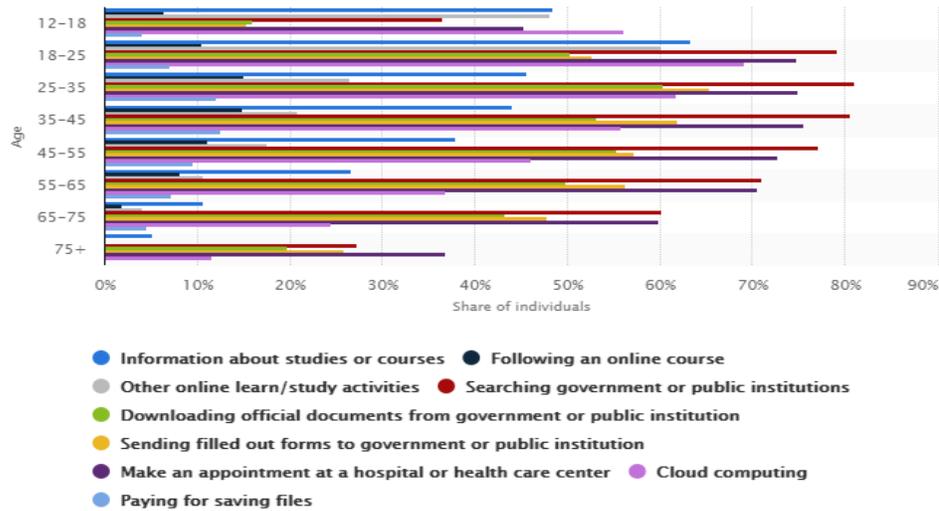
Figure 3-2 A Statistical data on the Usage of E-governance in Netherlands [World bank, 2018]

Figure 3-2 shows responses of citizens in Netherlands regarding their usage of the internet online services related to eGovernance for three months. The survey also touched on the education of utilizing eServices. Moreover, the survey was categorized in terms of age. The youth, as shown in the graphical presentation above, topped the list of utilizing eGovernance digital technologies. Digital government services also benefit young people below 18 years of age [62]. Significantly, many people proved to be searching for government and public institutions online rather than other services. People searching for public institutions between the ages of 25 to 35 amounted to 80% and above, which is a relatively high number that is relatively advantageous for the country. Similarly, 80% of people between the ages of 35 and 45 proved to be searching for government and public institutions online in the previous three months. Making appointments at hospitals or health care centres was the most utilized eGovernance service by the people of Netherlands. While the people from Netherlands value their health, the government is concerned about its people, hence it innovates online technologies to improve the health of such people [31]. The old population aged above 75 years and above only utilized small percentages of government digital technologies. Downloading of official documents provided by the government seemed to be uniform across all ages as the data analysis above reveals. The above graphical presentation also relates to other developed countries different from Netherlands. For instance, most developed countries have the young utilizing the internet more than people of other age groups.

3.2.2 Developing Countries

The implementation of eGovernance in developing countries lies between 30% and 70% of government service deliveries. Some countries in the developing world have employed e-governance hugely in their governments whereas some nations are newly introducing the program to deliver most of the services [64]. Manual service delivery is common in developing countries. Negative factors such as corruption eat into the economies of developing countries even in the present day due to minimal utilization of eGovernance programs. The population growth in the developing countries is quite high and that calls for the need of eGovernance to ease the management of public services. Most government institutions in developing countries can hardly afford to operate 24 hours 7 days a week throughout the year as opposed to most of the eGovernance programs in developed countries. Mostly, developing nations consider eGovernance for special purposes other than that of the economic growth and development. First, eGovernance aims at enabling possible handling of extremely large populations, which are not rare in developing nations.

Most developing countries face governance challenges that are mostly political and technological. Both politics and technological development influence the prosperity of eGovernance. That is, eGovernance relies enormously on technology and the decisions of the top political leaders. Calvin notes that political conflicts hinder the progress of eGovernance [62, 63]. The agreement of politicians is quite significant for the development of a country. Unfortunately, the political stability in developing countries is unreliable for continuous development. While technologies are available, exploring the same may not be pragmatic in developing nations due to inadequacy of expertise in the various fields. Gillian asserts that most developing countries depend on developed nations for development in communication technologies [62, 63]. Most eGovernance technologies originate from the developed nations hence the developing countries may need to either seek for help or borrow. However, developing countries also come up with some eGovernance programs on rare occasions.

Country	e-Particip.		EIU	Freedom House Index		Country	e-Particip.		EIU	Freedom House Index	
	Internet	Rank	Rank	Press	Internet		Index	Rank	Rank	Press	Internet
Netherlands	1,0000	1	10	F	F	Bahrain	0,8235	10	131	NF	NF
Republic of Korea	1,0000	1	19	PF	PF	Canada	0,8235	10	8	F	F
Uruguay	0,9804	2	18	F	F	Costa Rica	0,8235	10	21	F	F
France	0,9608	3	26	F	F	Greece	0,8039	11	30	F	F
Japan	0,9608	3	22	F	F	Morocco	0,8039	11	89	NF	PF
UK	0,9608	3	16	F	F	Italy	0,7843	12	29	F	F
Australia	0,9412	4	6	F	F	New Zealand	0,7843	12	5	F	F
Chile	0,9412	4	32	PF	PF	Spain	0,7843	12	23	F	F
USA	0,9216	5	20	F	F	Estonia	0,7647	13	41	F	F
Singapore	0,9020	6	71	PF	PF	Kazakhstan	0,7647	13	124	NF	NF
Colombia	0,8824	7	52	PF	PF	Brazil	0,7059	14	40	PF	PF
Israel	0,8627	8	33	F	F	Finland	0,7059	14	9	F	F
United Arab Emirates	0,8431	8	130	NF	NF	Germany	0,7059	14	14	F	F

Figure 3-3 UN E-participation Index for Developing Countries

Figure 3-3 shows the statistical data by the UN showing eParticipation in most developing nations across the globe. However, it should be clear that eParticipation is different from eGovernment. eParticipation refers to the level of engagement of the public in eGovernance technology as provided by the government. The ranking is done according to the e-participation index per country. Bahrain, as a developing nation, has had a good record concerning eParticipation of its citizens over the recent years. However, UK, Uruguay, United Arab Emirates, and parts of the US have been doing well in terms of e-governance development. According to the UN statistics, Uruguay has an e-participation index of 0.9804 while UK has a relatively low index of 0.9608. From this statistical analysis, UK has put more effort into developing its eGovernance services. Bahrain's eParticipation or eGovernance is preferable over those of other nations such as UAE due to its consistency in technology development [6, 7].

UK eParticipation index is higher than UAE's index albeit by a small margin of 0.1177. In terms of ICT development UK seems to do better than most of the developing countries as seen in the tabular representation above. Notably, Netherlands and the Republic of Korea are doing slightly better than UK as far as e-participation is concerned. The Bahrain government has maintained e-governance development for quite some time hence stability in development. E-participation indices for developing nations are more likely to be unstable than stable. That is, they are bound to change with the passage of time due to inconsistency in overall development in terms

of education, infrastructure, and ICT. Major developing countries that embrace e-governance are found in Southeast Asia, parts of UK, and in Arab countries. eGovernance is evident in developing countries such as UAE, Bahrain, OMAN, and KSA amongst other Arab countries. These countries have an inconsistent record of development and mostly ineffective e-governance strategies.

Using examples such as Morocco, South Africa, Rwanda, and Kenya, eGovernance proves to have a potential to change the operations of the government in terms of bettering the lives of the citizens. Farmers in India often require government support in ways such as accessing the price per given quantity in kiosks and the market by visiting various government websites to avoid unnecessary overpricing or under-pricing [60, 61]. Farmers from the rural areas in India use the e-governance program to connect to the government business person in the urban areas without having to travel or use any tradition method of transaction. Government has much power over the stock markets and other markets in developing countries and citizens are in constant need of these services. While governments should make eServices available to the citizens, they may need to promote basic educations to millions of citizens to improve their level of literacy, which would enable them to utilize eServices exhaustively. The provision of eServices is not enough for developing countries. Some eServices fail due to many reasons of inadequate development and growth of a country. Rwanda introduced an initiative to promote distance learning for its population known as eLearning, which takes place online to enlighten the citizens of a country on how to connect to the government through the internet or national network to access services provided by the government. Thereafter, Rwanda established eRwanda initiative that is more developed and user friendly. eRwanda initiative is more of an eGovernment program rather than e-governance [61, 70]. Rwanda is developing at a tolerable rate in terms of basic education acquisition and eGovernance utilization.

Kenya is a third world country whose growth and development is relatively high. Markedly, e-governance comes hand in hand with the rate of development of a country. Countries that develop at a low rate are more likely than unlikely to have a poor growth of e-governance programs [45, 71]. eCitizen is one of the eGovernance tools that Kenya utilizes to serve its citizens effectively. The growth of e-governance and eGovernment programs in Kenya has been evident in the last decade. Before the introduction of e-governance programs, Kenyans used to queue and wait for a relatively long time to receive services from the government [72]. Due to long difficulty

in accessing programs, many people did not hesitate to engage in corruption to get their services done faster and conveniently, which has contributed to the country's third position in the list of most corrupt countries in Africa. With the introduction of eCitizen program, many Kenyans can access government services more effectively. In turn, the level of corruption in the country has reduced slightly. The development of eGovernance in Kenya is in progress and the country is likely to make enormous progress in the sector in the near future. Kenyans can today get their national identity cards instantly if not within a short period of time unlike before the implementation of the eCitizen program when citizens had to wait for months before they were served. Poor networks in developing nations has made it difficult for the developing nations to fully utilize e-governance. For instance, Kenya relies on one communication company known as Safaricom which operates in an oligopoly market. The company dominates other communication companies due to its strong and reliable networks and servers such as ns3.kenet.or.ke, ns1.kenet.or.ke, and ns2.kenet.or.ke. Through the help of Safaricom Company, citizens can get services from government agencies online including visas, passports, title deeds, driving licences, and do their car registrations. The developing countries are making worthwhile efforts in getting to the higher levels of eGovernance that are even more effective. Digitalization is influencing both the developed and developing world through eGovernance implementation and other technologies [72].

Unlike developed countries, developing nations view eGovernance as a service to enable people to live sustainable lives rather than make profits. Sustainable living is a challenge in developing countries. Such countries focus on streamlining processes, digitizing information, enhancing employee productivity, performing transactions, providing access to information and more importantly, fostering citizen participation [72]. One point of view holds that eGovernance programs may become a necessity for developing nations given the huge number of people that require services from the government. Markedly, there exist a few teams of programmers in developing countries that can undertake the development of new software codes aimed at customizing applications even though eGovernance remains a fundamental technological concept for the citizens. At the same time, large populations that happen to exist in developing nations may require the writing and testing of a large number of lines of codes before final documentation to assist in managing the requirements and desires of the population. Software developers who are familiar with the developing nations admit approximately 25% increase in the number of tasks performed by eGovernance software. The increase in demand for tasks or services calls for high-

level technology, which is adjustable or may require regular check-ups that most countries under discussion may not be able to afford.

Apart from political unrest, other major barriers of eGovernance in developing nations include culture and legal issues. From the cultural context, some people especially in the developing countries prefer meeting in-person to transact business rather than doing it online. The strong cultural norms deter online socialization and operation by the involved citizens hence minimizing the use of the internet irrespective of how developed they may become. Legal models of some developing countries are quite strict hence limiting the rights of citizens and activities carried out online. For example, the infringement liability, uniform computer information transaction, and the digital signature may hinder the illiterate and semi-illiterate populace. Additionally, e-governance helps in boosting democracy in developing countries. India is an epitome of countries that use e-governance to promote democracy amongst its citizens. Democratically, governance is merely about the access to information and freedom of expression [65]. Both lead to e-democracy that the citizens of India enjoy more often.

3.3 eGovernance Models

The applicability of eGovernance models in public institutions and governments varies from one country to another. Some countries use models to boost the responsiveness of their technologies. Models have their space in eGovernance development and modification [73]. The models provide potential ways of serving the public in an electronic environment. Each model highlights on a different subject and criterion of implementing technology to benefit the people in the best way possible. Considerable models for e-governance for this study include Theory of Reasoned Action (TRA), Diffusion of Innovation (DOI), Technology Acceptance Model (TAM), Technology Organization Environment (TOE), and Theory of Planned Behaviour (TPB).

3.3.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) proposes that behavioural intention is subject to two perceptions of new technology including perceived usefulness and perceived ease of use. The model was developed by [74]. The perceived usefulness refers to the extent to which an individual feel that a specific system will be beneficial to him or her and improve his or her performance [74]. For example, adoption of a technology by many people improves its acceptance

by the same people. Perceived usefulness predicts acceptance of a specific new technology. On the other hand, perceived ease of use is the extent to which an individual expects technological innovation to be efficient. Attitude towards using and behaviour intention use are major features of the model. The model enhances the relationship between innovation usage and actual usage behaviour of potential adopters.
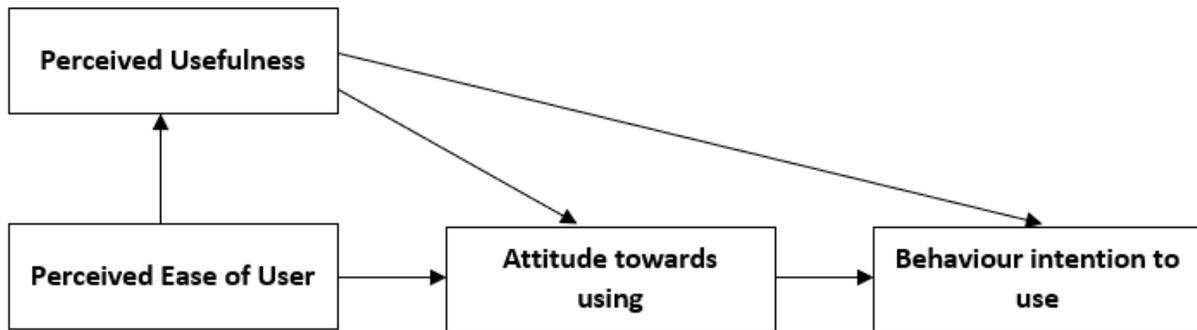
Figure 3-4 Technology Acceptance Model [75]

Figure 3-4 shows a diagrammatic presentation which illustrates how TAM enhances eGovernance from perceived usefulness to the perceived ease of use. The model illustrates the cycle in which TAM simplifies the implementation of eGovernance and how it influences the citizens in terms of expectation and benefit [76, 77]. As shown in the above diagram, behavioural intention is determined by perceived usefulness and attitude. 'Attitude towards using' is determined by perceived ease of use and perceived usefulness.

TAM specifies the general determinants of personal technology acceptance. Furthermore, the theory is applicable in explaining and predicting individual behaviours or response to technology across a broad range of users. Significantly, the main goal of TAM is to provide a potential explanation of individual behaviours towards new technologies across huge masses of end-users and other user populaces [78]. TAM is an old model that has proved to be workable after it was adopted by many countries and proved by numerous researches. Confirmedly, TAM is readily acceptable and suitable for modelling computer acceptance.

Davis introduced TAM as an adaptation of another theory, the Theory of Reason Action [78], which will be analysed later in the study. Following the development of the model, many researchers and management institutions have considered including it in the studies to enhance

management and improve governance if not eGovernance. TAM often features in major journals by reliable researchers. User acceptance is a crucial issue in eGovernance. The main parties who are expected to utilize eGovernance programs are the publics. Perceived ease of use together with perceived usefulness are fundamental theoretical constructs and key determinants of system use. eGovernance involves the use of systems, which necessitate the scrutiny of perceived usefulness
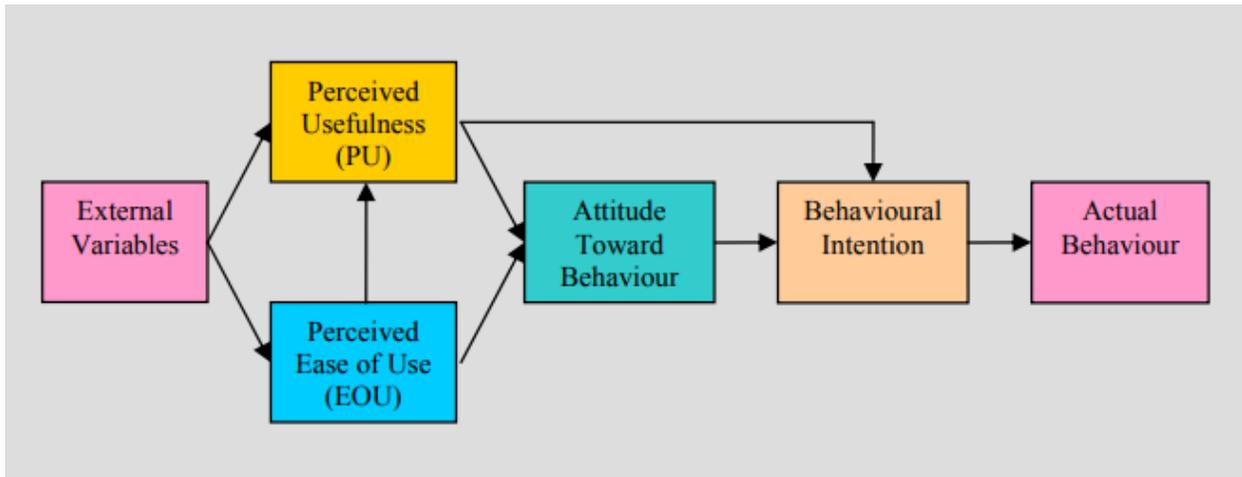
Figure 3-5 Comprehensive Technology Acceptance Model [80]

not leaving out the perceived ease of use. TAM also helps in measuring the prediction and explanation of system use that gives a potential practical value for governments and citizens who would consider exploring eGovernance in conjunction with information systems [78].

Figure 3-5 illustrates a comprehensive Technology Acceptance Model that originates from the external variables that expound on technology acceptance and the use of the system. Every single step in TAM development has a role that it plays in justifying if not enhancing the acceptance of technology. The easier the technology, the more useful and acceptable it is by the people or governments.

eGovernance ought to be reliable and user-friendly to the citizens, business entities, and other interest groups [79, 80]. The major assumption evident in TAM is that the utilization of a specific technology is voluntary. That is, the interest groups make their decisions whether to use a technology or not especially if there are options. In governance, the beneficiaries of the system simply choose to use it or not. Some may prefer the manual means of paper and face-to-face communications. Another assumption of the model is that individual predicted behaviours are closely related given the same level of knowledge and adequate time; it is referred to as behavioural

activity. Behavioural activity assumption is applicable partially, that is, when the behaviour is under an individual's volitional control.

Users of technology have different perspectives and minds. How people view and interpret technology, differs from one place to another and from one person to another. As mentioned earlier in the paper, some factors such as culture may make the expected users of eGovernance avoid using a technology merely because of cultural beliefs. Therefore, TAM attempts to explain the origin, cause, and effect of certain behaviours in relation to technology adoption. The acceptance of technology is the main concentration of TAM as the prime target [74, 81]. Personal intentions to use a certain technology may also vary. While some people utilize technology due to its availability, others use it to satisfy their needs more effectively. Others may also use it because it is a government provided service. By understanding human behaviour, technologists together with the government may be able to provide services that are all-inclusive. In some countries such as Saudi Arabia, most researchers use technology to analyse the major factors that influence eGovernment services as well as eGovernance programs.

3.3.2 Theory of Planned Behaviour

According to [82] that suggested the Theory of Planned Behaviour (TPB) to further the analysis of the Theory of Reasoned Action (TRA). The extension was due to the enormous weaknesses of TRA, which connects to voluntary behaviour. According to TPB, a person may lack some mandatory resources or control of executing the planned action. The theory helps in predicting planned or deliberate behaviours of individuals towards something, in this case, eGovernance programs. TPB focuses on intentions of people and uses intention to predict behaviour using three major elements including subjective norms, attitudes, and perceived behavioural control. Subjective norms refer to the regular behaviour of individuals especially within their society. Additionally, attitude towards behaviours helps in predicting the possibility of the occurrence of some behaviours. People have different attitudes towards specific behaviours. While some people would perceive one behaviour as good, others would possibly perceive the same behaviour as bad and intolerable [82], [83]. For example, some people dispute technology and blame it for the harms it has brought in the contemporary society rather than the benefits that it has earned for people. People respond differently to the impacts of eGovernance on the society today both in the developed and developing world. Perceived behavioural control is an individual's

36

intent or his or her capability of executing a behaviour. Significantly, it is important to note that perceived behavioural control has a worthwhile influence over individual's behaviour.

People develop their own intentions when they have control over their own behaviours. When people have enormous control over themselves, they tend to act immediately an opportunity shows up. The theory of planned behaviour highlights on the nature of human behaviours under certain circumstances. Identifiably, the impact of eGovernance influences people's behaviours differently [84]. Contrarily, people respond to the e-services differently when in the community. Examples of conditions that are researchable through TPB include whether to implement eGovernance, and whether to wear a seat belt. Some questions may not be easy to answer given their debatable nature hence the Theory of Planned Behaviour comes into place to help in analysing such issues before coming up with the right decision.

Markedly, TPB is characterized with three major types of beliefs, that is, behavioural beliefs, control beliefs, and normative beliefs. The behavioural beliefs major on the likely results or consequences of a behaviour and the examination of such results or consequences. The outcomes may be either positive or negative to the subject matter. In addition, normative beliefs refer to the predetermined behavioural expectations of a person's relations such as friends, family members, doctors, or fellow workers amongst others [84]. Normative beliefs propel pressure to an individual from the people who surround him or her. Notably, it also results in potential subjective norm. Ultimately, control beliefs refer to factors that may influence performance of a specific action and the extent to which they may influence performance.
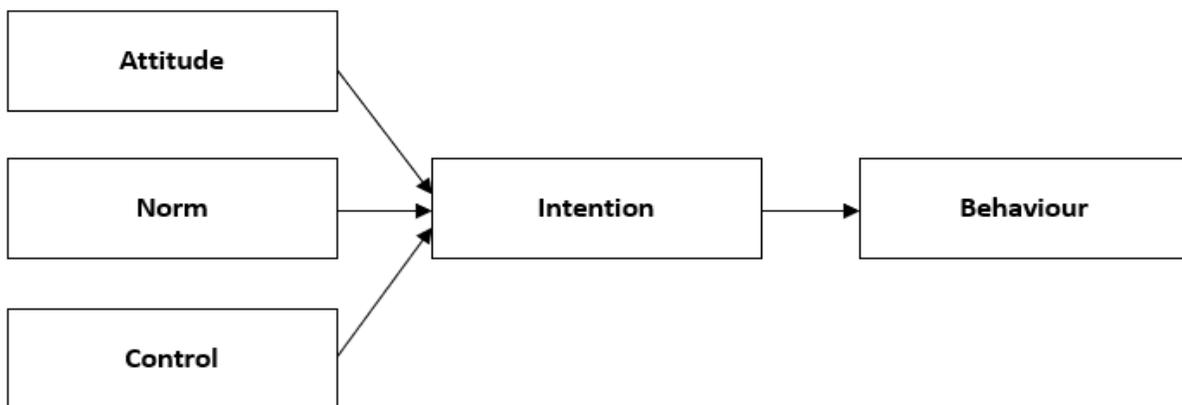
Figure 3-6 Theory of Planned Behaviour

37

The diagrammatic representation of the TPB (showing in Figure 3-6) illustrates the workability of the theory from how attitude, norm, and control translate to intention before ultimately influencing the happening of a certain behaviour. When a person changes his or her attitude, he or she will be more likely than unlikely to pursue a desired action. A flexible person that can consider compromising his norms or perceived behaviour control has increased chances of exhibiting different behaviours that are predictably positive.

Moreover, TPB also addresses the ease or difficulty of a behaviour occurring. For this reason, the model is highly applicable in the development of information systems as well as eGovernance implementation. The predictability of behaviour occurrence is vital for eGovernance as subordinate to technological advancement [84]. The behaviour of some people may not be quite easy to predict especially they behave peculiarly. TPB is an essential model that assists in analysing such difficult behaviours exhaustively for promoting development in various fields including computer science subject to eGovernance.

Perceived behavioural Control is made up of two main components; self-efficacy and facilitating conditions. The self-efficacy is a person's self-confidence to behave in a certain manner [84]. On the other hand, facilitating conditions means availing the mandatory resources to involve in a specific behaviour. The TPB influences behaviour control having possessed both knowledge and facilitating electronic government transactions. Self-efficacy, in this context, insinuates how a person may respond to the positive or negative effects of eGovernance with respect to his or her self-confidence in the technological programs. TPB assumes imitation of behaviour or peculiar behaviour. Moreover, the model assumes that a person will always be consistent in their behaviour, which may not always be true [85]. Some people prefer eGovernance programs at one time and disregard them at other times hence making it relatively challenging to predict their behaviour. One notable weakness of the models is that some behaviours are motivated by specific actions rather than an individual being able to control his or her behaviours.

3.3.3 Diffusion of Innovation

Diffusion of Innovation (DOI) model or Innovations Diffusions Theory (IDT) is a model of the 1950s that is used to expatiate user diffusion through a predetermined innovation adoption

process. Innovation process, in this context, involves possession of appropriate knowledge, developing an attitude towards the new technology or decision-making, receiving or repelling from the innovation, implementing and confirming the new decision. The mentioned occurrences explain how the diffusion of innovation model takes place in each field. Diffusion is the spread of innovation through specific channels of communication to reach the societal members. eGovernance is always meant to serve the wider community [38, 43]. However, before it is implemented, the communal members may need the knowledge on how to use the eServices before the message is spread throughout the community for the benefit of every person. Without the necessary knowledge, the eGovernance programs may not benefit the public as intended.

Furthermore, DOI examines the spread of ideas through people in a society. According to the theory under discussion, innovation of an idea is not restricted to remain within one place or for one culture. Technology must transfer from the founders to other people across the world [32]. However, the spread of technology may take place in two ways. Firstly, the spread of technology or innovation would take place when other people acquire the necessary education of a technology and further it to become either more advanced or more efficient in serving its intended need. Another way in which diffusion of innovation can take place is when one innovation from an individual or group is used to benefit the founder and even other people, the third parties. Technology is never meant to benefit specific persons but ought to be social and pass across borders [86]. For instance, eGovernance technologies do originate from specific places or persons before they spread to other parts of the world. When nations come together and share ideas, innovations, and technologies, eGovernance propels. Many times, developing countries borrow innovations, ideas, and technologies from developed nations. Nevertheless, some potential innovations have been able to rise from the developing nations. In turn, the developing world also shares such technologies with the developed countries to enable the world to share ideas as far as eGovernance is concerned.

Adoption of technologies may also take time, while a society may adapt to some technologies rapidly, some societies may lag in adapting to technologies. In most cases, people from the city centres adapt faster to technologies than rural area residents. According to [38, 43], a multi-step diffusion involves an opinion leader who acts as an intermediary and hugely influences the actions of individuals known as adopters. Another intermediary in the process of

diffusion of innovation is called a change agent. The key role of a change agent is to push for the opinion leader to either accept or reject an innovation. Rarely does the entire population adapt to a specific innovation. That is, it is nearly impossible for 100% of the population of a given geographical region to adapt to a predefined innovation or e-governance technologies. Adoption to innovations occurs in time sequence as well as adopter categories. Confirmedly, new ideas take time and acquire specific resources for complete exploration. Humans interact and change ideas that ease life. eGovernance ideas and innovations are meant to benefit the public and, the world. When an initial adopter of an innovation shares the idea with his or her fellows, DOI suggests that the innovation diffuses to many more people leading to an enormous distribution termed as binomial expansion [86]. According to [38, 43], asserts that distribution of innovation adoption takes a specific shape known as the bell curve as shown in diagram below.
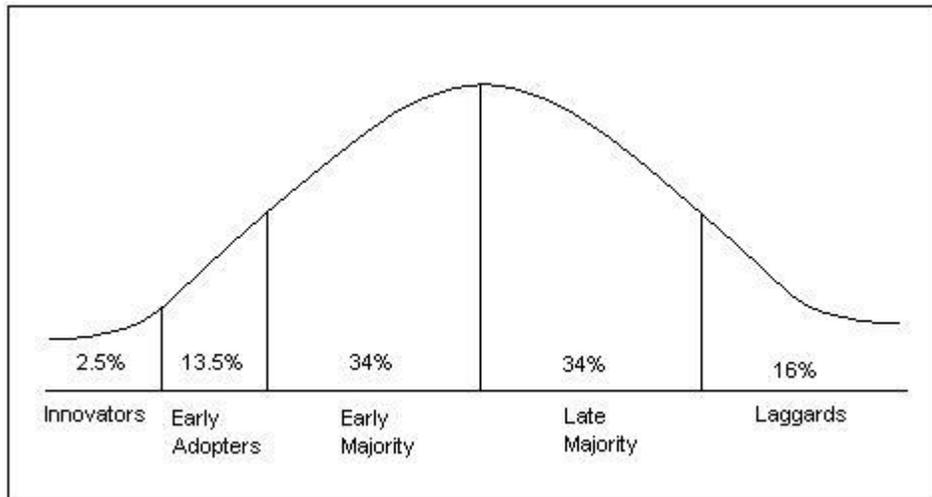
Figure 3-7 The bell-curve innovation adopter categorization [38, 43]

Figure 3-7 insinuates that innovators are generally fewer than the beneficiaries of their innovations. As innovations emerge in the community, people receive them differently and at different rates. Suppose 2.5% are innovations of a given populace, the early adopters of their innovation would be approximately 13.5%, the early majority as well as the late majority who adopt the innovation would be about 34% [38, 43]. Ultimately, about 16% of the population would delay or completely fail to give attention to the innovation. The section of population that is slow to adopt new technologies, according to the DCI model, are known as the laggards. Considerately, the laggards may have tangible reasons for their delay in adoption of innovation even though some people simply chose to ignore innovations. Adoption of technology, as seen in the above diagram, leads to formation of a normal curve. The DOI model refers to the shape of the curve as normal

and dependent on a normality approach. Some regions would perhaps have a different situation where a larger part of the population becomes the early adopters and a small population becomes the laggards. Such a scenario is only common in the developed world. The normal curve of adopter categorizations mainly applies in the developing world where many people take time before adapting to a technology and only get to know of it when they need it. DOI explores e-governance adoption in specific communities. Education plays a vital role in adoption of e-governance amongst the communal members [79, 80]. An educated population may adapt easily to innovations.

The DOI model has five key phases of innovation guiding the decision-making process; they include decision, persuasion, knowledge, confirmation, as well as implementation (not arranged accordingly). At the knowledge stage, innovators acquire the necessary education or knowhow concerning a technology [38, 43]. The persuasion stage is the learning and acceptance period when people are adopting to the technology. After persuasion, people or the societies make their decisions whether they prefer a technology or not. Acceptance of an innovation idea would lead to the implementation of the same. Suppose the new technology is implementable, it is confirmed to be a potential innovation. eGovernance undergoes all the mentioned processes. One critique of the DOI model is that it majors on the spread of knowledge and innovation rather than its formation and benefit to the beneficiaries. For instance, eGovernance technologies would only be transferred from one individual or community to another after discovery or development.

3.3.4 Theory of Reasoned Action

The main aim of the Theory of Reasoned Action (TRA) is to enhance information integration subject to human actions, behaviours, and attitudes. Importantly, the theory works as a predictive tool for human behaviour with respect to the pre-existing attitude. Specifically, the theory asserts that individuals are bound to behave in a certain way bearing the outcomes of their behaviour or action in their mind. Every action has a consequence [87, 88]. The outcome of an action may propel a person to either execute the action or avoid it. The theory is oriented towards understanding voluntary behaviour of individuals. The model attempts to analyse what motivated people's behaviour. When people act in a manner, they ought to have a potential reason why they act so.

According to the theory which is depicted in Figure 3-8, a person's intent to execute a specific action is the main predictor of whether he or she may perform the act or not. The first thing that comes before performing an action is the intention to do. Lack of intention to perform a task thwarts such an act from happening [87, 88]. Intention is the main cause of an action according to the developers of the theory under discussion. Many times, people value the real action more than the intent to commit that action. Contrarily, the TRA is based on the intent to commit or omit an action or behaviour instead of the behaviour happening. In this case, an intention is perhaps a plan or an urge to perform a task. However, the performance of the mentioned task comes along with an expected outcome that may influence the environment in any way.
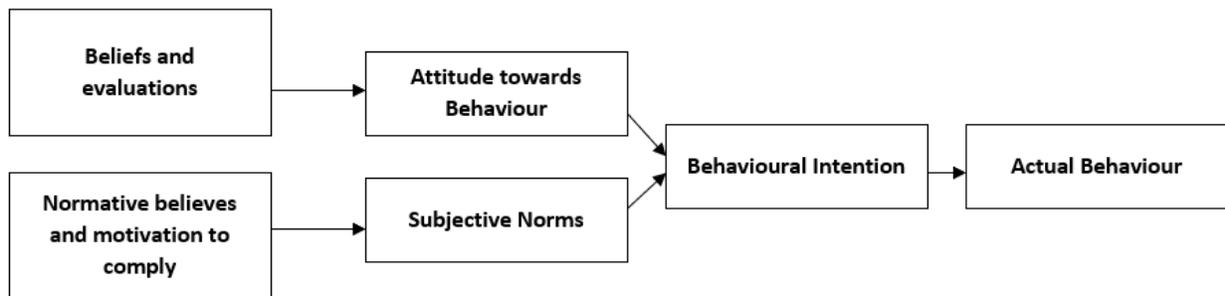
Figure 3-8 Theory of Reasoned Action Diagrammatic Representation [57]

The people's intentions originate from their beliefs. In addition, it is important to note that the Theory of Reasoned Action relates enormously to the TPB [85], [89]. A thin line stands between the two theories. Behavioural intention is a fundamental subject in TRA. Behaviours shape subjective norms and determine attitudes of the people. Importantly, normative beliefs shape intentions of people. For example, a community that believes in growth, development and technology may find it easier to adopt eGovernance amongst other digital technologies. Similarly, a society that does not prioritize technology may disregard eGovernance and the outcomes related to it. TRA holds that strong intentions push for an occurrence of a behaviour and improve the likelihood of performing a behaviour [87, 88]. In using TRA to analyse eGovernance, strong and effective governments may experience technological development even as years come and go. Critiques on the model suggest that it devalues science and majors on beliefs. Stereotypically, science and beliefs hardly converge to make sense.

3.3.5 Technology Organization Environment (TOE)

Technology Organization Environment (TOE) theory interconnects technological innovations to organizational and environmental elements. The theory scrutinizes innovation from a technological context, environmental context, and organizational context. Tornatzky and Fleisher were the developers of the TOE theory in 1990 . Notably, TOE theory is quite brief in its nature even though relatively specific. More specifically, technological context refers to both external and internal innovations that are essential to an entity, or a firm. In relation to eGovernance, technological context may mean internal and external technologies that are fundamental to the society [90, 91], [43]. TOE model would be important in identifying the technological needs of the communal members and coming up with appropriate technology that is helpful to the people.

On the other hand, organizational context can be defined as resources and various features of the firm [90, 91]. Environmental context involves macroeconomic elements of the firm, regional regulations, and industrial structure. In terms of eGovernance, TOE would analyse various external factors that affect the society in terms of technology shortages and eGovernance problems. Additionally, it is possible for people from different regions to compete over eGovernance technologies. Rivalry amongst nations is real especially in the contemporary world. For this reason, even sharing of eGovernance technologies may be characterized with competition. Therefore, considering key environmental and organizational factors is vital while implementing eGovernance innovation across the community.
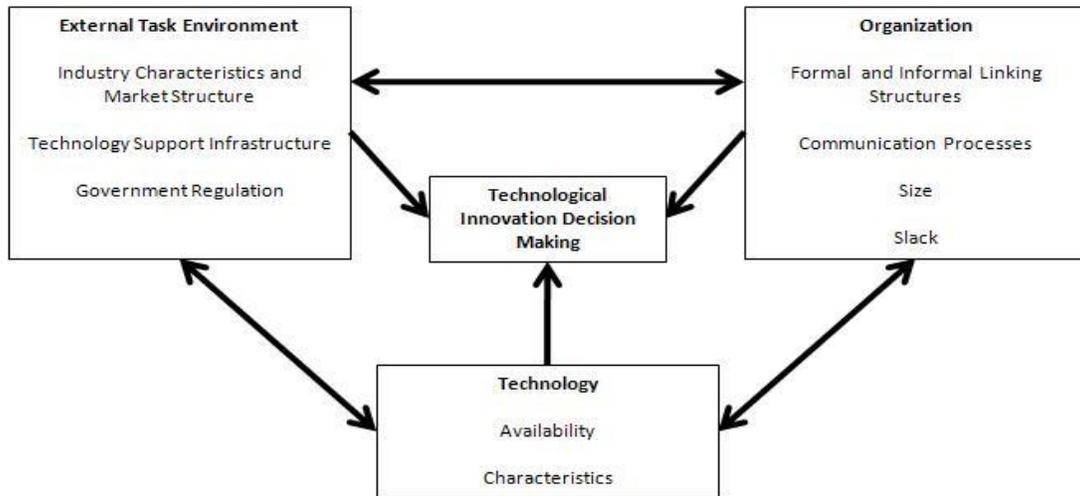
Figure 3-9 Technology Organization Environment Framework [45]

Figure 3-9 illustrates how TOE works pertaining to the adoption of technology. Moreover, it gives a summary of TOE involving the environmental context, expounds on technological innovation, and various organizational factors. The interconnection between the three subjects in promoting technology adoption is evident. Observationally, technological innovation creates opportunities and has potential constraints. In turn, the three elements influence the way a community desires for, adopts, and embraces modern technology. A notable critique of the theory under discussion is that it is limited to only three elements [81, 90, 91]. eGovernance or technology adoption may involve other issues such as human behaviours, which TOE hardly addresses.

Table 3-1 A summary of the five models

No.	Name	Author(s)	Main Independent Constructs/Factors	Beliefs	Use	Originating Area	Remarks
1	Technology Acceptance Model (TAM)	Fred Davis 1989	1. Perceived usefulness 2. Perceived ease of use	NA	1. Promote general acceptance of new technologies 2. Assess technology acceptance across people of different kinds	Sociology	Over emphasizes on acceptance of technology than other aspects of e-governance
2	Theory of Planned Behavior (TPB)	Ajzen 1985	1. Attitude towards a specific behaviour: personal attitude based on past experiences 2. Subjective Norm-social pressure imposed on a person to behave in a certain way.	1. Behavioural beliefs. 2. Normative beliefs 3. Control beliefs	1. Used in examining behaviour 2. Used in prediction of behaviour in from academic perspective	Social psychology	Significant for understanding people of different personalities
3	Diffusion of Innovation (DOI)	Everett Rodgers 1962	Perceived features of innovations 1. Triability 2. Relative advantage 3. Observability 4. Compatibility 5. Complexity	NA	1. Description of innovation-decision process 2. Enhancement of innovation distribution 3. Promote technology adoption and implementation.	Diffusion/Communication/Management/Anthropology/Sociology	Applicable in e-governance development
4	Theory of Reasoned Action (TRA)	Icek Ajzen and Martin Fishbein 1967	1-Attitude towards a specific behaviour. 2-Subjective Norm	1. Normative beliefs and analysis of final behaviour. 2. Motivation	1. Used in many academic fields for behaviour evaluation 2. Used in analysing IT innovation usage.	Social psychology	Significant for understanding people of different personalities
5	Technology Organization Environment (TOE)	Tornatzky and Fleisher 1990	1. Organizational context 2. Environmental context 3. Technological context	NA	1. Mainly used by organizations to access their external technology environment 2. Used in adapting technology to organizational activities	NA	Quite applicable in organization than in e-governance institutions

3.4 Overview of the Partial Least Square

Quantitative Structure Activity/Property Relationships (QASR/QSPR) are considered the most successful research methods. In recent years, the application of such methods has expanded to accommodate various disciplines: toxicology, pharmacokinetics, chemometrics, and pharmacodynamics. There has also been expansion on the mathematical regressions used in analysing various components of QASR/QSPR. Therefore, it is not only the previous methods like the Partial Least Squares (PSL) that are upgraded through improvement of the kernel algorithms or are combined with various approaches, but also involves inclusion of the other methods like Project Pursuit Regression (PPR), Gene Expression Programming (GEP), and the Local Lazy Regression (LLR) which recent studies have been consequently mentioning while analysing QSAR/QSPR [92]. The paper also investigates the merits and demerits of the model and presents the potential future studies of the model.

3.4.1 The Partial Least Squares

PLS is considered a practical and common approach applied broadly in numerous disciplines. The most common and applicable models of PLS are CoMFA and CoMSIA, especially while offering various eGovernment products and services. Nonetheless, with continued development PLS models have witnessed a high level of evolution, and with the combination of various mathematical methods, it has become effective especially in performing various analyses. The evolution has also contributed significantly in the birth of other models considered important to PLS: Genetic PLS, Orthogonal Signal Correction PLS, and Factor Analysis PLS. On the G/PLS, it has been derived from the calculation methods used in PLS and Genetic Function Approximation (GFA). The algorithm used in the derivation of G/PLS uses GFA in the selection of the function deemed as appropriate to model the data. In addition, PLS regression is considered a fitting method used to weigh the basic functions which are viewed as important to the development of the final model. Based on the analysis, G/PLS plays a significant role in constructing the larger equations which are appropriate to QSAR while at the same time preventing various cases of overfitting and elimination of most variables in the equation. Most of the studies use G/PLS as the regression method, especially in the Molecular Field Analysis (MFA) that most studies refer to as the 3D-QSAR analytical tool [92].

Factor Analysis Partial Least Squares (FA-PLS) is another popular model derived from PLS. The FA-PLS model offers unique features due to its ability to combine both the Factor Analysis and PLS. In such a combination, the Factor Analysis is considered to play a significant role in the early stages of selecting the descriptors before carrying out the required PLS. In addition, FA plays a critical role as it gives a good grounding as a tool used in finding out the existing relationship between various variables. FA also reduces the variables into the required number of latent factors from the critical variables selected to ensure the effectiveness of the PLS regression. To ensure optimum selection of the components to be used in the PLS, most studies employ the leave-out-time-out approach. Another model derived from PLS is the Orthogonal Signal Correction Partial Least Squares (OSC-PLS) which is believed to have been introduced by [92] to facilitate the removal of systematic variation from the response matrix X that has no relation or perpendicular to the property matrix Y. Thus, it is notable that one can remain convinced and confident with the retention of vital data on the analysis. Since then, there have been numerous publications on the OSC algorithm with an aim of reducing the complexity of the model. This has been achieved through removal of the perpendicular factors from the signal. In most cases, the researchers employ the abstractor method which mainly helps to process the model using the OSC which is considered important as it helps the traditional PLS in acquiring better models. This makes it effective and precise in developing spectral analysis. Until recently, it is quite unfortunate that that are few reports and studies carried out on OSC-PLS applicable in eGovernment models and QSAR/QSPR studies. Nonetheless, there is a greater expectation in the future on the studies of application of OSC-PLS IN BOTH QSAR and QSPR research [92].

3.4.2 PLS Uses and Studies

PLS analysis offers researchers more advantages compared to the traditional regression methods especially in determining the existing association among the constituents of configuration. With continued development in technology, researchers use PLS to find the existing relationship between two different matrices (X and Y) which often represents the latent variable approach used to model covariance structures that exist between the two spaces [93]. In addition, PLS is effective in finding the multidimensional direction within the X space which is then used in explaining the maximum multidimensional variance direction within the Y space. For the study, various observations were made using different parameters used as a data set. The study revealed three important issues: firstly, there were no doubts on the effectiveness and efficiency of the model; secondly, the linear parameters were largely compared to the

standard errors estimates and research could not arbitrarily take the parameters to be zero; and finally, the least square method applied served its analytical purpose well. Initially, the original application of the PLS models was in the social sciences. However, with continued development and expansion of the model to accommodate the diversifying nature of research, PLS regression today is applicable widely in the chemometric disciplines, neuroscience, anthropology, bioinformatics, and sensometrics. Being a statistical method bearing some relationships to the principal components of regression, PLS is unique as it focuses on finding the linear regression models through projection of the predicated variables and observable variables to the new space instead of focusing on finding the hyperplanes between the independent and response variables [94], [95].

The first stage of PLS-SEM was to draw the path diagram. A generic path diagram to illustrate the direct relationships between three independent (exogenous) variables and one dependent (endogenous) variable is illustrated in Figure (3-10). The oval symbols represent the latent variables, and the rectangular symbols represent the indicator variables. The unidirectional arrows between the symbols represent hypothesized relationships. Each arrow travels from a hypothetical cause to a hypothetical effect. The arrows between the latent variables and the indicators represent the factor loading coefficients (λ). The arrows between pairs of latent variables represent the path coefficients (β).
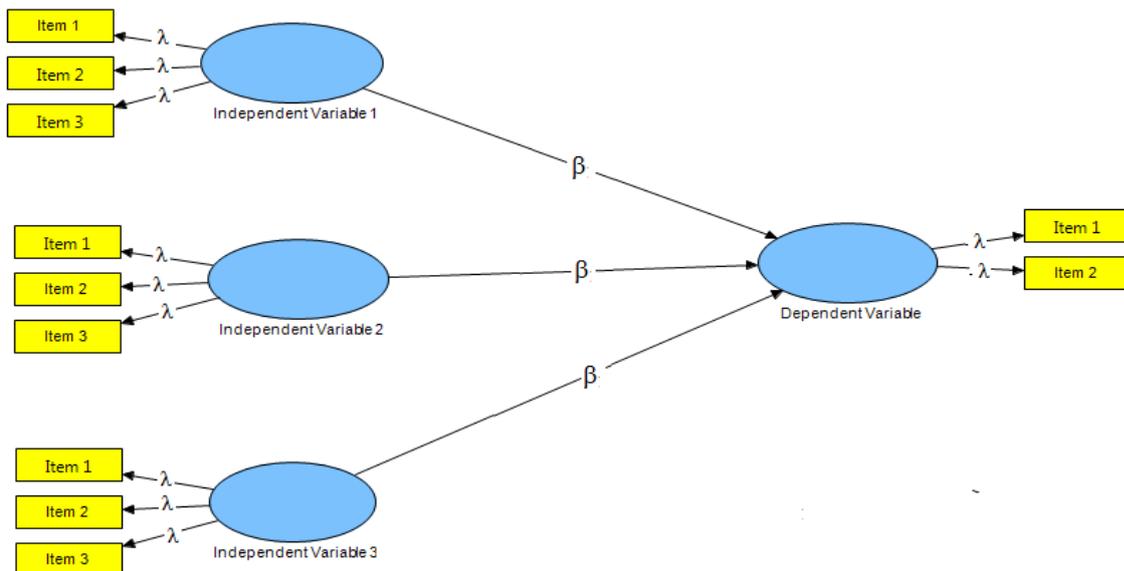
Figure 3-10 Generic PLS-SEM path diagram

Indirect or mediating effects can be examined by entering a mediating variable (the cause of the correlation between two other variables) at the centre of a triangle of arrows between an exogenous and an endogenous variable; however, mediation was not examined in this study.

The second stage of PLS-SEM was to evaluate the quality of the measurement model. The general criteria used for evaluating the measurement model were (a) the loading coefficients for the items that constituted each latent variable should be strong (≥ 0.5) to indicate the validity of the constructs; (b) the average variance explained (AVE) by each latent variable should ideally be at least 50% to indicate convergent validity (i.e., the constituent indicators shared a high proportion of their variance in common) and (c) the composite reliability of the multiple indicators that constitute each latent variable should be ≥ 0.7 to indicate the internal consistency of the items [95]. The discriminant validity of the model was also tested, meaning that each latent variable should represent a separate construct. The inclusion of correlated latent variables based on similar measurement scales results in a lack of discriminant validity. Discriminant validity was acceptable if the factor loading coefficients for the items that constituted each latent variable were greater than their cross-loadings, and if the square roots of AVE (expressed as decimals) were larger than the path coefficients between the latent variables [96].

Having evaluated the quality of the measurement model, the next stage was to compute and interpret the structural model, in terms of the path coefficients (β) and the R2 values between the latent variables. Because the data were standardized before the analysis (using z scores with a mean of 0 and a variance of 1), the β coefficients (equivalent to the partial regression coefficients in a multiple linear regression model) ranged in value from -1 to $+1$. The β coefficients indicated the relative strengths and directions (positive or negative) of the correlations between each pair of latent variables (after the correlations with other latent variables had been removed). The R2 valued measured the proportion of the variance in a latent variable explained by the variance in the latent variable(s) leading into it. An R2 of at least 25% was considered to represent a substantial effect size [95, 96]. The final stage was to estimate the statistical significance of each β coefficient. This process involved drawing 5,000 random samples repeatedly from the data with 200 cases in each sample. The means and the standard errors of each β coefficient were computed. Two-tailed T-Test statistics were used to determine if the mean value of each β coefficient was significantly different from zero at the conventional $\alpha = .05$ level of statistically significance.

3.5 Analysis Techniques

The statistical analysis or techniques employed in both quantitative and qualitative analysis techniques are different.

3.5.1 Quantitative Data Analysis

The author in [97] asserts that quantitative research focuses on logic, numbers, and objective stances so that its interest is in convergent reasoning instead of divergent. Its other characteristics include use of a structured data collection method, basing results on large sample sizes, replicability of the study, clear definition of the research question, reliance on a pre-study study, and ability to predict future and investigate causation between concepts. These characteristics determine the statistical technique used to analyse quantitative data. For example, numeric or scale attributes for a sample size of less than 30 can be analysed using student t-test, but if the sample size is as large as 100 then the z-test is the most suitable. The other consideration is on the type or level of measurement of the dependent and independent variable. For example, in cases where the dependent variable is categorical with two levels while the predictors are numerical, techniques such as logit, probit, or tobit regression, chi-square tests, and contingency tables can be used to analyse the data. However, in cases where both the predictand and predictors are numeric (scale or ratio) then the regression (simple or multiple), analysis of variance, and other statistical tests such as student t-test, Fisher's F-test, and z-test can be used to disprove the study hypothesis [97] [98].

3.5.2 Qualitative Data Analysis

The approaches used in qualitative data analysis are dependent on whether the design used in the study is naturalistic, emergent, or purposeful. Some of the rudimentary forms of qualitative analysis include identification and isolation of themes and capturing of direct quotations from the interviews. The analysis can consider a unique case or use inductive techniques to unveil patterns, interrelationships, and themes based on analytical principles and not rules. Despite the method, most contemporary text-based analysis can identify polarity or position on the opinion investigated. Such analysis techniques include sentimental analysis and association mining. The techniques used in qualitative analysis are diverse, complex, and nuanced with thematic analysis as the tenets of the methods. Consequently, it is important to thematize meanings in qualitative data and draw conclusions based on shared ideas emerging from the respondents. Whether conversational or interpretative, or not, the application of qualitative analysis has limited variation of method used within its major model.

Qualitative data analysis tools such NVIVO have sentimental analysis capabilities. NVIVO has been used in different social network analysis [99]. The sentimental analysis tool available in NVIVO identifies negative and positive and neutral sentiments based on the corpora created from the interview responses. The software further divides the sentiments into very positive, moderately positive, moderately negative, and very negative. Some of the queries available for sentimental analysis include word frequency, cases coded as either positive or negative, and charting tools including word cloud and hierarchical chart with interview item as the node, and negative sentiments as the first branch node, and very positive, moderately positive, moderately negative, and very negative as the final node. The nodes are auto-coded although the coding can be done manually to control the thematic meaning deduced from the data. The auto-coding function can also segment hidden attributes into positive, negative, neutral, and mixed. The attitudes and sentiments can be discretized to verify the results obtained from the quantitative analysis. The used NVivo 12 (Version 12.0.0.71) Plus Edition.

In this study, the case classification and the nodes are based on gender, level of education, and organization. The qualitative data were collected from six respondents though from two different sectors. The respondents provided information on 20 different constructs and the constructs and related theory are demonstrated in Table 4-1. The subsequent data exploration will also include cluster analysis of the sentiments and attitude nodes identified in the data using cluster analysis.

3.6 Collaborative Filtering

Collaborative filtering (CF) is an approach mainly used in building personalized recommendations on the website platforms. CF is also considered as among the most fruitful methods used to build the recommender systems and commonly applies known preferences of the group users in predicting and recommending the unknown preferences for the other users. In every aspect of life, people depend on recommendations from other people in various forms spoken words, travel guides, letters, as well as news reports. With continued development of the systems, there has been the emergence of recommender systems which have been assisting and augmenting the natural social processes to help individuals sift various sources of information [100]. Earlier researchers coined the term CF from the initial user-customization and rule-based recommenders and have seen wide adoption despite possible absence of collaboration by the recommenders with the recipients with recommendations suggesting important items. The main assumption of CF that needs to be noted is that if users' *X and Y* at rate *n* are the same or exhibit analogous traits, then the system would act or rate the other stuff

51

in a comparable manner. The CF approaches use a database of the preferences for the items by users in predicting the supplementary themes.

With the development of technologies, there has been an increased amount of information available across the globe which makes it difficult for the customers to locate their most suitable products. To provide the required information, recommender systems have been developed which apply the knowledge in the decision-making process for the users and have grown to be a significant part in businesses. Most of the recommendation systems have been developed for application within the industrial and education sectors with an aim of creating a list of suggestions and ensuring adequate provision of information considered important to help the customers choose their products. For instance, the Grundy system was the first recommendation system which described the models of users using stereotypes with results showing the effectiveness of the user modes to guide its performance. CF is another example that suggests products and services to the customers on the eCommerce systems. It is critical to note that the system advices the user depending on the favourites of the same user and can analyse the relationship between the user and products and services to identify the appropriate association. In this case, K-means and CF methods have been adopted to reduce the sparsity problems. CF has proved to be the most successful technique in the recommender systems. The commonly used algorithms for CF are the memory-based CF and model-based CF [100].

3.7 Research Methods and Paradigms

Research design or methodology can either be qualitative or quantitative, but it is also possible to amalgamate the two approaches for superiority and improved performance of the inferences made as well as the generalizability. The popularity of mixed research methods can be attributed to the development and perceived legitimacy of both quantitative and qualitative research methods because researchers continue to trust results from both research approaches [101]. The continual evolution of the mixed research design sustains the popularity and many researchers embrace the approach because it leverages the strengths of both qualitative and quantitative approaches [102]. Additionally, the problems addressed in both social and health sciences are complex and using either qualitative or quantitative research designs does not suffice to find comprehensive solutions. As such, combining the two methodological paradigms provide insight that neither quantitative nor qualitative methods can achieve when deployed individually. The mixed methods, therefore, provides an expanded and in-depth understanding of the underlying research problem. It is imperative to understand the philosophical assumptions underlying the pragmatic approach obtained through use of hybrid techniques derived from both qualitative and quantitative approaches.

The basic characteristic of qualitative research is its objective to create an understanding from the data as the different analytical tools are implemented. That is, qualitative research design does not endeavour to disprove a pre-stated hypothesis; an approach which dictates specification, conceptualization and operationalization of variables. Hence, it suffices to conclude that qualitative research tends not to be pre-emptive and the variables are deduced from the research question depending on the defined scope, selected thematic areas as well as selected goals that can be inferred from the data. According to [103] discussed qualitative research and provided in-depth insight on the issue under investigation and confirmed that it suits social or health related studies that require free expression of opinion or simulation of experiences or studies that do not require pre-judgements on the underlying issue. Furthermore, with the qualitative design and because of the nature of the data collected, it is also difficult to make systematic comparisons and inferences, and the overall interpretation and generalizability are dependent on the skills and experience of the researcher.

The studies of [104] and [105] argued qualitative research from a different perspective although the sentiments echoed on the merits and demerits of the approach are more or less similar. In their description of qualitative designs, the authors acknowledged and credited the

technique's ability to capture feelings, opinions and experiences of the participants. Furthermore, the authors reiterate the claim that the interpretive nature of the technique renders it suitable for holistic understanding of specific experiences. However, these attributes are contrary to those associated with quantitative research, which as per Bryman's definition is "a research strategy that emphasises quantification in the collection and analysis of data" . The general notion associated with quantitative research is the attempt to answer questions starting with how many, how much, to what extent among other variants. The approach also has its advantages and disadvantages [104].

The authors in [102, 105, 106] discussed the advantages of quantitative research design and concluded that the quantitative results or findings from such studies can be generalised to a population because it mandates researchers to use large but randomly selected samples. Furthermore, the techniques used to analyse the quantitative data are less time consuming because such data are compatible with an array of statistical software including R, SPSS, and SAS among other advanced statistical and analytics tools. More importantly, quantitative research is founded on a positivist paradigm and as such emphasizes the importance of variables and their levels of measurement. The paradigm provides the background for the pre-emptive nature of quantitative research because the variables and levels of measurement are created from pre-determined research questions.

According to [106, 107] pointed out that the positivism paradigm used in quantitative research completely leaves out social phenomena and other related aspects that may have adverse influence on the discussion. The approach also fails to account for deeper underlying meanings and explanations associated with or influencing the addressed research problem. More importantly, the approach cannot account for the processes that shape social reality just as it cannot explain how social relationships are maintained [105, 106]. Therefore, quantitative research does not investigate the phenomenon from a historical perspective but rather focuses on snapshot-based measurements obtained for a specific moment.

It is apparent that both qualitative and quantitative approaches have their weaknesses and strengths although the weaknesses are undermining the results obtained from the studies that use either qualitative or quantitative methods. Hence, a mixed method was used to study and validate a technology acceptance model (TAM) in health and education. The quantitative method relied on an online survey to collect data from the education sector about using online or smart services. As for qualitative data collection approach, a semi-structured interview

consisting of open-ended TAM related questions was used in the study. The information from the study was then used to build a TAM-based model for the health and education sectors.

3.7.1 Qualitative and Quantitative Methods

The mixed-methods approach used in this study although the justification for the approach was based on the differences between qualitative and quantitative paradigms. The subsection therefore addresses these differences and provides a concise model for each paradigm as a build up to the mixed-methods paradigm used in the study. On the other hand, both qualitative and quantitative methods have their weaknesses and strengths and the literature has demonstrated that neither of these methods produce ideal results when used singly. The tabulated differences between qualitative and quantitative research methods based on common foundation are shown in Table 3-2 below.

Table 3-2 Differences between Qualitative and Quantitative Research Methods

Comparison Basis	Qualitative Research	Quantitative Research
Purpose/ Meaning	To develop understanding on different human and social aspects.	To generate data (numeric) for statistical, logical and mathematical analysis
Nature / Paradigm	Holistic / Interpretivism	Particularism /Positivistic
Type of Research	Exploratory	Conclusive
Research Approach	Subjective	Objective
Research Reasoning	Inductive	Deductive
Sampling Technique	Purposive	Random
Nature of Data	Verbal /Narrative	Measurable with levels
Approach of Inquiry	Process-oriented	Result-Oriented
Research Hypothesis	Generated from collected data	Tested using collected data
Analytical Elements	Words / texts, pictures and relevant objects	Numerical Data
Goals/ Objectives	To explore and discover conjectures within processes and relationships	To examine cause and effect associations between pre-defined variables.
Data collection methods	Non-structured methods such as focus group discussions	Structured data collection instruments such as closed-ended questionnaires
Actions based on the results	Proving conjectures and developing theories as part of initial understanding	Provision of actionable recommendation based on the established cause and effect

The differences highlighted in Table 3-2 can be grouped into objective/purpose, methodology (data collection and analysis including theoretical considerations), and results and interpretation categories. Nonetheless, the exploration of the differences highlighted in the

table do not conform to such categorisation because different research prospects have discussed different aspects in different contexts. Allwood [108] discussed the distinction between the two approaches and asserted that the intended meaning or purpose of qualitative research is to develop an understanding based on observable human and social interactions based on emotional and experience dimensions. On the contrary, quantitative research targets the generation of numerical data using statistics, logics and mathematics [108]. In [109] attributes the different ontological and epistemological perspectives drawn from different health applications. In specific, the differences in paradigm and the subsequent differences in type and approach are based on logic and not differences in method. That is, due to its holistic approach, qualitative research uses an explorative type of approach and it does so to subjectively explore the different aspects and process of the human development from a broader perspective [110]. As [111] elaborate, the dilemma that comes with the interpretivism and positivistic paradigms in which, qualitative and quantitative methods are based on the subjectivity and objectivity applied to broader and narrower research areas respectively. The subjective nature of qualitative research is attributed to the fact that the method relies on inductive reasoning to infer the original idea based on the observed participants or population [111, 112].

According to [113] on his discourse on social research methods noted that qualitative research is process-oriented and is meant to generate rather than test a hypothesis and the contextual validity of such an approach is based on the nature of the data collected and the intended analysis objective. The approaches of collecting qualitative data are non-structured and the settings create environments where participants can open up about issues affecting their lives. As [114] explains, quantitative research methods are based on structured instruments with specific measures and variables defined depending on the problem under investigation. Further, quantitative techniques are objective, result-oriented, and use numerical data to establish causal relationships based on statistical tests. The most outstanding differences between these two research methods is the applicability and generalizability of their results. For instance, generalization in qualitative research is limited by the sample size, especially given that collected verbal data can be strenuous and time consuming to analyse and interpret. Consequently, qualitative research tends to focus on a smaller sample size although it addresses the issue from a broader perspective [114]. Conversely, quantitative research uses a randomly selected sample size that represents the target population and as such generalization is easier because of the other determinate aspects of the statistical analysis techniques used.

In [115] on revisiting the qualitative-quantitative debate with the perspective of mixed research methods, explained the paradigms used in each method including their weaknesses and reasons for pursuing mixed-methods research. The authors argue that each of the methods is based on specific assumptions about reality (ontology), knowledge about the said reality (epistemology), and specific ways of learning the reality (methodology). Concisely stated, quantitative paradigm relies on positivism and as [116] postulates, the application of the paradigm is not confined to social linguistics with its application in quantitative research being one of the most recognized applications. The quantitative paradigm argues that since science is based on empirical research, all problems can be reduced to empirical variables resenting the truth about the issue, and the ontological position of the quantitative research is that only one truth exists; "an objective reality that exists independent of human perception" [115]. From an epistemology perspective, the researcher and the participants or object of investigation are independent entities and as such the researcher can study the phenomenon without having an influence on the entity or the entity influencing the researcher. Hence, the investigation and data collection process occur in a one-way setting with the goal being to measure and to analyse causal relationships between empirical indicators in a value-free model. Notably, the quantitative paradigm mandates randomization, use of structured instruments and use of both written and oral questionnaires with fixed pre-determined responses.

Conversely, the qualitative paradigm is interpretivism and constructivism oriented. From an ontological perspective, the qualitative paradigm supports the idea of multiple truths or realities for a single construction of reality, and social norms construct the said reality and as such is undergoing gradual changes. From an epistemological perspective, the qualitative paradigm does not have access to a reality that is independent of the mind of the participants, and the paradigm lacks an external reference for benchmarking and comparing truth claims [117]. Both the researcher and the participants or objects of the research interact so that the results of the study are created in a mutual process but in the context of the problem. Based on the tenets of the qualitative paradigm, it suffices to conclude that reality does not exist before the commencement of the investigation and it ceases to exist once the focus on it stops [115]. Of importance, however, is the fact that the qualitative paradigm focuses on processes and meanings and it does so through small but purposeful sampling with greater emphasis on respondent articulation on the underlying issue. The assumptions and principles of quantitative and qualitative paradigms account for the differences between the two methods; the differences extend beyond both methodological and philosophical discourses. For instance, the debate on

the differences has led to language and semantic differences such as referring to control experiment in 'observational work' in the quantitative paradigm but 'ethnographic study' in the qualitative paradigm.

Having explored the assumptions of qualitative and quantitative paradigms, it suffices to explore and explain the reason for using a mixed-methods approach in the research. Several researchers have listed innumerable reasons for combining the two approaches in one study, although the reasons are dependent on diverse viewpoints. Firstly, both paradigms are combined because they share the objective of understanding the society and the world at large. According to [118] and [119] who made the claim that both paradigms share a unified logic and that, despite the differences, the same inferential rules are applicable to both.

Secondly, the compatibility of the two approaches can be ascribed to the fact that they share the principles of "theory-leadenness", in determination of theory using facts, and fallibility of knowledge" [115]. Additionally, the two paradigms share an inherent commitment and dedication of understanding and subsequently improving life regardless of economic and political differences. The paradigms also share an objective of knowledge dissemination and capacity support for practical implementation of some of the recommendations and observations. Both paradigms serve as part of a research continuum with the modification that research objectives and goals differ depending on the circumstance and problem under investigation.

Thirdly, combining the different techniques can benefit some fields, especially in circumstances when the problem or phenomenon under consideration requires complex data collected from innumerable perspectives [120]. The public health sector has been known to have research projects that are complex and require different perspectives, especially those aligned towards social intervention for reducing re-admission rates and creating awareness for a given malady. For instance, in a case where doctors have established the cause of re-admission for a given condition, both qualitative and quantitative research may be used to reduce communal risk factors while improving health outcomes and patient efficacy.

It is pertinent to note that these arguments do not resolve the differences between the two paradigms. However, the prospects of using both requires due diligence and process modification to ensure that the results from the two paradigms are complementary instead of contradictory [121]. Even though the two approaches are incommensurate, they can be used in

a single study but independently [122]. Each of the methods addresses a different problem and as such it becomes a fundamentally distinct phenomenon addressed in the mixed-methods approach [107]. For each paradigm, the phenomenon must be labelled for identification and interpretation purposes. The best approach of implementing the mixed-method approach is sequential explorative design which surpasses the need to bolster weaknesses in each of the paradigms. Most researchers have concluded that both paradigms can be used in a single study; either simultaneously or sequentially. However, the order of implementation is dependent on the objective of the model created using the mixed-methods approach. It is imperative to note the objectives of the two paradigms are different, but they can be streamlined to solve a specific problem. The general configuration of mixed-methods model can be as illustrated in Figure 3-11
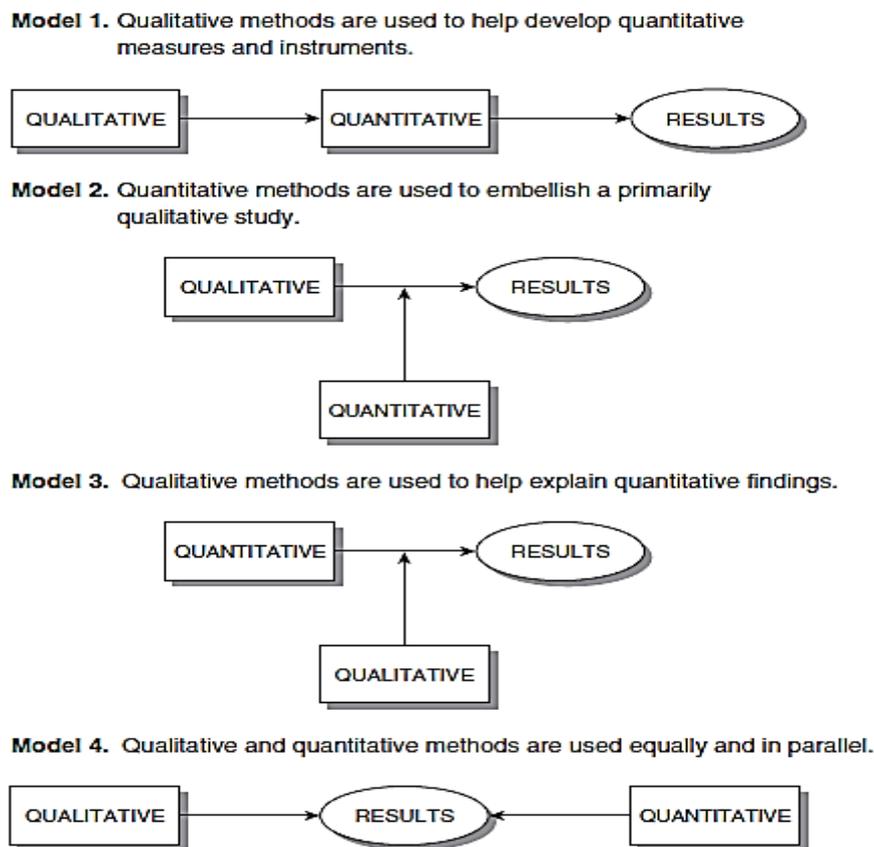
Figure 3-11 The Visual Representation of Mixed-Methods and Plausible order of [131]

Figure 3-11 shows four different models of implementing the mixed-methods research paradigm. The arrows in Figure 3-11 designate different priority of data collection and the first instance involves collection of qualitative data followed by collection of quantitative data and a subsequent synthesis of the information obtained from the two datasets. In Model 1, the

qualitative data is used to develop empirical indicators for the subsequent quantitative study. In Model 2, the quantitative data are used to improve the qualitative study. In the third model, the qualitative methods are used to complete quantitative results. The final model involves simultaneous implementation of both quantitative and qualitative paradigms.

3.7.2 Sequential Explanatory Design

The implementation of both methods in a study can also be done systematically for optimum results. For instance, the qualitative method can be used during a pilot study to establish ground truth and the information subsequently used to design a quantitative study for testing the hypothesis derived from the results of the qualitative study. The mixed-methods paradigm has six models namely sequential exploratory, explanatory, and transformative and concurrent triangulation, nested and transformative [123].

The sequential design has three variants; one with the quantitative approach implemented first and the other with the qualitative method implemented first. That is, sequential exploratory design involves collection and analysis of quantitative data followed by collection and analysis of qualitative data [118, 124, 125]. The priority is given to the quantitative data and the two paradigms are integrated when interpreting the data from both approaches. It is imperative to note the phase may or may not be based on any theoretical perspective. In general, sequential exploratory design helps in using qualitative results to complement and interpret the findings of the quantitative data [123]. Ideally, the quantitative study is regarded as the primary data source and finding in the sequential exploratory approach. It is suitable when unexpected or ambiguous results arise from quantitative results and in such cases the subsequent qualitative research is aimed at explaining the ambiguity or reconciling the obtained results using underlying probable causes and explanations [126]. However, in another variation, the qualitative research is prioritized and in such a case the quantitative data collected and analysed characterizes participants based on common statistical characteristics [123, 126, 127]. The quantitative results can also be used to guide the sampling process to improve the purposefulness of the participants of the qualitative study.

The method is up straight and simple to implement it consists of simple concise stages. Additionally, the features of the model make its description and reporting much easier, especially upon completion of data collection and analysis. The results from the design can be discussed in two distinct phases with final discussion emerging when collating the results in

the discussion section [128, 129]. The sequential exploratory design is also beneficial when a quantitative investigator has interest in further exploration of the results. More importantly, the integration of qualitative methods within the design can offer some comfort to quantitative researchers and it can serve as a means of introducing the principles of qualitative research methods [128, 130]. It is an ideal method for introducing new research techniques and thereby encouraging cross-paradigm participations. Despite these strengths, the sequential exploratory design has weaknesses as well. First, it requires considerably longer time to collect and analyse the two independent data sets since it does not support simultaneous data collection . The time constraint can be a drawback especially in cases where the two phases have been awarded the same priority. The figure below represents the three variants of the sequential exploratory design models based on [123].

Sequential Explanatory Design

QUAN → qual

QUAN Data Collection → QUAN Data Analysis → qual Data Collection → qual Data Analysis → Interpretation of Entire Analysis

Sequential Exploratory Design

QUAL → quan

QUAL Data Collection → QUAL Data Analysis → quan Data Collection → quan Data Analysis → Interpretation of Entire Analysis

Sequential Transformative Design

QUAL → quan
Vision, Advocacy, Ideology, Framework

QUAN → qual
Vision, Advocacy, Ideology, Framework

Figure 3-12 Sequential Design Models based on [123]

The sequential designs presented in Figure 3-12 consist of a sequential explanatory design, a sequential exploratory design, and a sequential transformative design. The differences between the three designs is the order of implementing qualitative and quantitative paradigms.

61

In the sequential explanatory design, the quantitative data is collected and analysed then the results supplemented using qualitative data [123]. The model of interest is the sequential explanatory design because it was used in the study. That is, the quantitative data on different aspects of technology acceptance both in education and health care sectors was first collected and analysed and the results were later complemented using a qualitative online survey that was administered to policy makers within the same sectors. The detailed information on research design is presented in the following subsection.

3.7.3 Research Design

The research was based on sequential explanatory design and as such the quantitative approach was implemented first and collected data analysed before embarking on the online survey. However, the research process involved a desktop study phase which consisted mainly of comprehensive literature review, development of conceptual model, planning and implementing pilot study.

Prior to conducting the actual interviews with the decision makers, a pilot study conducted using two candidates. These candidates were chosen intentionally to test the validity of the questions in-depth. The final refined interview questions presented in Appendix E.

The subsequent stages include data collection, data analysis, interpretation of analysis, discussion of results, and drawing of conclusions and inferences based on quantitative and qualitative results. The sequential explanatory model was part of the research design and it influenced the time decisions with regards to the implementation of the two approaches. Since the research design has been discussed in the previous section and the diagram provided, the research workflow is provided in the following section.
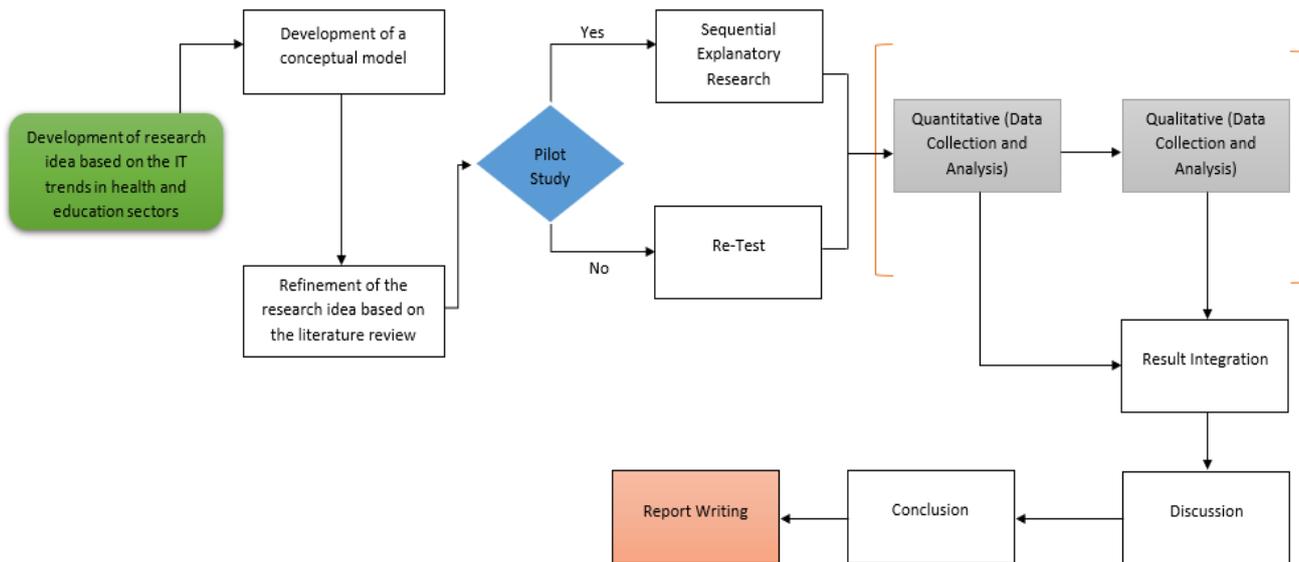
Figure 3-13 Research Workflow Diagram with a Simplified version of the Sequential Explanatory Design

In Figure 3-13, the sequential explanatory design model is shown in the red coloured inverted bracket. It consists of quantitative data collection and analysis followed by qualitative data collection and analysis. The target sample consisted of policy makers in both education and healthcare sectors. As the workflow, the research commenced with desktop study which involved the development of the research idea, its refinement through the literature review and eventual planning and implementation of the pilot study. The sequential explanatory research was pursued on the condition that the pilot study results met the minimum validity criteria otherwise a re-test or re-take of the pilot study was inevitable. The results from both quantitative and qualitative approaches interacted at integration and subsequent discussion while the research workflow ended with report compilation.

3.7.4 Case Study: UAE Overview

United Arab Emirates, commonly known as the UAE, is known on the global platform for its opulence in wealth despite being amidst one of the cruellest deserts in the world. Despite the unfavourable climatic conditions, the UAE is one of the regions in the Middle East with the most exciting developments and advancements in the world. It consists of seven states, its current gross domestic product as a measure of economic growth is at par with developed western nations. The UAE economy is driven by oil and positive global financial force, especially considering that most countries are importing oil from the region. Nonetheless, the UAE has had its fair share of hard times. For instance, a combination of declining prices of oil and dwindling real estate values against a backdrop of a banking crisis at international level hit the region in 2008-2009 fiscal year. The UAE has been rising from the impact of the crisis and

managed to evade the murky waters of the 2010-11 Arab Spring uprising. The government made a pact to invest about $1.6 billion in poorer areas of the region. The region continues to gain stability and create rapport within the Middle East and its influence and involvement in regional affairs is rapidly growing [131].

3.8 Critique of Literature Review

eGovernance is literally a form of technology that governments adopt in serving their citizens. Irrespective of all the good that comes with it, it may have a potential negative side of it beyond what is revealed in the above literature review analysis. Objecting to the fact that the world needs technology may not be easy but identifying the repercussions of eGovernance technology is not so difficult in the present developed and developing worlds. Some theoretical concepts in e-governance may lack adequate proofs to enhance their applicability in the community. Giving suggestions on the introduction or improvement of eGovernance is quite different from implementing the same. As much as the whole world may decide and be able to employ electronic governance, it may not benefit 100% of the world's population. As mentioned earlier in the literature review, some individuals or institutions may simply choose to avoid government technologies rather as a choice or for political reasons if not otherwise. Many theoretical claims of the literature analysis are pragmatic. However, the literature review under critique is supportive of theoretical eGovernance concepts and models without considering the real-life shortages or hindrances that may emerge even on the verge of implementation [15, 16].

In the current day, people surround tables in conferences to hold various formal discussions as to whether ICT is taking the world in a preferable direction or otherwise. Such questions subject e-governance, as part of modern technology, to potential doubt. That is, whether its prolonged use would benefit the community or harm the live of its users in one way or another. Some computer experts use their knowledge to rob the government through altering e-governance programs in an illegal way. Accessing government or individual private information was not as easy as with the presence of eGovernance. Notably, this is not to disregard eGovernance programs but to call for further perfection in implementing the program. Online platforms may also be inappropriate for sharing private information since some people, including the government, may access them and opt to use such information to their advantage, perhaps in an informal and unacceptable way [49].

Additionally, the literature review does not exhaustively analyse the technical aspects of computer science that relate to eGovernance. eGovernance is not only a subordinate of

computer science but also part of many other subjects such as education, sociology, and community development. Technical aspects of e-governance may need qualified experts to analyse and go ahead to ensure technical implementation of the technology. Apart from technology dynamism, other things that influence e-governance also continue to change. The social lives of people influence the implementation of e-governance.

The world is divided and never fully united to enable adequate transfer or implementation of e-governance technology across borders. Implementing eGovernance may call for other special needs such as maintaining peace among countries. The literature review is not so specific on the external factors that would influence e-governance directly in various countries. Also, local citizens of specific countries are never united, which may hinder the implementation of e-governance where a person would possibly reject the technology in realization that it is innovated by his or her rivalry. Peace is quite important in a country that focuses on implementing e-governance [7].

eGovernance may not necessarily boost the economy and propel the achievement of millennium goals. Some countries have had stable e-governance services especially in the developing side of the world and their economies have not necessarily improved in terms of growth of development. eGovernance can only contribute to the prosperity of an economy after making the necessary adjustments that influence the economy directly such as a country's revenue, exports, and imports amongst others. Achieving the millennium goals has more to be done apart from implementing eGovernance. An irresponsible government may not improve economic performance or stimulate development in a country even with effective e-governance programs. The possibility that a country may perform poorly in its economic activities remains regardless of effective implementation and utilization of e-Governance technologies. In some countries, residents have a plethora of complaints even after the application of e-governance in offering government services. Internet connectivity is not uniform across the globe for e-governance application especially in the developing side of the world. As the literature review has it, electronic governance is highly reliant on internet connection. The assumption that a country only requires a few resources for implementing e-governance may not be true for some nations. The relevance of technology differs from one person to another as well as one country to another. Countries have priorities to attend to before considering e-Governance. Governments have plans on how to unveil their projects and may hardly put e-governance in the forefront if it does not fit. Some countries have basic things to focus on hence technologies such as e-governance come in as secondary needs of a country. Some nations in the developing world still experience basic problems such as starvation hence the implantation of e-

governance technologies may not be as necessary as for some countries. Generalization of the need for e-governance is evident in the literature review. Even though the reviewed literature notes a clear difference between e-Government and e-Governance, some countries refer to the two terms as one [2].

With effective e-governance in some countries, corruption and lack of transparency in public institutions continue to thrive. Corruption is more of a question of leadership, culture, or personal attributes rather than a technological issue. While it is true that e-governance technologies promote transparency and mitigate corruption, it does not guarantee complete elimination of corruption and the likes. Corruption is a social issue that may need to be addressed in special ways other than in a technological way. Technology only contributes in minimizing corruption and other malicious acts. Accessing and presenting the data analysis of every country from the developed and developing worlds would not be possible. Therefore, the data presented in the literature reviews only give a glimpse of how the world operates with respect to application of digital technologies in provision of government services. Even so, the data analyses are hardly enough to exhaust the topic. Data scrutinization plays a vital role in authenticating and strengthening the research. The data used in the research are some of the latest figures, which make them reliable and appropriate for enhancement of accurate information. Essentially, it is prudent to note that data keeps changing. On the verge of changing, people change their decisions and life takes different directions. For instance, people who may have agreed to be using e-governance services more often may have died or changed their minds to use utilize the services at a lower rate. Moreover, new e-governance services have been introduced. Since technology is dynamic and innovation is an ongoing process, the accuracy of the data may be subject to regular adjustments. e-Governance utilization is also likely to take a different direction in future given the ever-changing data [61, 80].

The models and theories included in the research gives a deeper analysis of the literature review. However, the contradiction between the models is apparent. Every model has a specific theoretical perspective and allegation that it emphasizes on. Some models are also too close in terms of their meanings and assertions. The models concentrate on different technological aspects, which diversify the research as they bring in mixed thoughts of the same. While some models such as TOE, TPB, and TRA, concentrate on human behaviour, intention, and response to new technology, others such as the TOE model give much weight to environmental and organizational issues. Each model has a predetermined subject to address pertaining to e-governance programs if not technologies. At some point, some models reconcile, for example,

TRA and TPB. The two models are close in their definition and assertions. Both theories focus on technology adoption in a setting [64, 78, 90].

On the PLS model, it is mostly used outside psychology though most studies have recommended that its uses should be confined within the boundaries of psychology. Nonetheless, most researchers have identified the demerits of using the model basing their arguments on two factors: PLS is equivalent to the regression model through its indicator variables used in creating weighted composite clusters and that its benefits have been overstated by most studies. The ability of PLS to deal with measurement errors is false considering that creation of the composites from the indicator variables have no ability to do such things. Implementation of the PLS model seems to be dangerous considering that it inflates the Type I errors for small effects which in turn affects the effectiveness and efficiency of operation for the developed models. The latter property of the model might be considered appropriate as it gives the impression of the attenuating measurement errors. However, it only provides bias that could to some extent counteract the attenuation that arises from the measurement error. There are various limitations associated with the PLS model. Most studies have advocated for the model majorly while dealing with the multicollinearity which makes sense because multicollinearity can be handled reasonably through replacement of the predictors with the composites. With continued development in research, studies have noted that the drawback of PLS is that the composites are derived automatically from the PLS algorithm. Such processes often produce good predictions though over-capitalize on the quirks within the samples. To some extent, the composites might be difficult to interpret. Most psychologists often prefer using interpretable applications rather than focusing on the non-optimal composite [95, 132].

Retrospectively, the literature review under critique has potential weaknesses and strengths. The strengths outweigh the weaknesses. In turn, the review is more relevant than not for the study and objectives of the thesis. e-Governance is relatively wide with a variety of data for analysis throughout the world. Information remains a subject of change since the world is on the move. e-Governance is bound to change in terms of technological advancement or overall usage. Information from many different sources improves the quality of the literature review of the study.

3.9 Chapter summary

The research methodology chapter provides more information on different research paradigms with specific focus on qualitative, quantitative, and mixed-methods approaches. The key reason for pursuing a mixed-methods approach is to leverage the weakness of each of the used methods although this does not necessarily mean that gaps in each individual method are addressed. As such, it is pertinent to follow a scheme or model when implementing the mixed-methods approach. The models of implementing the mixed-methods approach consist of six models although the sequential explanatory design model was considered. The model involves implementation of a quantitative research method, including data collection and interpretation, and a subsequent qualitative analysis is sanctioned to explain unexpected or ambiguous results from the quantitative study. The study outlined in the results section of the research was based on both the health and education sectors with a specific focus on the role of mobile or smart services on the sectors. Given the role of smart services and e-services, especially in the context of e-Governance, a case of UAE has been included in the study. The UAE was considered because of the federal monarchy's interest in smart services, e-Governance, and artificial intelligence.

The chapter expands on the essence of eGovernance to the contemporary society. Moreover, it explores various programs of eGovernance including how the government implements such programs to influence the lives of the people in a country. The connection of ICT to e-governance is well-elaborated in the chapter. eGovernance is an element of modern technology that is always subject to change. The implementation of eGovernance in countries minimizes corruption to a certain level and encourages transparency in offering government services. The study also gives various definitions of e-Governance from different scholarly sources and different countries. Notably, the chapter expounds on the difference between e-government and e-governance. The e-governance's influence on the community is more positive than negative. Furthermore, the literature review puts forward e-governance implementation processes from the computerization stage to online interactivity. E-governance implementation differs from country to country. The level of services around the world has improved courtesy of e-governance innovations. Through data analysis, the chapter explores the level of awareness and usage of digital technologies by governments and their people in numerous countries. Partial Least Squares and Collaborative Filtering were also analysed in detail. In addition, the chapter compares e-governance in developed countries with that of

developed nations including various ways in which technology can be transferred and shared in various ways. This study focused on various models such as Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM), Technology Organization Environment (TOE), Diffusion of Innovation (DOI), and the Theory of Reasoned Action (TRA). Each model has significance in the study. The models give ways in which implementation and adoption of e-governance can take place in various platforms and with different people of diverse behaviours. Particularly, the chapter expatiates on the definition of eGovernance from wider perspectives, its contribution to the world, and possible ways to improve it.

Chapter 4 STATISTICAL METHODOLOGY

4.1 Introduction

In this research, both quantitative and qualitative research methods have been used. The qualitative research is exploratory, and it is a tool for gaining an understanding on opinions, expert or otherwise, motivations, and reasons underlying identified problems or circumstances. In most applications, quantitative research uncovers trends in non-quantitative constructs such as opinions and thoughts about a problem or an issue. Regarding data collection, there are two methods that are widely used. The tool used for gathering primary data is either unstructured or semi-structured, and it can depend on observation making, engaging in focus group discussion, conducting individual or face-face-interviews.

The quantitative research method, on the other hand, uses numerical data to quantify a problem. In most cases, the data used are either numeric or can be transformed into acceptable statistical attributes. As such, quantitative research quantifies attitude, behaviours, and opinions through conceptualization and operationalization of constructs. That is, constructs related to opinions, attitudes, and behaviours are represented as either ordinal or nominal attributes using the Likert scale and other recognizable scales and analysed based on the sample and the subsequent results generalized to the whole study population. The generalizability of quantitative results is dependent on the sample size and the quality of the statistical analysis used.

The questionnaires were distributed, and 545 responses were collected. The responses were deemed to be usable and the reason behind selecting this sample size was because the sample size of this research (545) was greater than 30 and less than 600, secondly this research included 20 variables (19 independent and 1 dependent) and the sample size of this research was 30 times as large as the total number of the variables in the study. Finally, the sample size was larger than 200 and the analysis technique used in this research was the SEM.

On the other hand, the SEM was very useful especially when validating the quantitative data as the data analysis for the collected responses from questionnaire go through several steps of validation including the distribution of latent variables, construct specification of accuracy, measurement model, structural model and confirmation of the proposed hypothesis.

Quantitative methods rely on structure data collection techniques compared to qualitative ones. Of these techniques, online surveys and computer assisted types are the most commonly used.
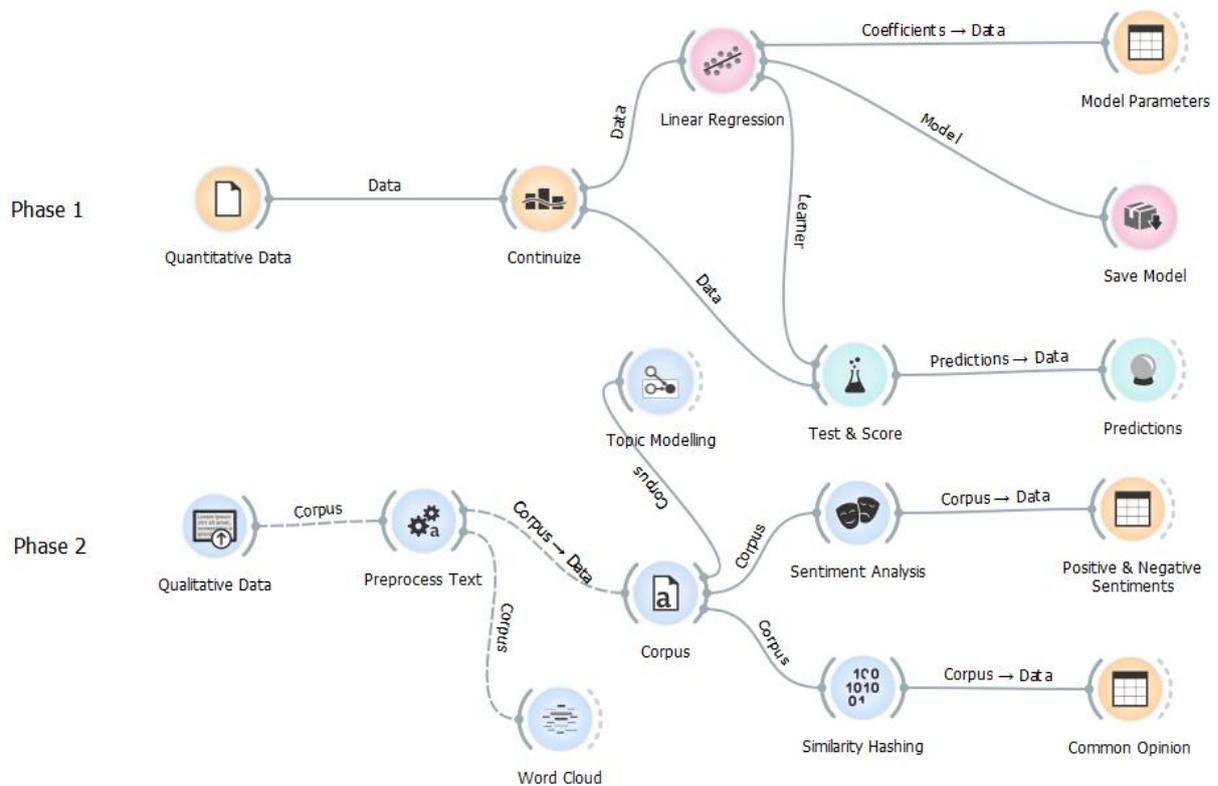
Figure 4-1 The Visual Programming of the Research Methods.

Figure 4-1 Illustrates Phase 1 (Quantitative Analysis) and Phase 2 (Qualitative Analysis). The first phase involves the development of a multiple linear regression model using pre-processed data. The pre-processing ensures that all the predictors or attributes used in the study are continuous or converted as required to meet the assumptions of the model. Besides the coefficients and necessary test statistics, the mean square, root mean square error, mean absolute error, and R-squared are used to evaluate the fitness of the developed model. The multiple regression model is also tested for its predictive power and it is saved for references. The second phase entails analysis of interview data (qualitative data) using similarity of words and emerging sentiments from expressed opinions. Visualization techniques such as word cloud are used to analyse subtexts, pretexts, and attitudes based on commonly used words. Additionally, similarity hashing, which involves comparison of similarity between documents, is also employed to establish differences or similarity in opinions. The techniques used in the analyses for both phases are discussed in more detail in the following section.

4.2 Operationalization of Variables

The attributes used in the study are summarized in following table. The attributes are based on UTAUT constructs and the respective definitions are found in Table 4-1.

Table 4-1 Constructs and Attributes Used in the Study.

7 UTAUT Attributes	The Measured Study Variables
Effort Expectancy (EFE)	Technological Anxiety (TECA)
	Resistance to Change (RTC)
Facilitating Conditions (FAC)	Facilitating Conditions (FAC)
Performance Expectancy (PEX)	Perceived Ease of Use (PEOU)
	Perceived usefulness (PU)
	Relative advantage (RAD)
	Services Quality (SERQ)
	System Quality (SYSQ)
	Information Quality (INFQ)
	Compatibility (COM)
	Trialability (TRI)
	Observability (OBS)
	Complexity (COMX)
Social Influence (SIN)	Perceived Enjoyment (PE)
	Social Influence (SINF)
	Self-Efficacy (SE)
Trust on Data (TOD)	Data privacy (DP)
Trust on System (TOS)	Perceived Trustworthiness (PT)
	Perceived security (PS)
Intention to Use (ITU)	Personnel Innovativeness (PIN)

The 20 Attributes are based on the elements of the Unified Theory of Acceptance and Use of Technology (UTAUT). The elements of the UTAUT model used as attributes in the study are based on specific theories and have been used in different studies. Those derived variables from the literature used as an extension to the new model. The derived variables were chosen and investigated from a user/ non-user perspective in the developing country of UAE. The following table summarizes studies and constructs related to UTAUT and the variables in Table 4-2.

Table 4-2 Explanations of the UTAUT Constructs Including Relevant Theories and Sample Reference Articles

UTAUT Constructs	Definition	Related Construct	Related Theory	Related Theory Reference
Performance expectancy	The degree to which an individual believes that using the system will help him or her to attain gains in job performance	Relative advantage	Innovation diffusion theory	Rogers (1995) Moore & Benbasat (1991)
		Perceived usefulness	Technology Acceptance Model	Davis et al., (1989) Bagozzi et al., (1992)
		Extrinsic motivation	Motivational model	Taylor & Todd (1995a)
		Job fit	Model of PC utilization	Thompson et al., (1991)

		Outcome expectation	Social cognitive theory	Compeau & Higgins (1995)
Effort expectancy	The degree of ease associated with the use of the system	Perceived ease of use	Technology acceptance model	Davis et al., (1989) Bagozzi et al., (1992)
		Complexity	Model of PC utilization	Taylor & Todd (1995) b
		Ease of use	Innovation diffusion theory	Moore & Benbasat (1991)
Facilitating conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system	Perceived behaviour control		Ajzen (1991) Mathieson (1991)
		Facilitating conditions		Taylor & Todd (1995b)
		Compatibility	Innovation diffusion theory	Moore & Benbasat (1991)
Social Influence	The degree to which individual emotions and opinions are affected by people in their inner cycle or friends in general.	Normative Social Influence Informational Social Influence	Kelman's Typology	Kelman (1958)
Trust on Data	Refers to the degree and/ or extent to which users believe the ability of the system to uphold privacy requirement and as such ensure confidentiality and integrity of data	Benevolence and Integrity of Data	Disconfirmation Theory Expectation confirmation	Zuiderwijk-van (2016) Bhattacherjee (2001)
Trust on System	Trust on systems is an extension of Talcott Parsons and Niklas Luhmann's theory of trust to system where it postulates that trust in people using a system and their belief in its efficiency reinforces their trust in that system.	Theory of Trust Perceived Trustworthiness Data Privacy	Social Systems Theory	Jalava (2003)
Intention to Use	Refers to the degree and desire of an individual to use technology in future. It is based on subjective desires.	Perceived Usefulness	Technology Acceptance Model	Teo (2011)

4.3 Descriptive Analysis of Variables

Prior to constructing the PLS model, a descriptive analysis of the questionnaire (Appendix D) data was conducted using IBM SPSS. This involved an examination of the demographic and contextual characteristics of the participants (based on their responses to items 1 to 6 in Part A: Background information). Chi Square tests were used to determine if there were statistically significant ($p < .05$) associations between the frequencies of the participants classified by gender, age and education. Twenty latent variables were operationalized by averaging the item scores specified in Part B: Constructs and Measured Items. The descriptive statistics (mean, median, standard deviation, minimum, maximum, skewness) were computed

for each variable. A test for multicollinearity was conducted by use of a correlation matrix. Strong multicollinearity, indicated by significant ($p < .05$) correlations between the exogenous variables, causes redundancy (i.e., the model is over-specified if too many correlated variables are included). Strong multicollinearity also compromises the results (because correlations between multicollinearity variables are excluded).

4.3.1 Quantitative Results of Education Sector

The results are presented in the following sub sections; starting with Characteristics of Participants, then Descriptive Analysis of Variables, and then Partial least squares –structural equal modelling (PLS-SEM). A. Validation of the Measurement Model. B. Evaluation of the Structural Model.

4.3.1.1 Characteristics of Participants

The demographic characteristics of the 204 participants (based on their responses to items 1 to 6 in Part A: Background information) are summarized in Table 4-3.

Table 4-3 Demographic characteristics of participants

Variable	Category	Frequency	Percent
Gender	Female	81	39.7
	Male	123	60.3
Age (years)	18-20	115	56.4
	20-29	51	25.0
	30-39	33	16.2
	40-49	3	1.5
	50+	2	1.0
Education	High school certificate	132	64.7
	Bachelor's degree	55	27.0
	Postgraduate degree	14	6.9
	Other	3	1.5
Nationality	Emirati	169	82.8
	Non-Emirati	35	17.2
Language	English	52	25.5
	Arabic	33	16.2
	English and Arabic	116	56.9
	Other	3	1.5

Most of the participants (123, 60.3%) were male. They ranged in age from 18 to over 50 years. Over half of the participants (116, 56.4%) were in the youngest age-group (18-20 years). The most frequent level of education was high school certificate (132, 64.7%). About one quarter (55, 27.0%) had a bachelor's degree, and the remainder had a Postgraduate degree or other qualification. The nationality of most of the participants (169, 82.8%) was Emirati, and over half (116, 56.9%) spoke both Arabic and English.

Pearson's Chi Square tests were used to determine if there were significant ($p < .05$) associations between the frequencies of the participants classified by gender, age and education. The categories were collapsed to ensure that the frequency in each cell of the cross-tabulation was ≥ 5, to ensure the validity of the results. The significant associations indicated that gender, age and education were not independent.

Gender was significantly associated with education (Chi Square (1) = 6.770, $p = .009$). The cross-tabulation indicated that the frequency of male participants with high school/other education (90, 73.2%) was greater than the frequency of female participants (33, 26.8%). The frequency of female participants with a Bachelor/Postgraduate degree (36, 44.4%) was greater than the frequency of male participants (33, 26.8%).

Gender was significantly associated with age (Chi Square (2) = 9.467, $p = .009$). The cross-tabulation indicated that the frequency of younger male participants aged 18 to 20 years (80, 65.0%) was greater than the frequency of younger female participants (35, 43.2%). The frequency of older female participants aged over 30 years (19, 23.5%) was greater than the frequency of older male participants (18, 14.6%).

Age was significantly associated with education (Chi Square (2) = 97.360, $p < .001$). The cross-tabulation indicated that the frequency of younger participants aged 18 to 20 years with a high school/other education (109, 94.8%) was greater than the frequency of older participants aged over 30 years (13, 35.1%). The frequency of older participants aged over 30 with a bachelor/postgraduate degree (24, 64.9%) was greater than the frequency of younger participants with a degree (6, 5.2%).

The contextual characteristics of the participants (based on their responses to items 7 and 8) are summarized in Table 4-4.

Table 4-4 Contextual characteristics of participants

Variable	Category	Frequency	Percent
How long internet has been used	Never	9	4.4
	< 1 month	11	5.4
	< 1 year	25	12.3
	> 1 year	75	36.8
	1 to 5 months	90	44.1
Frequency of using internet	Never	3	1.5
	Once per week	5	2.5
	Once a day	63	30.9
	2-3 per week	46	22.5
	Several times a day	87	42.6
Usage of Smartphone	Yes	196	96.1
	No	8	3.9
Current user of online/ mobile information system	Yes	188	92.2
	No	16	7.8
Frequency of visiting online/mobile learning systems	Never	9	4.4
	Once a day	11	5.4
	Once a week	42	20.6
	Once a month	43	21.1
	1-2 per month	99	48.5
Preferred channels when accessing information	Websites	72	35.3
	Mobile	102	50.0
	SMS	11	5.4
	Services center	19	9.3

The length of time the participants had used the internet ranged from never (9, 4.4%) to over 1 year (75, 36.8%). Their use of the internet ranged from never (3, 1.5%) to several times a day (87, 42.6%). Nearly all the participants (196, 96.1%) used a Smartphone, and most (188, 92.2%) were current users of online/mobile information systems. Their frequency of use of online/mobile learning systems ranged from never (9, 1.4%) to 1 to 2 times a month (99, 48.5%). Half of the participants (102, 50.0%) preferred a mobile channel whilst about one third (72, 53.5%) preferred websites and the remainder used SMS or service centres.

4.3.1.2   Descriptive Analysis of Variables

Twenty latent variables were operationalized by averaging the item scores specified in Part B: Constructs and Measured Items. The descriptive statistics are summarized in Table 4-5.

Table 4-5 Descriptive analysis of 20 latent variables

Variable	Abbrev.	Mean	Median	Mode	SD	Skewness	Minimum	Maximum
Perceived ease of use	PEOU	4.22	4.40	4.40	0.61	-1.43	2.20	5.00
Perceived usefulness	PU	4.42	4.60	4.60	0.50	-2.17	2.00	5.00
Perceived security	PS	4.33	4.60	4.60	0.67	-2.51	1.40	5.00
Perceived enjoyment	PE	4.41	4.40	4.60	0.38	-2.32	2.40	5.00
Perceived trustworthiness	PT	4.43	4.60	4.60	0.40	-1.96	2.60	5.00
Personal innovativeness	PIN	4.44	4.60	4.60	0.45	-3.10	1.80	5.00
Data privacy	DP	4.41	4.43	4.67	0.44	-2.41	2.00	5.00
Social influence	SINF	4.43	4.67	4.67	0.44	-1.70	2.00	5.00
Relative advantage	RAD	4.46	4.50	4.50	0.44	-2.30	2.00	5.00
Compatibility	COM	4.41	4.50	4.50	0.47	-2.93	1.25	5.00
Complexity	COMX	4.44	4.67	4.67	0.50	-2.11	2.00	5.00
Trialability	TRI	4.43	4.67	4.67	0.59	-3.16	1.00	5.00
Observability	OBS	4.47	4.50	4.50	0.46	-2.71	2.00	5.00
Technological anxiety	TECA	4.47	4.67	4.67	0.51	-2.84	1.67	5.00
Resistance to change	RTC	4.45	4.67	4.67	0.47	-2.38	1.67	5.00
Self-efficacy	SE	4.46	4.67	4.67	0.50	-2.08	2.00	5.00
Facilitating conditions	FAC	4.48	4.60	4.60	0.42	-2.34	2.40	5.00
Services quality	SERQ	4.46	4.60	4.60	0.46	-2.21	2.00	5.00
System quality	SYSQ	4.46	4.60	4.60	0.42	-1.91	2.60	5.00
Information quality	INFQ	4.45	4.67	4.67	0.48	-2.16	2.00	5.00

Although the responses provided by each individual respondent encompassed the full range of the 5-point scales (1.00 to 5.00) the characteristic feature of all the latent variables was their strong negative skew (skewness = -1.43 to -3.16). Consequently (a) the frequency distributions were not normal bell-shaped curves, but were asymmetric, with the modes (4.40 to 4.67) at the extreme higher ends of the scales; (b) the median scores (4.43 to 4.67) were consistently higher than the mean scores (4.22 to 4.48). Examples of negatively skewed frequency distribution histograms are illustrated in Figures 4-2, 4-3, and 4-4, showing that most of the participants scored 4 to 5 (i.e., agreement or strong agreement) for Perceived ease of use (82.35%) Perceived usefulness (93.14%) and Personnel Innovativeness (95.58%).
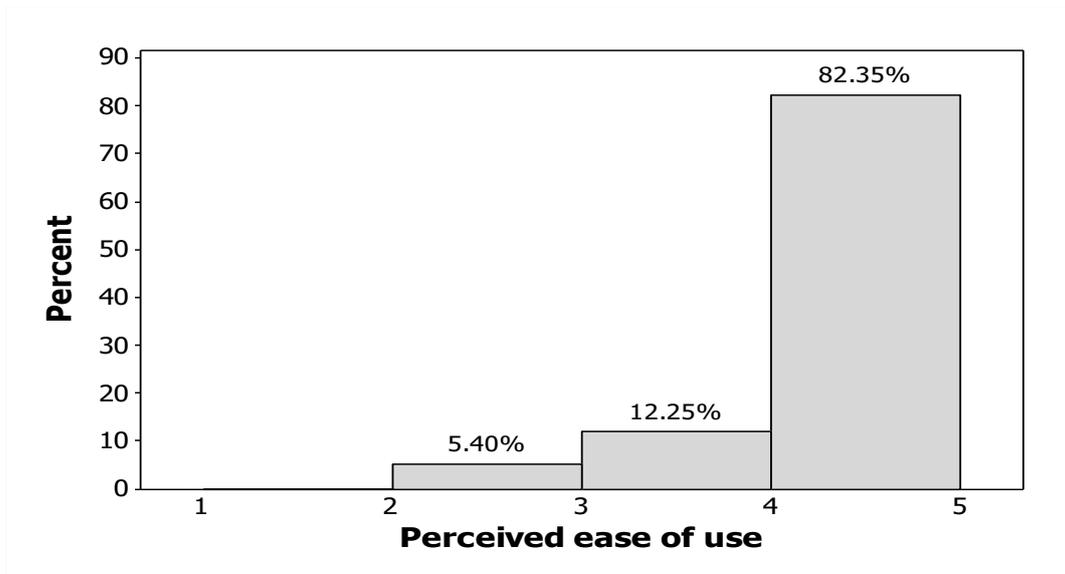
*Figure 4-2 Skewed frequency distribution for Perceived ease of use*
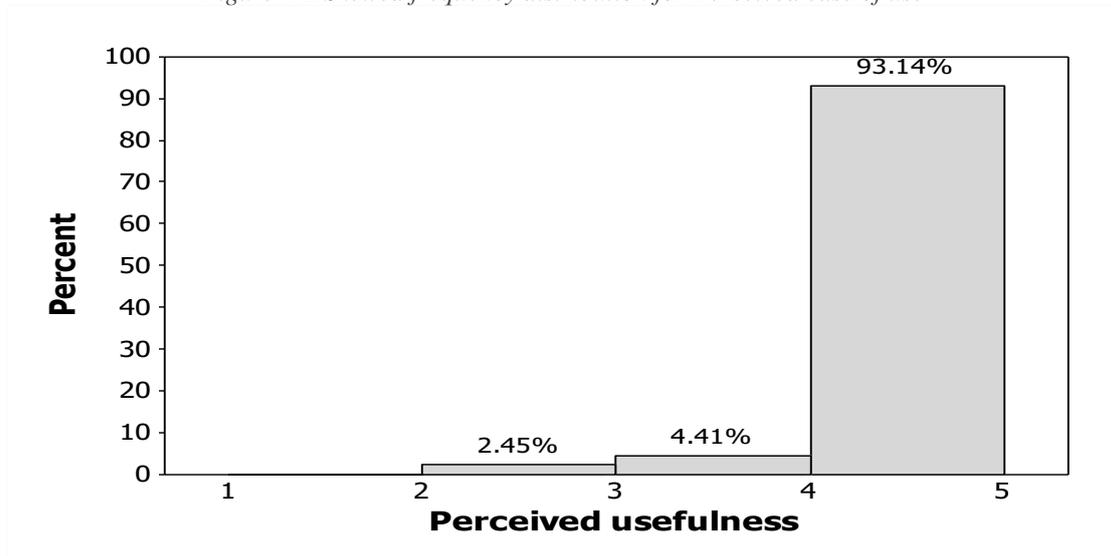
*Figure 4-3 Skewed frequency distribution for Perceived usefulness*
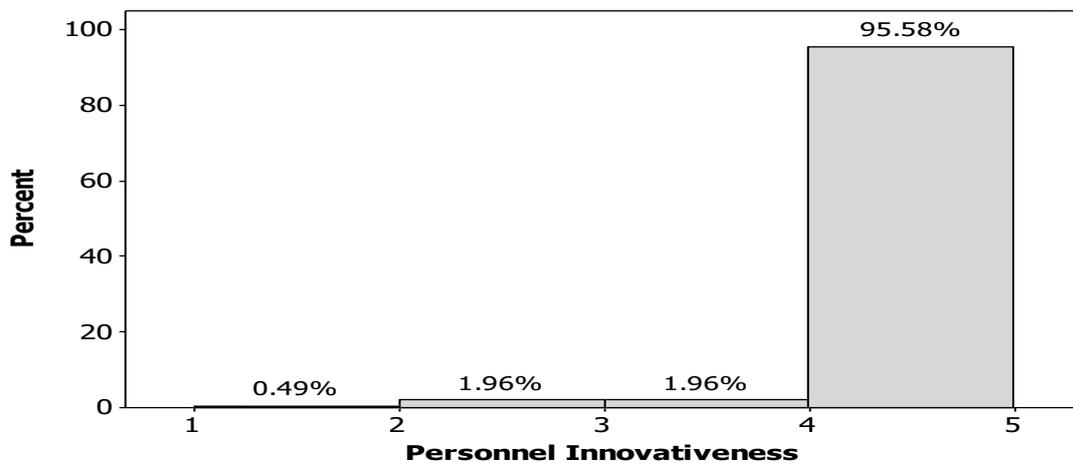
Figure 4-4 Skewed frequency distribution for Personnel Innovativeness

78

The deviation of the scores from normality meant that the use of parametric statistics was not justified, so that non-parametric statistics (e.g., PLS-SEM) were essential to construct the proposed model. The restriction of most of the scores to a narrow range between 4 and 5 at the higher ends of the 5-point scales, however, reduced the variances (reflected by the consistently low standard deviations (SD = 0.42 to 0.67) in Table 4-3). The reduced variances meant that the correlations between the variables could be attenuated, or misleadingly low. The reasons for the skewed distributions of the variables need to be considered. It is possible that the respondents' consistent endorsement of scores toward the higher ends of the item scales was due to social desirability bias. The similarities between the skewed frequency distributions of the scores for each variable, with most respondents scoring either 4 or 5 for each item, resulted in multicollinearity. Multicollinearity was reflected by the matrix of Spearman's rho (non-parametric) correlation coefficients in Table 4-5. Nearly all the 20 variables were significantly ($p < .01$) correlated with each other. To alleviate threats to validity, including redundancy and over-specification, associated with multicollinearity, clusters of inter-correlated exogenous variables were composited, to produce an optimum parsimonious model, with the smallest possible number of variables.

Table 4-6 Bivariate correlation matrix

	PEOU	PU	PS	PE	PT	PIN	DP	SINF	RAD	COM	COMX	TRI	OBS	TECA	RTC	SE	FAC	SERQ	SYSQ	INFQ
PEOU	1.000																			
PU	.478**	1.000																		
PS	.460**	.357**	1.000																	
PE	.350**	.372**	.505**	1.000																
PT	.352**	.493**	.485**	.386**	1.000															
PIN	.099	.316**	.359**	.469**	.271**	1.000														
DP	.199**	.302**	.235**	.382**	.417**	.232**	1.000													
SINF	.118	.264**	.240**	.291**	.263**	.195**	.328**	1.000												
RAD	.300**	.306**	.402**	.310**	.422**	.433**	.360**	.241**	1.000											
COM	.314**	.347**	.308**	.324**	.458**	.350**	.300**	.249**	.505**	1.000										
COMX	.233**	.237**	.429**	.249**	.392**	.312**	.250**	.248**	.502**	.432**	1.000									
TRI	.041	.291**	.318**	.378**	.374**	.293**	.288**	.390**	.334**	.344**	.321**	1.000								
OBS	.285**	.307**	.354**	.363**	.413**	.337**	.355**	.274**	.326**	.428**	.479**	.277**	1.000							
TECA	.431**	.365**	.494**	.421**	.488**	.365**	.260**	.225**	.536**	.462**	.399**	.294**	.382**	1.000						
RTC	.292**	.329**	.368**	.267**	.405**	.209**	.321**	.292**	.370**	.480**	.383**	.427**	.312**	.373**	1.000					
SE	.197**	.315**	.321**	.353**	.229**	.301**	.347**	.400**	.307**	.261**	.381**	.243**	.414**	.177*	.166*	1.000				
FAC	.269**	.396**	.395**	.285**	.571**	.377**	.445**	.310**	.510**	.424**	.520**	.395**	.461**	.352**	.425**	.391**	1.000			
SERQ	.345**	.342**	.374**	.395**	.385**	.292**	.483**	.223**	.399**	.317**	.419**	.260**	.433**	.376**	.356**	.387**	.535**	1.000		
SYSQ	.236**	.306**	.448**	.456**	.343**	.464**	.311**	.220**	.363**	.256**	.278**	.347**	.437**	.436**	.216**	.303**	.379**	.359**	1.000	
INFQ	.255**	.245**	.394**	.441**	.308**	.344**	.353**	.202**	.186**	.294**	.262**	.247**	.365**	.392**	.316**	.228**	.347**	.506**	.441**	1.000

Note: Significant correlation ** $p < .01$; * $p < .05$

Kruskal-Wallis (non-parametric) tests were conducted to determine if Intention to use (the dependent variable) varied significantly with respect to demographic variables (gender, age, and education). The results are presented in Table 4-7. The median scores for Intention to use (4.48 to 4.56) reflected the endorsement of the higher ends of the item scales by all groups of respondents. The Kruskal-Wallis Chi Square statistics indicated that the median scores for Intention to use did not vary significantly at the 0.05 level ($p = 0.051$ to 0.642) with respect to gender, age, or education. Consequently, it was not necessary to control for the demographic variables when conducting PLS-SEM.

Table 4-7 Variation in intention to use by demographic variables

Variable	Category	Median Intention to use	Kruskal-Wallis Chi Square	p
Gender	Female	4.48	0.217	0.642
	Male	4.54		
Age (years)	18-20	4.53	3.798	0.051
	>20	4.56		
Education	High school certificate/other	4.52	0.517	0.472
	Bachelor/Postgraduate degree	4.49		

4.3.1.3 Validation of Measurement (Outer) Model

The path diagram for the PLS-SEM measurement model is illustrated in Figure 4-5. All the factor loading coefficients in the measurement model (labelled between the seven latent variables and their respective clusters of indicators) were consistently ≥ .5, reflecting the construct validity of the latent variables. The average variance explained (AVE) and the tests for reliability are presented in Table 4-8.
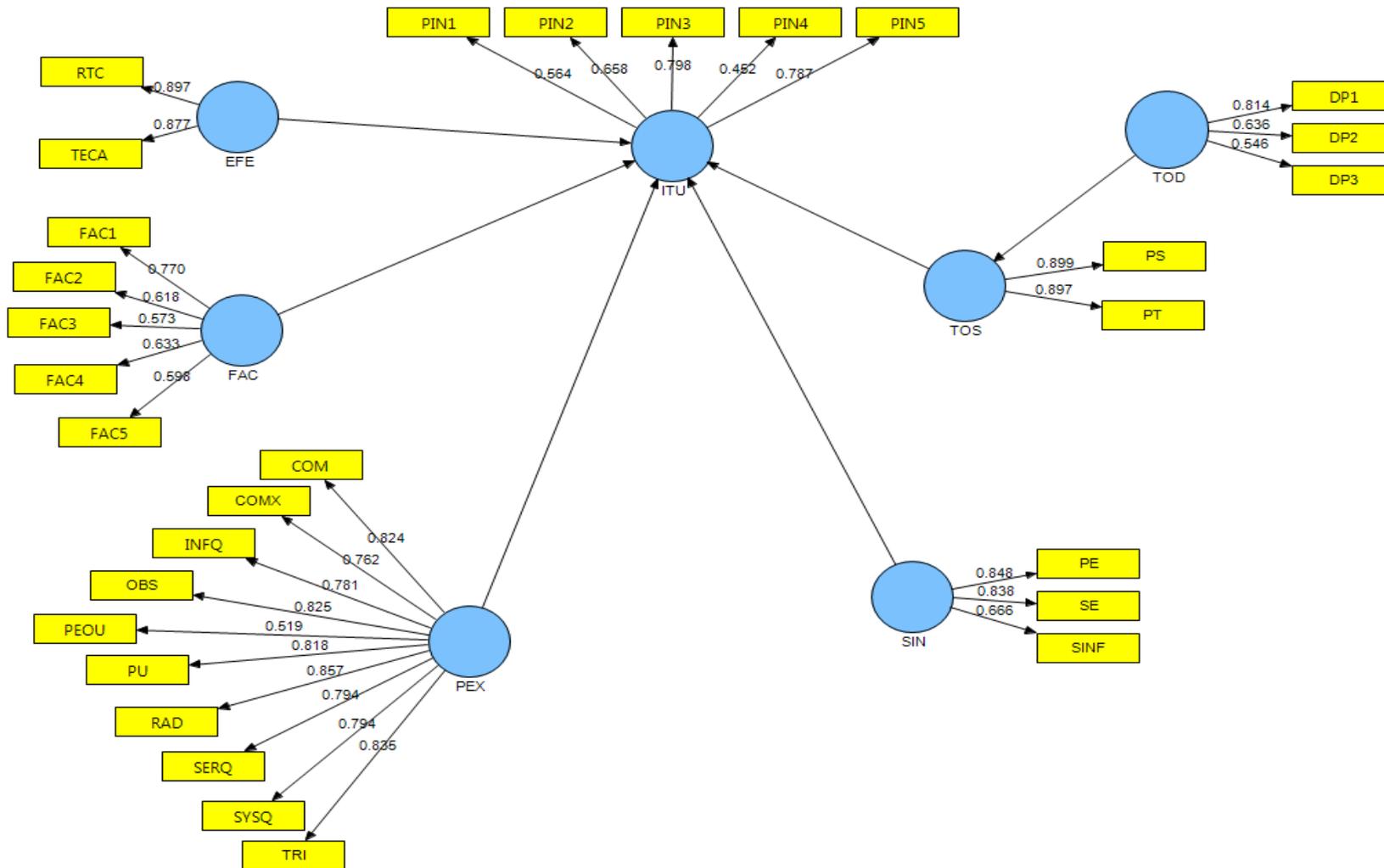
Figure 4-5 Measurement model (exported from the graphic user interface of SmartPLS)

82

Table 4-8 Average variance explained (AVE) and reliability

	AVE	Square Root AVE	Composite Reliability
Effort expectancy (EFE)	0.786	0.887	0.880
Facilitating conditions (FAC)	0.412	0.642	0.776
Performance expectancy (PEX)	0.618	0.786	0.941
Social influence (SIN)	0.621	0.788	0.830
Trust on data (TOD)	0.455	0.675	0.709
Trust on system (TOS)	0.807	0.898	0.893
Intention to use (ITU)	0.442	0.665	0.792

The average variance explained (AVE) for all the latent variables was close to or greater than the 50% AVE that is necessary to indicate an acceptable level of convergent validity. The AVE was greater than 60% for Effort expectancy (0.786), Performance expectancy (0.618), Social influence (0.621) and Trust on system (0.807) reflecting a high level of convergent validity. The AVE was, however, a little less than 50% for Facilitating conditions (0.412) Trust on data (0.455) and Intention to use (0.442) reflecting a lower level of convergent validity. The restriction of the item scores by most respondents to the higher ends of the item scales between 4 and 5 was probably responsible for reducing the AVE.

The composite reliability statistics exceeded 0.7 (ranging from 0.709 for Trust on data to 0.941 for Performance expectancy) reflecting an acceptable level of internal consistency for the items chosen to operationalize the seven latent variables. The cross-loadings of all the indicators on each of the latent variables are listed in Table 4-9. Discriminant validity was acceptable because the factor loadings for the items that constituted each latent variable (highlighted in bold) were consistently greater than their cross-loadings. Furthermore, the square roots of AVE listed in Table 4-8 were consistently greater than the path coefficients (β) reflecting the correlations between the latent variables listed in Table 4-5.

Table 4-9 Cross-loadings

Indicators	Latent variables						
	EFE	FAC	ITU	PEX	SIN	TOD	TOS
COM	0.688	0.657	0.592	**0.824**	0.655	0.648	0.899
COMX	0.593	0.667	0.603	**0.762**	0.623	0.479	0.635
DP1	0.522	0.501	0.445	0.542	0.540	**0.814**	0.563
DP2	0.391	0.505	0.465	0.482	0.398	**0.636**	0.495
DP3	0.399	0.255	0.301	0.403	0.426	**0.546**	0.351
FAC1	0.458	**0.770**	0.598	0.583	0.445	0.428	0.560
FAC2	0.400	**0.618**	0.375	0.513	0.387	0.328	0.471
FAC3	0.335	**0.573**	0.323	0.497	0.417	0.400	0.483
FAC4	0.337	**0.633**	0.517	0.488	0.407	0.482	0.444
FAC5	0.453	**0.598**	0.319	0.540	0.461	0.443	0.588
INFQ	0.672	0.597	0.557	**0.781**	0.674	0.640	0.655
OBS	0.690	0.662	0.601	**0.825**	0.710	0.547	0.696
PE	0.692	0.468	0.595	0.746	**0.848**	0.575	0.653
PEOU	0.441	0.361	0.328	**0.519**	0.420	0.276	0.466
PIN1	0.443	0.427	**0.564**	0.507	0.493	0.487	0.495
PIN2	0.351	0.526	**0.658**	0.498	0.382	0.440	0.466
PIN3	0.568	0.507	**0.798**	0.623	0.544	0.433	0.475
PIN4	0.200	0.290	**0.452**	0.240	0.223	0.165	0.214
PIN5	0.480	0.523	**0.787**	0.538	0.473	0.425	0.491
PS	0.688	0.657	0.592	0.824	0.655	0.648	**0.899**
PT	0.701	0.740	0.601	0.765	0.658	0.628	**0.897**
PU	0.654	0.628	0.630	**0.818**	0.721	0.587	0.715
RAD	0.686	0.749	0.697	**0.857**	0.679	0.593	0.785
RTC	**0.897**	0.620	0.593	0.739	0.634	0.622	0.704
SE	0.521	0.595	0.561	0.689	**0.838**	0.611	0.616
SERQ	0.639	0.673	0.567	**0.794**	0.632	0.632	0.664
SINF	0.396	0.482	0.365	0.521	**0.666**	0.371	0.427
SYSQ	0.638	0.628	0.607	**0.794**	0.669	0.527	0.666
TECA	**0.877**	0.456	0.545	0.724	0.602	0.528	0.665
TRI	0.745	0.648	0.644	**0.835**	0.757	0.585	0.726

Note: The indicators used to operationalize each latent variable are highlighted in bold type

4.3.1.4 Evaluation of Structural (Inner) Model

The path diagram for the structural model is illustrated in Figure 4-6. Table 4-10 shows that all the standardized path coefficients (β) were significantly greater than zero (p < 0.05), indicated by t > 1.98 for the t-tests.

Table 4-10 Statistical significance of path coefficients

Path	β	t	p
Effort expectancy (EFE) → Intention to use (ITU)	0.138	2.078	0.038*
Facilitating conditions (FAC) → Intention to use (ITU)	0.311	2.310	0.021*
Performance expectancy (PEX) → Intention to use (ITU)	0.388	2.102	0.036*
Social influence (SIN) → Intention to use (ITU)	0.119	2.207	0.027*
Trust on data (TOD) → Trust on system (TOS)	0.710	10.030	<.001*
Trust on system (TOS) → Intention to use (ITU)	-0.114	2.123	0.034*

Note: * Significant (p < .05)

The strongest positive predictor of Intention to use was Performance expectancy (β = 0.388); followed in order of importance by Facilitating conditions (β = 0.311); Effort expectancy (β = 0.138) and Social influence (β = 0.119). The positive path coefficients predicted that the participants perceived that a high level of agreement to use educational online/mobile Government services was associated with a high level of Performance expectancy, Facilitating conditions, Effort expectancy, and Social influence.

Trust on system was a significant negative predictor of Intention to use (β = -0.114). The negative coefficient implied that the participants perceived that a high level of agreement to use educational online/mobile Government services was associated with a low level of trust of the system (reflected by disagreement with responses to questions such as "I believe that online/ mobile systems of learning are trustworthy"). Although Trust on data was not a significant predictor of Intention to use online/mobile Government services, Trust on data was indirectly associated with Intention to use, via its very strong significant positive correlation with Trust on system (β = 0.710).

The effect size (R2 = 0.599) indicated that about 60% of the variance in Intention to use educational online/mobile Government services was explained by the model. The effect size was more than the 25% generally accepted to indicate a model with practical as well statistical significance.
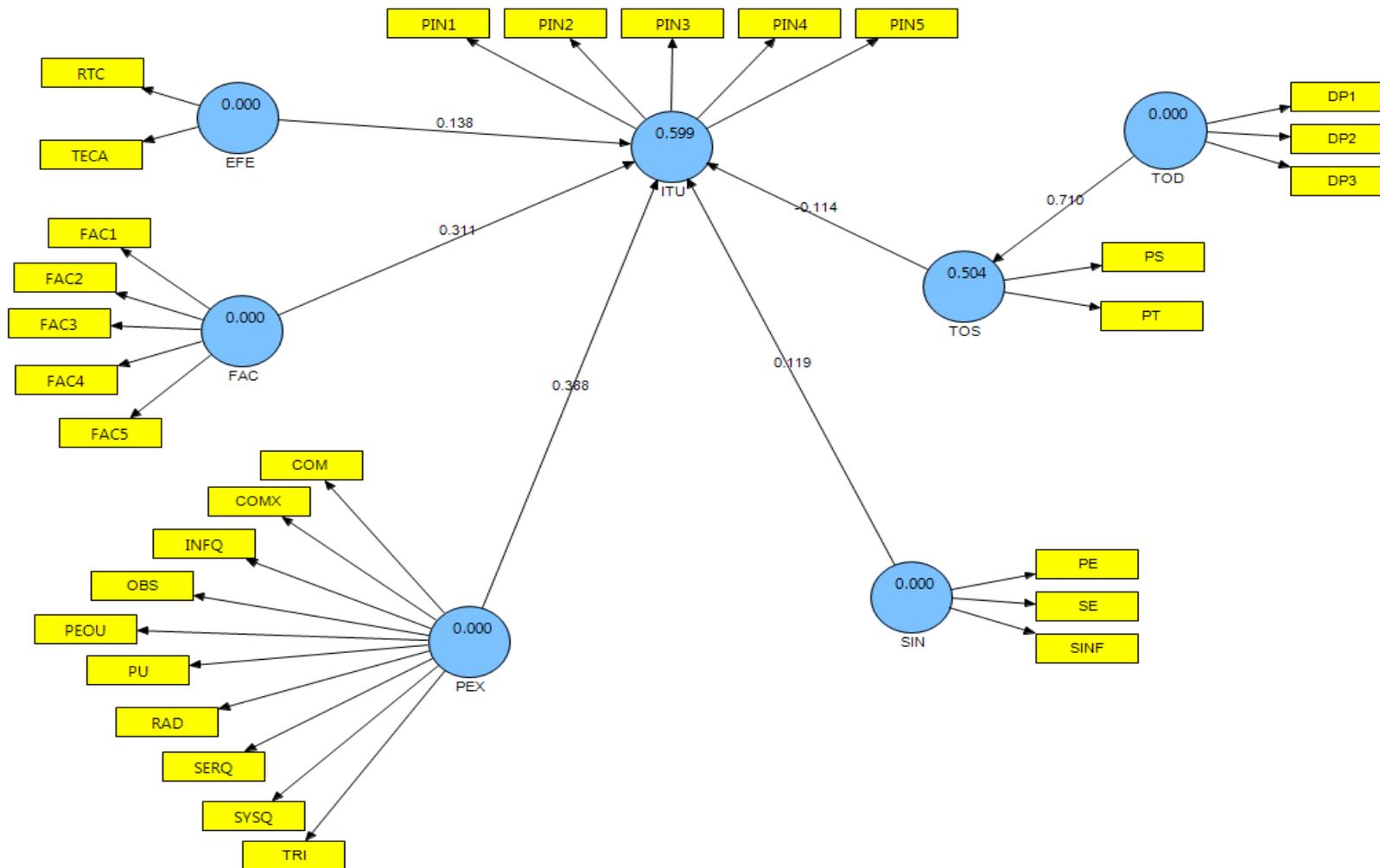
Figure 4-6 Structural model (exported from the graphic user interface of SmartPLS)

4.3.2 Quantitative Results of Health Sector

The results are presented in the following sections: 4.4.2.1 Characteristics of Participants; 4.4.2.2 Descriptive Analysis of Variables; 4.4.2.3 Validation of Measurement (Outer) Model and 4.4.2.4 Evaluation of Structural (Inner) Model.

4.3.2.1   Characteristics of Participants

The demographic characteristics of the 341 participants (based on their responses to items 1 to 6 in Part A: Background information) are summarized in Table 4-11.

Table 4-11 Demographic characteristics of participants

Variable	Category	Frequency	Percent
Gender	Female	221	64.8
	Male	104	30.5
	other	16	4.7
Age (years)	< 20	53	15.5
	20-29	182	53.4
	30-39	82	24.0
	40-49	24	7.0
Education	High school certificate	82	24.0
	Bachelor's degree	150	44.0
	Postgraduate degree	109	32.0
Employment	Student	100	29.3
	Government employee	216	63.3
	Non-government employee	25	7.3
Nationality	Emirati	266	78.0
	Non-Emirati	75	22.0
Language	English	118	34.6
	Arabic	98	28.7
	English and Arabic	125	36.7

Most of the participants (221, 64.8%) were female. They ranged in age from 18 to over 50 years. Over half of the participants (182, 53.4%) were in the 20-29-year-old age-group. The most frequent level of education was bachelor's degree (150, 44.0%). About one quarter (82, 24.0%) had a High School certificate, and the remainder had a Postgraduate degree. The employment of the participants included student, government employees, and non-government

employees, of which the most frequent was government employees (216, 63.3%) The nationality of over three quarters of the participants (266, 78.0%) was Emirati, and about over one third (125, 36.7%) spoke both Arabic and English.

Pearson's Chi Square tests were used to determine if there were significant ($p < .05$) associations between the frequencies of the participants classified by gender, age and education. The significant associations indicated that gender, age and education were not independent.

Gender was significantly associated with education (Chi Square (1) = 132.38, $p < .001$). The cross-tabulation indicated that the frequency of male participants with a high school/other education (56, 53.8%) was greater than the frequency of female participants (15, 6.8%). The frequency of female participants with a Bachelor/Postgraduate degree (100, 45.2%) was greater than the frequency of male participants (47, 45.2%).

Gender was significantly associated with age (Chi Square (2) = 155.98, $p < .001$). The cross-tabulation indicated that the frequency of younger male participants aged < 20 years (50, 48.1%) was greater than the frequency of younger female participants (3, 1.4%). The frequency of older female participants aged over 30 years (103, 40.6%) was greater than the frequency of older male participants (2, 2.0%).

Age was significantly associated with education (Chi Square (6) = 22.43, $p < .001$). The cross-tabulation indicated that the frequency of younger participants aged < 20 years with a high school/other education (16, 19.5%) was less than the frequency of older participants aged over 20 years (66, 80.5%). The frequency of younger participants aged less than 30, with a postgraduate degree (84, 77.1%) was greater than the frequency of younger participants with a postgraduate degree (25, 22.9%).

The contextual characteristics of the participants (based on their responses to items 7 and 8) are summarized in Table 4-12.

Table 4-12 Contextual characteristics of participants

Variable	Category	Frequency	Percent
How long internet has been used	Never	12	3.5
	< 1 month	2	0.6
	1-5 months	256	75.1
	< 1 year	56	16.4
	> 1 year	15	4.4
Frequency of using internet	Never	22	6.5
	Once per week	173	50.7
	Once a day	126	37.0
	2-3 per week	15	4.4
	Several times a day	5	1.5
Usage of Smartphone	Yes	169	49.6
	No	140	41.1
	Not specified	32	9.4
Current user of online/ mobile health system	Yes	298	87.4
	No	43	12.6
Frequency of visiting online/mobile health systems	Never	36	10.6
	Once a day	54	15.8
	Once a week	216	63.3
	Once a month	30	8.8
	1-2 per month	5	1.5
Preferred channels when accessing information	Websites	149	43.7
	Mobile	190	55.7
	SMS	1	0.3
	Services center	1	0.3

The length of time the participants had used the internet ranged from never (12, 3.5%) to > 1 year (15, 4.4%). The most frequent length of time was 1-5 months (256, 75.1%). Their use of the internet ranged from never (22, 6.5%) to several times a day (5, 1.5%). The most frequent use of the internet was once per week (173, 50.7%). About half of the participants (169, 49.6%) used a Smartphone. The majority (298, 87.4%) were current users of online/mobile health systems. Their frequency of visiting online/mobile health systems ranged from never (36, 10.6%) to 1 to 2 times a month (5, 1.5%). Nearly two thirds of the participants (216, 63.3%) visited online/mobile health systems once a week. Many participants (190, 55.7%) preferred a mobile channel whilst a lower proportion preferred the website (149, 43.7%) and very few used SMS or service canters (2, 0.6%).

4.3.2.2   Descriptive Analysis of Variables

Twenty latent variables were operationalized by averaging the item scores specified in Part B: Constructs and Measured Items. The descriptive statistics are summarized in Table 4-13. The responses provided by each individual respondent encompassed the full range of the 5-point scales. The frequency distributions of the variables were variably skewed (skewness = - 0.25 to 1.38). The skewness was not consistently negative or positive, meaning that the participants did not consistently cluster their responses at one extreme end or the other of the 5-point Likert scales. All the Kolmogorov-Smirnov test statistics were significant (p <.001) implying the 20 variables deviated from normality. Consequently, parametric statistics that assumed normal distributions (e.g., mean and standard deviation) were not applicable.

The highest median scores (> 3.0) reflecting the highest levels of endorsement were for Personnel Innovativeness (3.40); Technological anxiety (3.33); Perceived enjoyment (3.20); and Perceived ease of use (3.20). The smallest median scores (< 2.7) reflecting the lowest levels of endorsement, were for Social influence (2.67); Resistance to change (2.67); Services quality (2.60); Compatibility (2.50); and Facilitating conditions (2.40).

Table 4-13 Descriptive analysis and normality tests for 20 latent variables

Variable	Abb.	Mean	Median	Mode	SD	Skewness	K-S statistic	p
Personnel innovativeness	PIN	3.27	3.40	3.40	0.69	-0.25	3.41	<.001***
Technological anxiety	TECA	3.05	3.33	2.00	1.00	-0.09	3.10	<.001***
Perceived enjoyment	PE	3.16	3.20	3.20	0.68	0.41	3.47	<.001***
Perceived ease of use	PEOU	3.14	3.20	3.20	0.87	0.19	2.99	<.001***
Relative advantage	RAD	3.11	3.00	3.25	0.66	0.81	2.87	<.001***
Data privacy	DP	3.09	3.00	2.00	0.98	0.29	3.63	<.001***
System quality	SYSQ	3.06	3.00	3.20	0.95	0.33	3.43	<.001***
Observability	OBS	3.01	3.00	2.50	0.73	0.37	2.53	<.001***
Perceived trustworthiness	PT	3.02	2.80	2.80	0.76	0.93	4.36	<.001***
Perceived usefulness	PU	2.99	2.80	2.80	0.83	0.55	3.28	<.001***
Perceived security	PS	2.84	2.80	2.20	0.76	0.90	4.30	<.001***
Information quality	INFQ	3.16	2.67	2.33	0.98	0.48	3.94	<.001***
Trialability	TRI	3.05	2.67	2.67	0.89	0.48	5.08	<.001***
Self-efficacy	SE	2.90	2.67	2.67	0.86	0.86	5.90	<.001***

Complexity	COMX	2.88	2.67	3.33	0.85	0.40	3.37	<.001***
Social influence	SINF	2.83	2.67	1.67	0.99	0.26	3.07	<.001***
Resistance to change	RTC	2.80	2.67	2.00	0.94	0.79	3.39	<.001***
Services quality	SERQ	2.99	2.60	2.40	1.00	1.10	5.12	<.001***
Compatibility	COM	2.65	2.50	2.00	0.78	1.38	4.31	<.001***
Facilitating conditions	FAC	2.74	2.40	2.20	0.91	1.50	4.44	<.001***

Note: *** Significant (p < .001) deviation from normality

Table 4-14 presents a matrix of Spearman's rho (non-parametric) correlation coefficients between the 20 variables. All but five of the correlations were statistically significant (p < .01). To alleviate threats to validity, including redundancy and over-specification, associated with multicollinearity, clusters of inter-correlated exogenous variables were composited, in order to produce an optimum parsimonious model, with the smallest possible number of variables. Consequently, the 20 inter-correlated variables were condensed into the seven variables defined by the Unified Theory of Acceptance and Use of Technology (UTAUT) model.

Table 4-14 Bivariate correlation matrix

	PEOU	PU	PS	PE	PT	PIN	DP	SINF	RAD	COM	COMX	TRI	OBS	TECA	RTC	SE	FAC	SERQ	SYSQ	INFQ
PEOU	1																			
PU	.919**	1																		
PS	.458**	.629**	1																	
PE	.291**	.494**	.745**	1																
PT	.421**	.445**	.544**	.555**	1															
PIN	.431**	.569**	.740**	.710**	.294**	1														
DP	.595**	.542**	.248**	.039	.631**	.014	1													
SINF	.269**	.288**	.272**	.410**	.606**	.118*	.458**	1												
RAD	.491**	.481**	.431**	.307**	.698**	.133*	.636**	.586**	1											
COM	.595**	.676**	.720**	.507**	.606**	.443**	.543**	.453**	.809**	1										
COMX	.442**	.407**	.374**	.284**	.731**	.072	.663**	.506**	.773**	.783**	1									
TRI	.471**	.504**	.514**	.167**	.340**	.230**	.594**	.274**	.659**	.700**	.439**	1								
OBS	.556**	.668**	.561**	.590**	.427**	.399**	.355**	.508**	.674**	.765**	.479**	.546**	1							
TECA	.641**	.656**	.365**	.346**	.269**	.213**	.285**	.474**	.648**	.678**	.441**	.439**	.810**	1						
RTC	.724**	.678**	.527**	.251**	.559**	.388**	.591**	.315**	.692**	.813**	.728**	.530**	.516**	.634**	1					
SE	.480**	.576**	.753**	.491**	.219**	.669**	.110*	-0.038	.402**	.751**	.373**	.480**	.559**	.500**	.653**	1				
FAC	.405**	.438**	.467**	.346**	.278**	.402**	.177**	.473**	.432**	.532**	.196**	.366**	.534**	.620**	.556**	.428**	1			
SERQ	.505**	.597**	.383**	.431**	.051	.389**	.101	.193**	.207**	.505**	.220**	.195**	.603**	.668**	.436**	.551**	.629**	1		
SYSQ	.703**	.737**	.334**	.421**	.271**	.363**	.367**	.332**	.311**	.559**	.471**	.179**	.580**	.675**	.617**	.453**	.442**	.842**	1	
INFQ	.561**	.646**	.547**	.359**	0.048	.478**	.140**	0.091	.262**	.629**	.275**	.399**	.530**	.682**	.623**	.751**	.596**	.829**	.744**	1

Note: Significant correlation ** $p < .01$

Kruskal-Wallis (non-parametric) tests were conducted to determine if Intention to use varied significantly with respect to demographic variables (gender, age, and education). The results are presented in Table 5-15. The Kruskal-Wallis Chi Square statistics indicated that the median scores for Intention to use did not vary significantly at the 0.05 level (p = 0.065 to 0.266) with respect to gender, age, and education. Consequently, it was not necessary to determine if the results of PLS-SEM to predict the intention to use online/mobile Government health services varied with respect to these demographic variables.

Table 4-15 Variation in intention to use by demographic variables

Variable	Category	Median Intention to use	Kruskal-Wallis Chi Square	p
Gender	Female	3.59	2.649	.266
	Male	3.37		
	Trans	3.07		
Age (years)	< 30	3.18	2.903	.088
	30-49	3.99		
Education	High school certificate	3.37	5.462	.065
	Bachelor's degree	3.41		
	Postgraduate degree	3.56		

4.3.2.3 Validation of Measurement (Outer) Model

The path diagram for the PLS-SEM measurement model is illustrated in Figure 4-7. All the factor loading coefficients in the measurement model (labelled between the seven latent variables and their respective clusters of indicators) were consistently ≥ 0.5, reflecting the construct validity of the latent variables. Table 4-16 presents the statistics for the average variance explained (AVE) and the tests for reliability. Table 4-17 presents the cross-loadings of the factor loading coefficients for the items that constituted each latent variable.
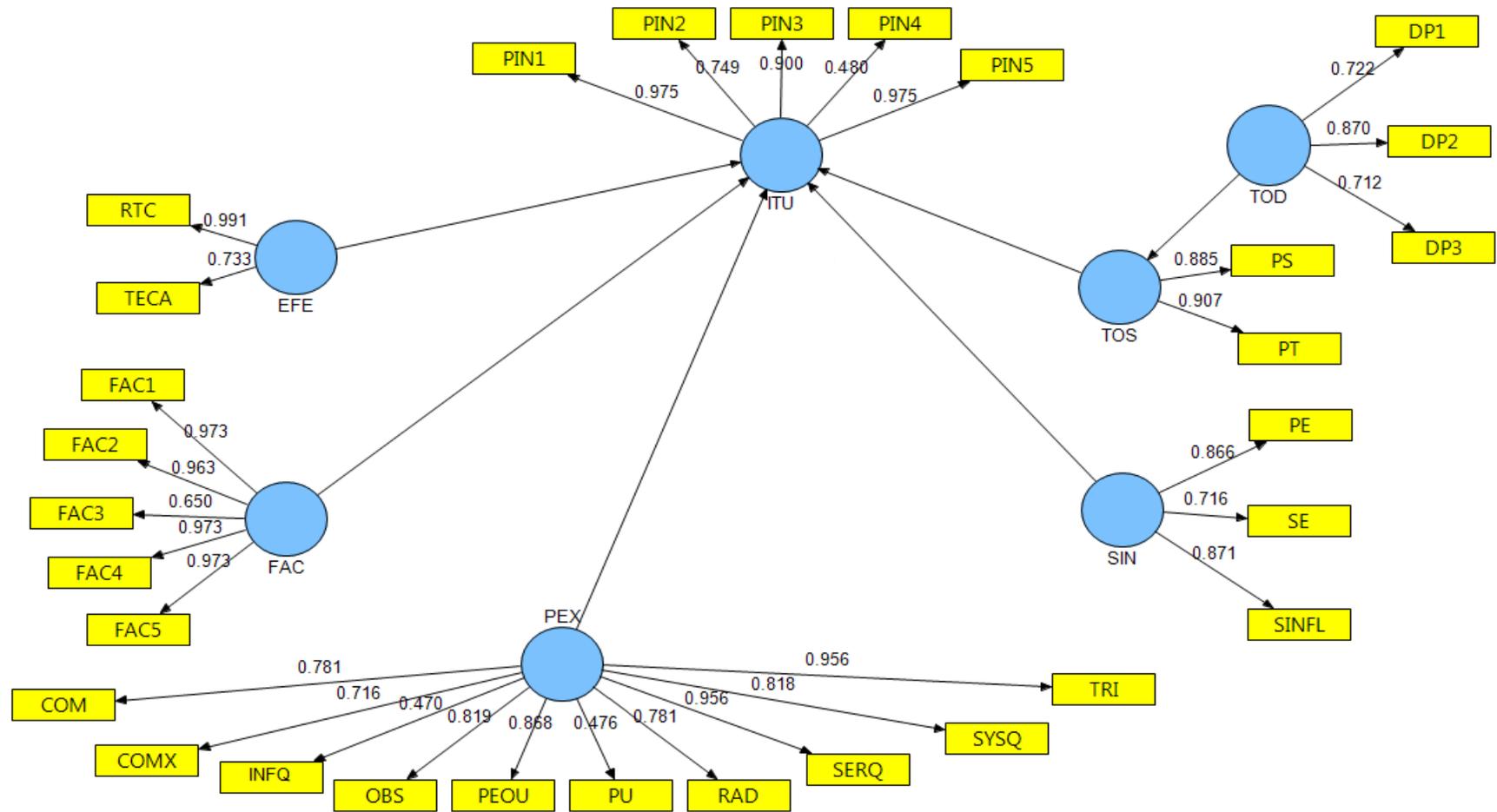
Figure 4-7 Measurement model (exported from the graphic user interface of SmartPLS)

Table 4-16 Average variance explained (AVE) and reliability

	AVE	Square Root AVE	Composite Reliability
Effort expectancy (EFE)	0.759	0.871	0.861
Facilitating conditions (FAC)	0.838	0.915	0.962
Performance expectancy (PEX)	0.683	0.826	0.909
Social influence (SIN)	0.580	0.762	0.928
Trust on data (TOD)	0.673	0.820	0.860
Trust on system (TOS)	0.595	0.771	0.814
Intention to use (ITU)	0.801	0.895	0.890

The average variance explained (AVE) ranged from 0.580 for Social Influence on 0.838 for Facilitating Conditions and was greater than the minimum AVE (0.5) that is required to indicate an acceptable level of convergent validity. The composite reliability statistics exceeded 0.7 (ranging from 0.814 for Trust on system to 0.928 for Social influence) reflecting a good level of internal consistency for the items chosen to operationalize the seven latent variables. Discriminant validity was acceptable because the factor loadings for the items that constituted each latent variable (highlighted in bold in Table 5-4) were consistently greater than their cross-loadings. Furthermore, discriminant validity was indicated because the square roots of AVE listed in Table 4-16 were consistently greater than the path coefficients (β) between the latent variables listed in Table 4-18.

Table 4-17 Cross-loadings

Indicators	Latent variables						
	EFE	FAC	ITU	PEX	SIN	TOD	TOS
COM	0.834	0.208	0.130	**0.781**	0.503	0.585	0.885
COMX	0.618	0.013	-0.056	**0.716**	0.136	0.661	0.644
DP1	0.449	-0.114	-0.152	0.379	0.250	**0.722**	0.539
DP2	0.470	-0.066	-0.384	0.353	-0.237	**0.870**	0.597
DP3	0.422	-0.142	-0.192	0.425	-0.098	**0.712**	0.411
FAC1	0.296	**0.973**	0.447	0.407	0.245	-0.078	0.238
FAC2	0.272	**0.963**	0.483	0.397	0.263	-0.113	0.228
FAC3	0.001	**0.650**	0.493	-0.028	0.348	-0.238	0.165
FAC4	0.296	**0.973**	0.447	0.407	0.245	-0.078	0.238

FAC5	0.296	**0.973**	0.447	0.407	0.245	-0.078	0.238
INFQ	0.718	0.013	-0.056	**0.885**	0.136	0.661	0.844
OBS	0.595	0.427	0.206	**0.819**	0.451	0.370	0.656
PE	0.281	0.390	0.752	0.558	**0.866**	0.046	0.594
PEOU	0.749	0.280	0.088	**0.868**	0.276	0.590	0.561
PIN1	0.079	0.531	**0.975**	0.256	0.749	-0.310	0.209
PIN2	0.014	0.128	**0.749**	0.234	0.871	-0.222	0.095
PIN3	0.069	0.653	**0.900**	0.305	0.625	-0.232	0.250
PIN4	-0.403	0.277	**0.480**	-0.459	-0.055	-0.442	-0.192
PIN5	0.079	0.531	**0.975**	0.256	0.749	-0.310	0.209
PS	0.834	0.208	0.130	0.781	0.503	0.585	**0.885**
PT	0.540	0.230	0.207	0.427	0.319	0.630	**0.907**
PU	0.718	0.013	-0.056	**0.876**	0.136	0.661	0.844
RAD	0.834	0.208	0.130	**0.781**	0.503	0.585	0.885
RTC	**0.991**	0.201	0.038	0.715	0.298	0.604	0.759
SE	0.663	0.220	0.370	0.661	**0.716**	0.189	0.525
SERQ	0.711	0.271	0.219	**0.956**	0.486	0.546	0.619
SINF	0.014	0.128	0.749	0.234	**0.871**	-0.222	0.095
SYSQ	0.660	0.236	0.224	**0.818**	0.364	0.308	0.455
TECA	**0.733**	0.441	0.007	0.786	0.205	0.270	0.517
TRI	0.711	0.271	0.219	**0.956**	0.486	0.546	0.619

Note: The indicators used to operationalize each latent variable are highlighted in bold type

4.3.2.4 Evaluation of Structural (Inner) Model
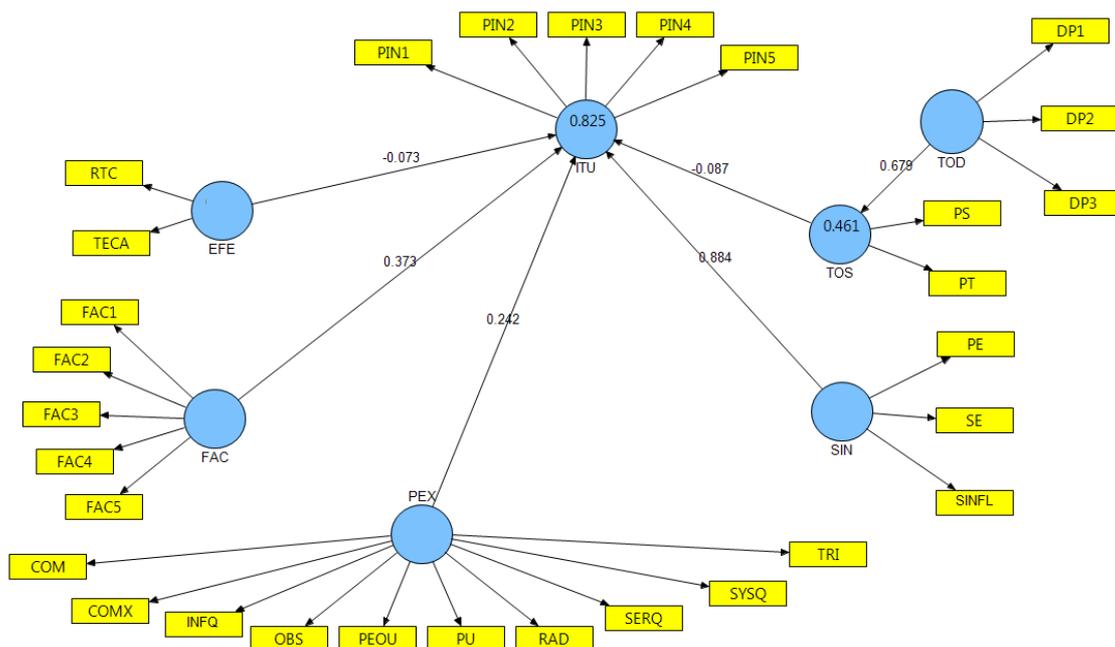
Figure 4-8 Structural model (exported from the graphic user interface of SmartPLS)

The path diagram for the structural model is illustrated in Figure 4-8. Table 4-18 shows that four of the standardized path coefficients (β) were significantly greater than zero (p < 0.05), indicated by t > 1.98 for the t-tests.

Table 4-18 Statistical significance of path coefficients

Path	β	t	p
Effort expectancy (EFE) → Intention to use (ITU)	-0.073	0.883	.377
Facilitating conditions (FAC) → Intention to use (ITU)	0.373	8.650	<.001*
Performance expectancy (PEX) → Intention to use (ITU)	0.242	3.138	<.001*
Social influence (SIN) → Intention to use (ITU)	0.884	22.169	<.001*
Trust on data (TOD) → Trust on system (TOS)	0.679	22.661	<.001*
Trust on system (TOS) → Intention to use (ITU)	-0.087	1.290	.197

Note: * Significant (p < .05)

The strongest positive predictor of Intention to use was Social Influence (β = 0.884); followed in order of importance by Facilitating conditions (β = 0.373) and Performance expectancy (β = 0.119). The positive path coefficients predicted that the participants perceived that a high level of agreement to use online/mobile Government health services was associated with a high level of Social influence, and lower levels of Facilitating conditions and Performance expectancy.

Trust on data was a strong predictor of Trust on system (β = 0.679); however, trust on system was not a significant predictor of Intention to use (β = -0.087).

The effect size (R2 = 0.825) indicated that a high proportion (82.5%) of the variance in Intention to use online/mobile Government health services was explained by the model. This effect size was well more than the 25% generally accepted to indicate a model with practical as well statistical significance.

4.4 Qualitative Methodology

The mixed methods used in the study were based on two reasons. Firstly, the problem of theory building and measurement in quantitative research which may result from insufficient and incomplete theoretical concepts, for example, a failure to identify explanatory variables, mis-specification of models among other things. Secondly, the problem of case selection and transferability in qualitative research due to inadequate operationalization procedures undermines the generalizability of qualitative research. However, using both in the study ensured that the weaknesses of each method are covered, and the resultant model based on counterchecked measures or metrics.

Moreover, there are very few UTAUAT studies that have used quantitative methods, especially pertaining to mobile learning. As elaborated, qualitative research studies focus on observations taking in natural settings and promote understanding of complex issues such as the ones investigated in this study. The study used interviews to gather the qualitative data. In-person interviews offer several strengths. By being physically present, the interviewer can decrease the number of "don't know" and "no answer" responses by probing for additional responses. Interviewers can clarify questions for respondents when needed. Moreover, interviews can be used in conjunction with surveys to gain more in-depth understanding responses. For this dissertation interviews can explore the use of mobile learning to provide data for subsequent research.

4.4.1 Qualitative Analysis Results

The data was collected from two participants from the health sector and one from the education sector. A conceptual saturation point was reached after the third interview because the same ideas from different interviewees started to be repeated. For this reason, three interviews were thought sufficient for this phase of data collection. As mentioned above, these participants are the decision makers who are involved in eGovernance projects.

4.4.1.1 Phase 1: Health Sector

The two participants from the health sector were both males in the age group of 40 to 50 years. The first participant, henceforth referred to as Participant 1, is a PhD holder and currently serving as the ICT Director at the Ministry of Health. The second participant, henceforth referred to as Participant 2, holds a bachelor's degree and is currently serving as the Head of Projects at the Ministry of Health.

In Figure 4-9, a word cloud based on the responses from Participant 1 suggests that mobile, services, and online were the most used words. These three words alongside explicitly expressed opinions suggest that e-governance, online health services, and the technologies used to deliver the services are dependent on acceptance and their contribution to efficiency.

Figure 4-9 The Word Cloud Summary of the Qualitative Data obtained from the first Participant.

The Word Cloud chart shows the most frequently used words. The Chart suggests Important Views Hidden in the Data

In Figure 4-10, a hierarchical breakdown of the keywords suggests that services in the context of mobile health focus on mobile services whether for governance, educational or health care support. However, the ICT experts assert that these services are dependent on systems and platforms that are accessible online so that security and quality have a greater influence on perceptions as well as technical anxiety.
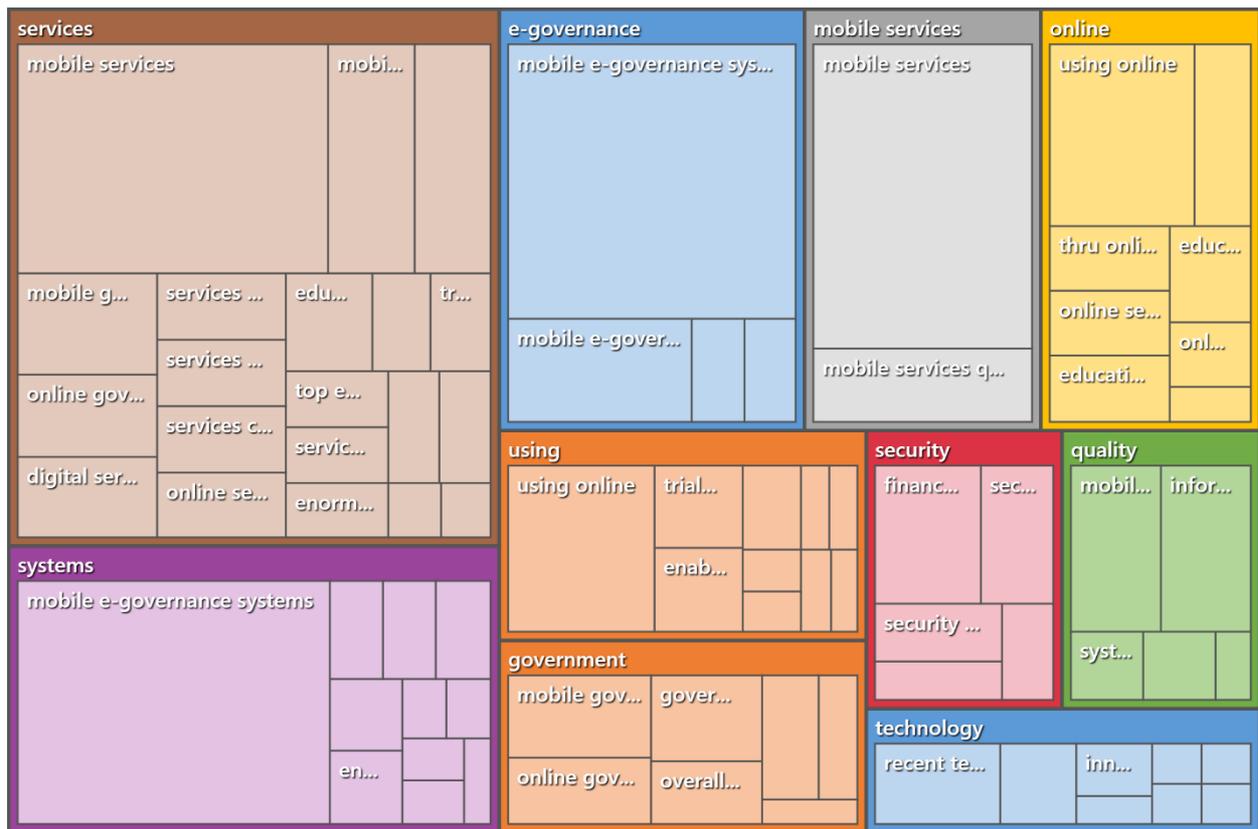
Figure 4-10 The Hierarchical Chart Associated with words

Figure 4-10 depicts the hierarchical Chart Associated with words that the first Respondent commonly used in answering the interview Questions. The key words revolve around services, e-governance, mobile services, and online activities as they pertain to use of technology in the Health Sector. The figure also demonstrated the themes that were automatically deduced from the data. Based on Figure 4-9 and Figure 4-10, the major thematic areas that emerged from the responses that the participant gave can be summarized as follows. It is pertinent to note that the coding of the themes was based on the major opinions that the respondent provided.

Table 4-19 Themes and Coding References of the Responses from the First Respondent

Themes	Files\\Participant 1
1: e-governance	16
2: government	9
3: mobile services	14
4: online	10
5: quality	8
6: security	7
7: services	36
8: systems	21
9: technology	12
10: using	12

The themes emerged from the questions that were asked to ascertain or solicit opinion regarding the underlying theoretical discourse. The distribution of the number of words coded under of the 10 themes is as shown in the following figure.
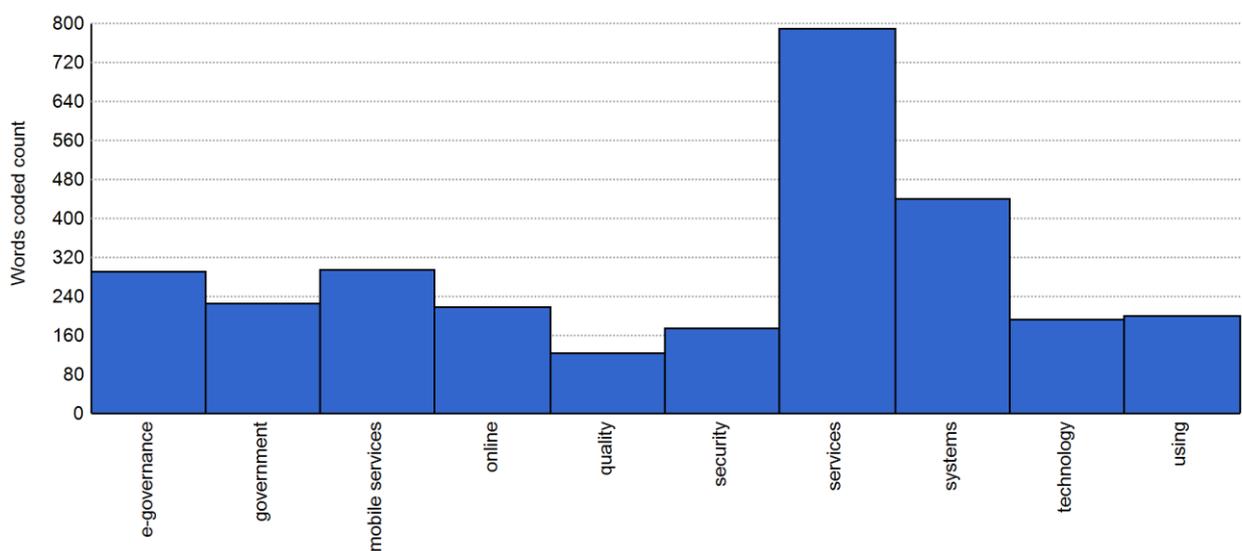

Figure 4-11 The Histogram Visualizing the Number of Words

Figure 4-11 shows the histogram visualizing the number of words coded for each of the focus themes for participant 1. The graphs show that the e-governance theme had 290 code referenced words. The service theme had the highest number of words (789), while the participant made the least reference about the quality of the services and technology used to offer the services. Government, Mobile Services, Online, Security, Systems, and Technology had 224, 291, 218, 171, 437, and 191-word references in the response provided by Participant 1.

The table below gives a further detailed account of the expression of opinions based on the identified themes. However, it is important to emphasize that the themes were considered in other contexts and the query criterion targeted the search for similar words to provide more semantic information about the user.

Table 4-20 Word Similarity based on Responses Provided for the Interview Questions

Word	Length	Count	Weight (%)	Similar Words
system	6	75	5.15	organization, organizations, system, systems, systems'
services	8	71	4.82	avail, available, help, helps, service, services
using	5	63	4.48	applied, enjoyable, enjoyed, functionality, usage, use, used, useful, uses, using
mobile	6	49	3.55	mobile, mobility
online	6	39	2.83	online
governance	10	39	2.47	established, governance, government, organization, organizations
find	4	51	2.38	chance, encounter, feel, feelings, find, get, getting, happen, notice, noticed, observed, received, see
well	4	37	2.26	comfortable, considerable, easily, good, health, well
think	5	29	1.69	believe, consider, considered, guess, mean, think, thinking, thoughts
technologies	12	23	1.67	technical, technological, technologies, technology
users	5	21	1.52	user, users
new	3	22	1.45	modern, new
good	4	31	1.31	beneficial, dependent, depends, effective, full, good, honest, rights, secure, security, skill, skills
proposed	8	21	1.20	offer, offered, offering, offers, proposal, proposed, proposing
features	8	16	1.16	feature, features

The above table samples some of the emphasized phrases giving an overall view of the opinions and attitudes expressed on various aspects of technology acceptance in healthcare.
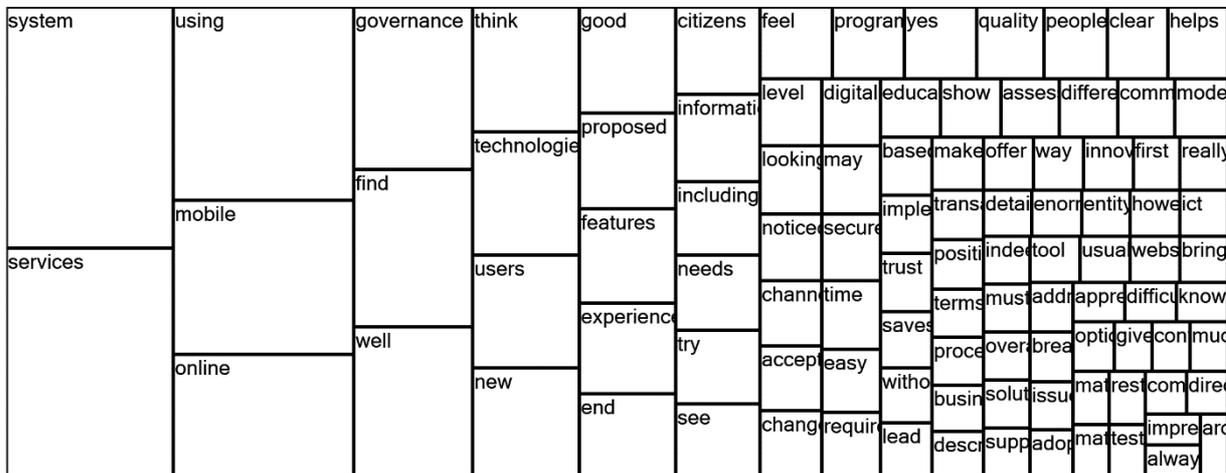
Figure 4-12 The Tree Map Associated with the Word Cloud and Word Similarity for Participant 1.

The tree map suggests that System and Services are the root cause or the key factors that influence technical anxiety and perceived usefulness of technology in the health sector.

The word cloud of the responses provided by Participant 2 is as shown in Figure 4-13. The keywords include online, government, system, mobile, and find. The figure suggests similarity of thoughts between the participants.

Figure 4-13 The Words Cloud Summary of the Qualitative Data obtained from the Second Participant.

In Figure 4-13, the words cloud chart shows the most frequently used words. The Chart suggests Important Views Hidden in the Data. The figure also shows a hierarchical breakdown of the keywords, which suggests that services in the context of mobile health focus on mobile services whether for governance, educational or health care support. However, the ICT experts assert that these services are dependent on systems and platforms that are accessible online so that security and quality have a greater influence on perceptions as well as technical anxiety. The diagram visualizing the hierarchy of the coded references of the most frequent words is as shown in Figure 4-14.

Figure 4-14 The Hierarchical Chart Associated with words of Second Respondent

Figure 4-14 shows The Hierarchical Chart Associated with words that the second respondent commonly used in answering the interview Questions. The keywords revolve around services, mobile serves, mobile e-governance, systems, and mobile e-governance systems. Based on Figure 4-13 and Figure 4-14, the major thematic areas that emerged from the responses that the participant gave can be summarized as follows. The theme and coding table shows that services had the most references and despite reporting only 9 themes, the similarity in the opinion that Participant 1 and Participant 2 expressed cannot be ignored.

Table 4-21 Themes and Coding References of the Responses from the Second Respondent

	Files\\Participant 2
1: government	12
2: mobile e-governance	17
3: mobile services	11
4: online	7
5: quality	7
6: services	33
7: systems	23
8: technology	7
9: using	10

The themes emerged from the questions that were asked to ascertain or solicit opinion regarding the underlying theoretical discourse. The distribution of the number of words coded under the 10 themes is as shown in the following figure.
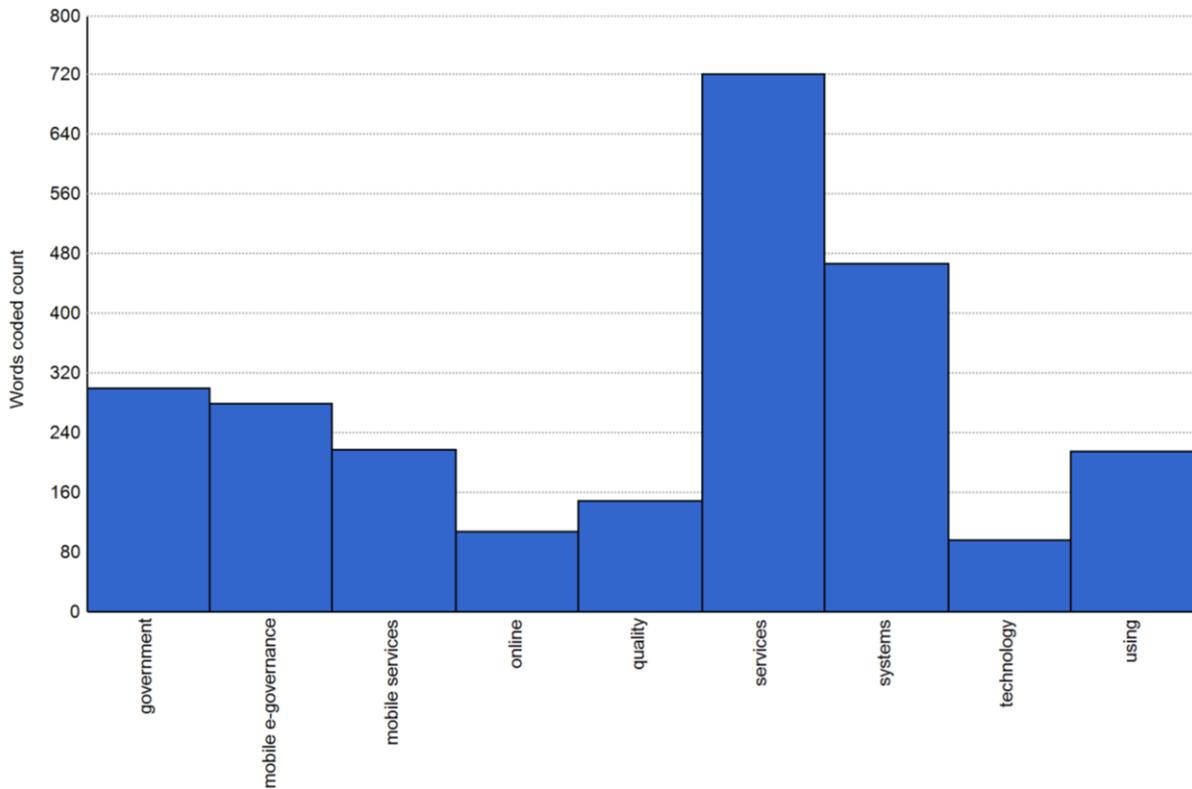
Figure 4-15 The Histogram Visualizes the Number of Words Coded for Each of the Focus for Participant 2.

The histogram shows that the e-governance theme had 290 code referenced words. The service theme had the highest number of words (720), while the participant made the fewest references about technology used to offer the services. Government, Mobiles eGovernance, Mobile Services, Online, Quality, and Systems had 299, 278, 217, 107,147, and 467-word references in the response provided by Participant 2.

Word	Length	Count	Weighted Percentage (%)	Similar Words
system	6	76	5.28	organization, organizations, system, systems, systems'
services	8	70	4.72	available, help, helped, helps, service, services
using	5	60	4.20	enjoyable, enjoyed, enjoyment, functioning, practical, use, used, useful, using, utilizing
government	10	51	3.38	controller, governance, government, organization, organizations
mobile	6	42	3.11	mobile
online	6	38	2.81	online
find	4	55	2.79	feel, find, finding, get, getting, happen, happening, happens, notice, noticed, observed, received, see
think	5	37	2.10	consider, considered, guess, intelligence, mean, means, reasons, recall, think, thoughts
new	3	24	1.73	modern, new, newly
users	5	23	1.70	user, users, users'
technologies	12	19	1.41	technical, technological, technologies, technology
citizens	8	17	1.26	citizen, citizens
needs	5	23	1.15	asked, involve, involved, need, needs, require, required, requirement, requirements
end	3	16	1.11	end, last
secure	6	19	1.10	ensure, good, protected, secure, security
proposed	8	19	1.06	offer, offered, projects, proposed, proposing, suggestions
information	11	15	0.96	data, ease, information, informing

The table samples some of the emphasized phrases giving an overall view of the opinions and attitudes expressed on several aspects of technology acceptance in healthcare.
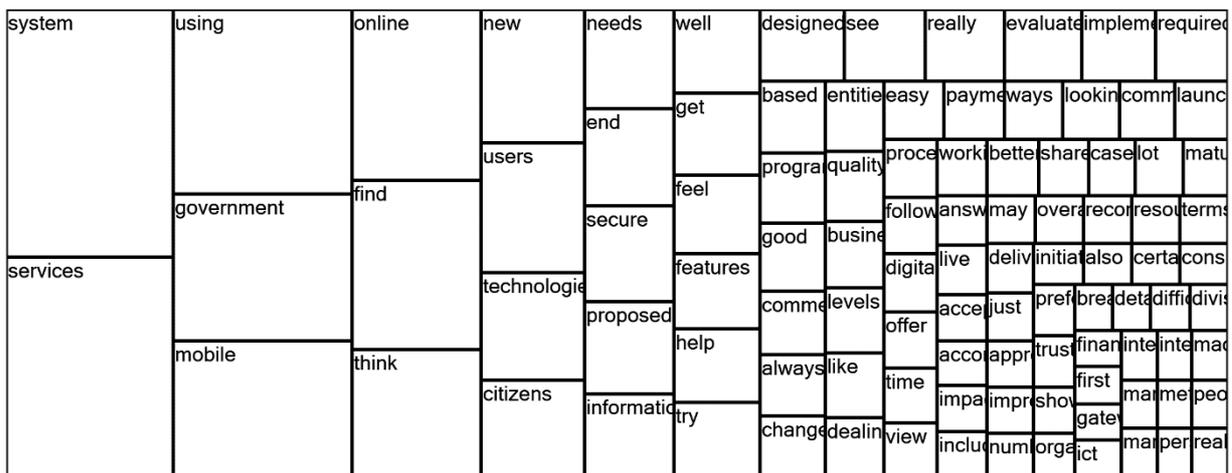
Figure 4-16 A Tree Map

Figure 4-16 depicts a Tree Map associated with the Table 28 showing system and services as the main features in the responses.

4.4.1.2 Sentiments Analysis (Health)

Both Participants expressed both negative and positive sentiments about the application and importance of mobile technology in the health sector.

4.4.1.3 Positive Sentiments

The general positive comments that the respondent made about the subject are summarized in Table 4-23. The table includes a percentage weighting of the polarity embedded in each of the identified statements.

Table 4-23 Very Positive Sentiments from Participant 1 on the Role of Technology in the Health Sector

<Files\\Participant 1> - 10 references coded [16.01% Coverage]
Reference 1 - 0.33% Coverage
It is much easier than traditional commonly used systems.
Reference 2 - 0.47% Coverage
For me, I find very useful and much easier to use than other electronic channels.
Reference 3 - 5.00% Coverage
It is much easier than the traditional systems and the instruction is clear.
Reference 4 - 0.65% Coverage
it is very beneficial as it saves the time and looks very convenient to me.
Reference 5 - 1.54% Coverage
The mobile version that you proposed looks very useful as well in terms of offering end-users with other channels to access same services but on mobility solution.
Reference 6 - 2.32% Coverage
Therefore, at this stage, the system saves a lot of time by enabling users to find out the services offered by health and education services online as well as using mobile version.
Reference 7 - 1.74% Coverage
The citizens may have already seen different web systems and mobile Apps, but they are always looking for something new or new features, which makes their experience more convenient.
Reference 8 - 0.46% Coverage
The current technological advancement sometimes brings new tools and features.
Reference 9 - 1.11% Coverage
It looks very secure because it uses encrypted features as we tested it and it passed without any problems.
Reference 10 - 2.40% Coverage
However, for the system, you are proposing which uses the MVC that is a fully secure model and great API implemented within the system is very good for enterprise-grade security implementation

The number of moderately positive sentiments identified in the responses exceed those of the very positive ones and they are summarized in Table 4-24.

Table 4-24 Moderately positive sentiments of participant 1

<Files\\Participant 1> - § 20 references coded [13.64% Coverage]
Reference 1 - 0.39% Coverage
I had to be honest with you that it was a little bit hard for me to trust these services at the beginning because I had very bad experience before but when I saw the system which offers us with options to use websites and mobile services it encouraged me to move forward using the system.
Reference 2 - 0.27% Coverage
For example, the positive comments included that end-users were able to walkthrough each online and mobile service pertinent to their health records in an effortless way and without any frustrations.
Reference 3 - 0.20% Coverage
Well, I think citizens may lack the information, skills and adequate training to accept modern technologies.
Reference 4 - 0.45% Coverage

However, in my opinion I guess there are many factors which may lead to resistance to adopt a recent technology that may include ICT maturity levels, backgrounds, intention to use, security issues, services and information quality and training.
Reference 5 - 0.41% Coverage
Without a doubt, all resources are available to end-users when using the online/ mobile services as the system offers a live chat assistance.
Reference 6 - 0.26% Coverage
The system which you proposed shows all instructions with clear business services cards.
Reference 7 - 0.68% Coverage
End-users don't really need to go to different websites and use different mobile platforms however they could possibly use this system to find out a comprehensive detail about each government entity especially in health and education.
Reference 8 - 0.83% Coverage
This system helps us as well as end-users including the citizens to find all health and educational services easily without having to search different health websites and or mobile platforms.
Reference 9 - 0.38% Coverage
The proposed system really helps us big time to find all details about services easily.
Reference 10 - 0.38% Coverage
The same I have noticed being implemented in the mobile version as well.
Reference 11 - 1.26% Coverage
The information about all health and education organizations online and mobile services were managed properly, and I noticed how neat was the information about e-services description.
Reference 12 - 0.39% Coverage
People believe using their mobile is more convenient to avail government services.
Reference 13 - 0.36% Coverage
For me I have seen the system, the rest of my team also tested the system who also observed a high level of adoption.
Reference 14 - 0.78% Coverage
Likewise, the system you are proposing is looking very easy to use and the innovative features show a high level of potential adoption by an enormous number of end-users.
Reference 15 - 0.30% Coverage
The multimedia features as well as using social media options were great.
Reference 16 - 0.90% Coverage
The system recommends unique features such as the top ranked organization, top e-government services based on a user's ratings, this feature is good because it helps to improve end-user's system's usage and experience
Reference 17 - 2.50% Coverage
Yes indeed, as I said the end-users will rely on other members or groups to use a new system and will be impacted by their experience and recommendations either to use or not to use the system.
Reference 18 - 1.06% Coverage
I guess what matters to us most is getting the full picture or the overview of what's going on and your system can be a supportive tool for us by bridging some of the existing gaps, which is the inability to realize the ongoing monitoring, steering and directing government entities to achieve national agendas pertinent to e-Governance implementations.
Reference 19 - 0.51% Coverage
Some of them they are trustworthy, and the rest are not.
Reference 20 - 1.34% Coverage
Modern technologies sometimes bring complexity and security concerns, so it is all dependent on the technology design and architecture.
<Files\\Participant 2> - § 14 references coded [8.42% Coverage]
Reference 1 - 0.11% Coverage
Not at the moment, but our division launched it last year as per new services catalogue.
Reference 2 - 0.20% Coverage
Yeah, I think all resources are available when using the online/ mobile services.
Reference 3 - 0.31% Coverage
We saw that your system has some new facilitating and awesome features, which I did not see in other online/ mobile systems.
Reference 4 - 0.41% Coverage
Therefore, I guess your system with such features can really help to facilitate many areas of citizens' needs and I think the community is looking for such initiatives.
Reference 5 - 1.07% Coverage

I think your system is compatible with our business strategy, which supports the innovations and use of new technological advancements.
Reference 6 - 0.55% Coverage
For successful implementation of any government system, it must consider the tradability aspect that means it is good to let people try out a new system.
Reference 7 - 0.84% Coverage
I noticed that the implementation of e-government systems made good changes in terms of delivering new services to citizens.
Reference 8 - 0.53% Coverage
I guess this is a unique feature and I have hardly seen that in other systems.
Reference 9 - 1.42% Coverage
In my opinion, having features like sharing thoughts of users' experiences with each other and letting end-users share comments about each government entity may help to improve the overall enjoyment factor which is a very important thing to consider.
Reference 10 - 0.49% Coverage
In my view, I think people's recommendations have an impact on using the online/ mobile e-Governance systems.
Reference 11 - 0.72% Coverage
Therefore, using the modern technologies helps us to improve and align with government mandates.
Reference 12 - 0.83% Coverage
If it is trustworthy based on users' comments and recommendations and overall community suggestions and needs, I will certainly use it.
Reference 13 - 0.28% Coverage
Therefore, the system enables two-ways authentications and fee secure.
Reference 14 - 0.67% Coverage
By the way, the community is looking for such a unique and innovative tool like your system as it covers most of the technological, governmental issues as well as people's needs.

As for the second participant, the very positive sentiments are summarized in Table 4-25. These sentiments account for 21.65% of the content coverage of the survey questions.

Table 4-25 Very Positive Sentiments from Participant 2 on the Role of Technology in the Health Sector

<Files\\Participant 2> - 11 References Coded [21.65% Coverage]
Reference 1 - 1.27% Coverage
The system you are proposing showed some exceptional handling methods with very practical solutions to handle errors and I find it very useful.
Reference 2 - 1.36% Coverage
The artificial intelligence Chatbot features with a live-chat interface helped me actually to get some valuable answers such as when I asked about the nearest hospital that offers blood donation services and I was really happy at getting an answer in real-time and instantly.
Reference 3 - 1.51% Coverage
I find your system very useful and very practical as well.
Reference 4 - 3.47% Coverage
Like the example, I have given earlier about using the artificial intelligence the Chatbot feature really saves a lot of time and effort.
Reference 5 - 5.00% Coverage
Certainly, I find your system very useful, effective and better than conventional systems.
Reference 6 - 0.73% Coverage
The services, system and information quality look very impressive.
Reference 7 - 1.27% Coverage
We tested the proposed system which incorporated the use of MVC (Model View Controller) which is a model that is highly secure and supports the implementation of all sorts of APIs, so we feel we are in the safest zone to carry on with services that require some payment without any problem.
Reference 8 - 0.94% Coverage
To be fair, it all relies on the type of technology that we are dealing with.
Reference 9 - 1.53% Coverage
The system proposed seems to be trustworthy and very capable of functioning well as per the performance testing we have done.

Reference 10 - 2.63% Coverage
However, based on what I experience using the proposed system made me feel secure because from the registration phase, it enabled me to use the smart logging, which is a unique feature, and I got an SMS with digital number to confirm the registration as well as received an email following successful registration into the system.
Reference 11 - 1.95% Coverage
For instance, I can see the evaluation results, which entities are ranked on top among other organizations, I can also track down all changes made, I can also check new assessments and new uploaded guidelines that are very supportive tools for us.

It emerged from the study that the number of the very and moderately positive sentiments varied between the two respondents. The difference based on the coding is as shown in Figure 4-17 below.
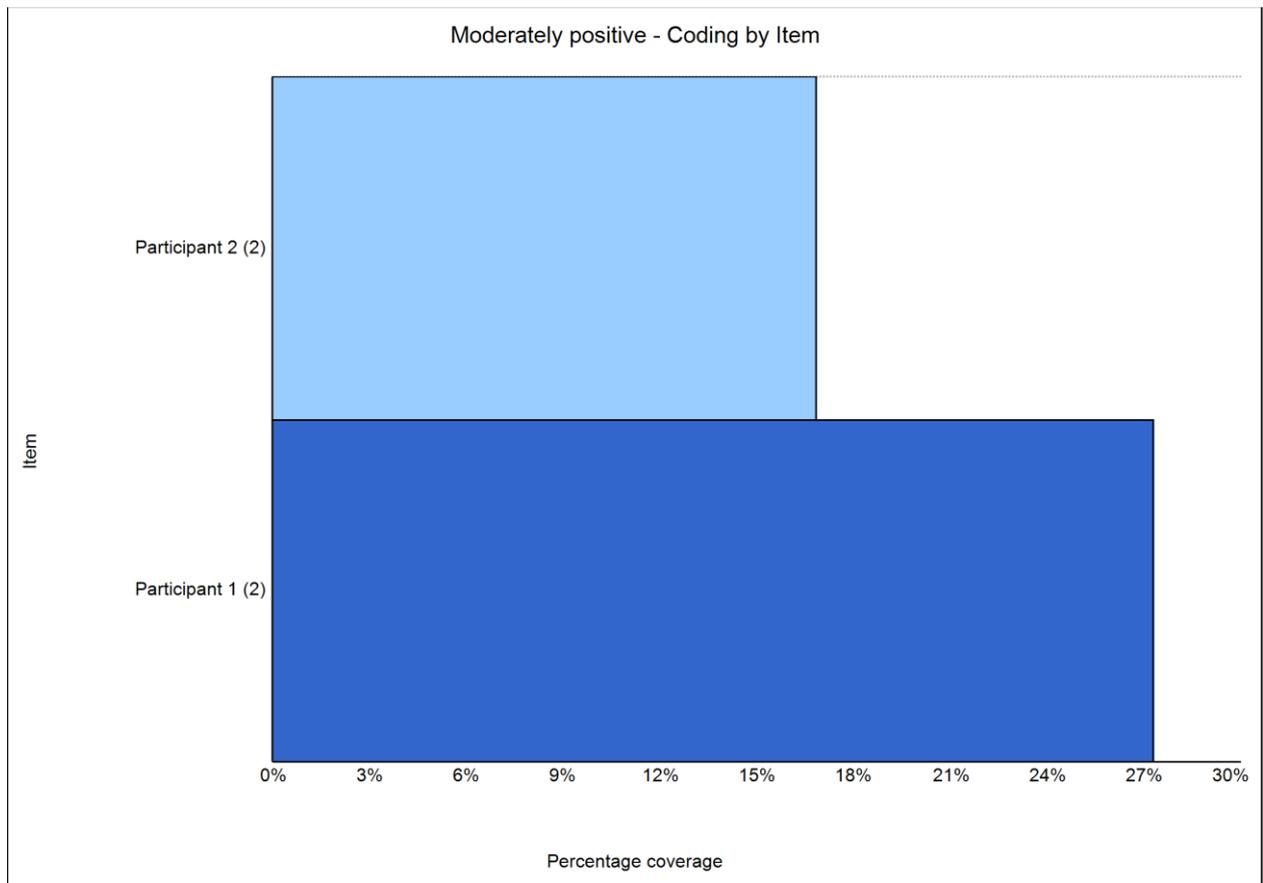
Figure 4-17 The Proportional Distribution of Total Moderately Positive Sentiments

Figure 5-19 shows the proportional Distribution of the total of moderately positive sentiments from the two participants. The second participant had a greater number of moderately positive comments that the first participant.

4.4.1.4   Negative Sentiments

The very negative sentiments that the first participant expressed about the subject are summarized in Table 4-26. The table includes a percentage weighting of the polarity embedded in each of the identified statements.

Table 4-26 Very Negative Sentiments from Participant 1 on the Role of Technology in the Health Sector

<Files\\Participant 1 > - 3 references Coded [3.23% Coverage]
Reference 1 - 0.66% Coverage
As opposed to other systems which offer such services, I don't really trust using them because I must first try them and see if others could share a review or communicate directly with me to tell me about their feelings on using those systems.
Reference 2 - 0.91% Coverage
However, in my opinion I guess there are many factors which may lead to resistance to adopt a recent technology that may include ICT maturity levels, backgrounds, intention to use, security issues, services and information quality and training.
Reference 3 - 1.66% Coverage
This system helps us as well as end-users including the citizens to find all health and educational services easily without having to search different health websites and or mobile platforms.

The very negative sentiments expressed by the second participant are summarized in Table 4-27.

Table 4-27 Very Negative Sentiments from Participant 2 on the Role of Technology in the Health Sector

<Files\\Participant 2 > - § 3 references Coded [1.38% Coverage]
Reference 1 - 0.21% Coverage
However, in reality this is not happening which leads sometimes to resistance to change.
Reference 2 - 0.56% Coverage
Unfortunately, most of our programs do not always succeed and I recall we launched systems that were never used by end-users due to the resistance to change, systems were not developed according to the business and end-user's requirements.
Reference 3 - 0.62% Coverage
Most government entities built their own systems according to their needs but did not consider security concerns and possible future breaches.

The moderately negative sentiments that the two participants made were slightly as illustrated in the figure below.
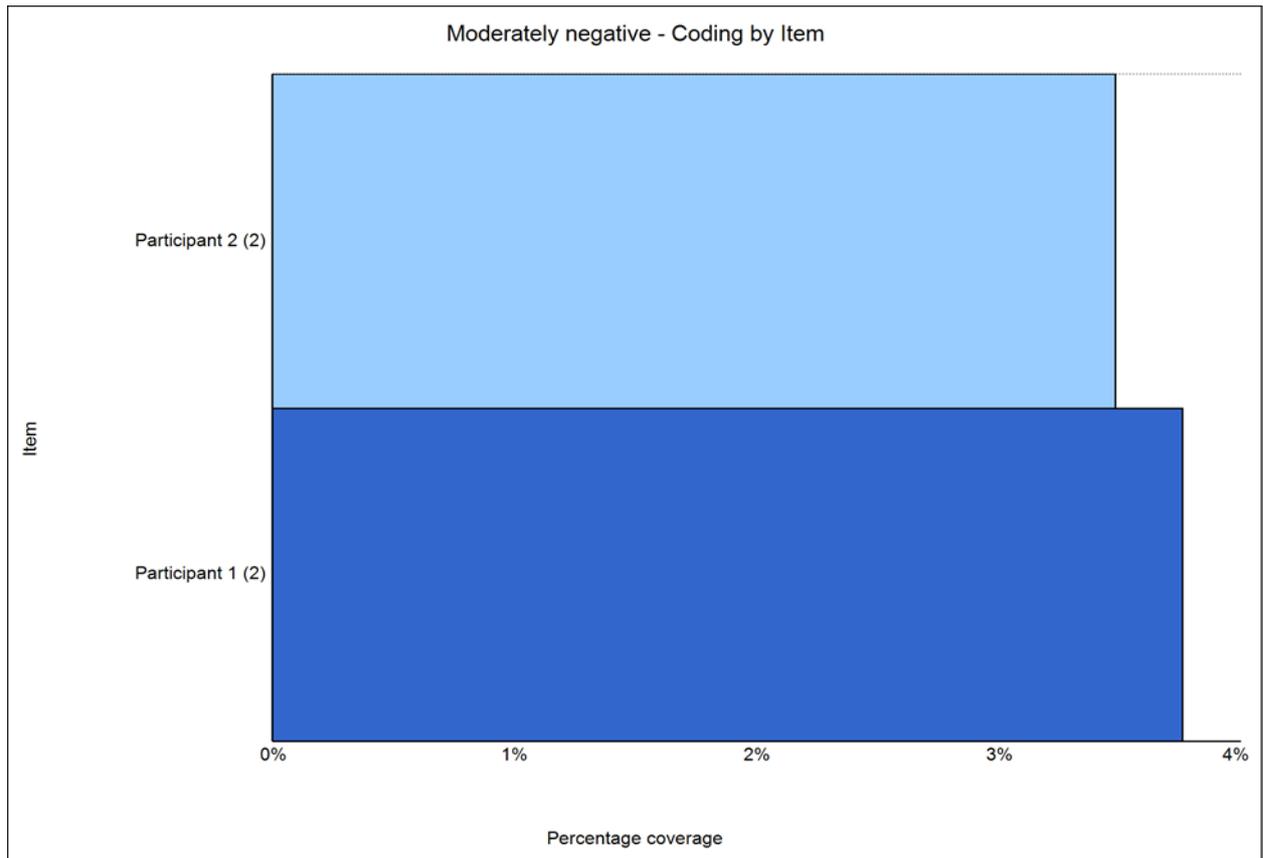
Figure 4-18 The Proportional Distribution of Moderately negative Sentiments

Figure 4-18 shows the proportional distribution of the total of moderately negative sentiments from the two participants. The second participant had a greater number of moderately negative comments that the first participant.

4.4.1.5 Summary of health sector

Regarding the sentiments, the number of words expressed and identified as very positive, moderately positive, very negative, and moderately negative were different and the word count is as summarized in the chart below.
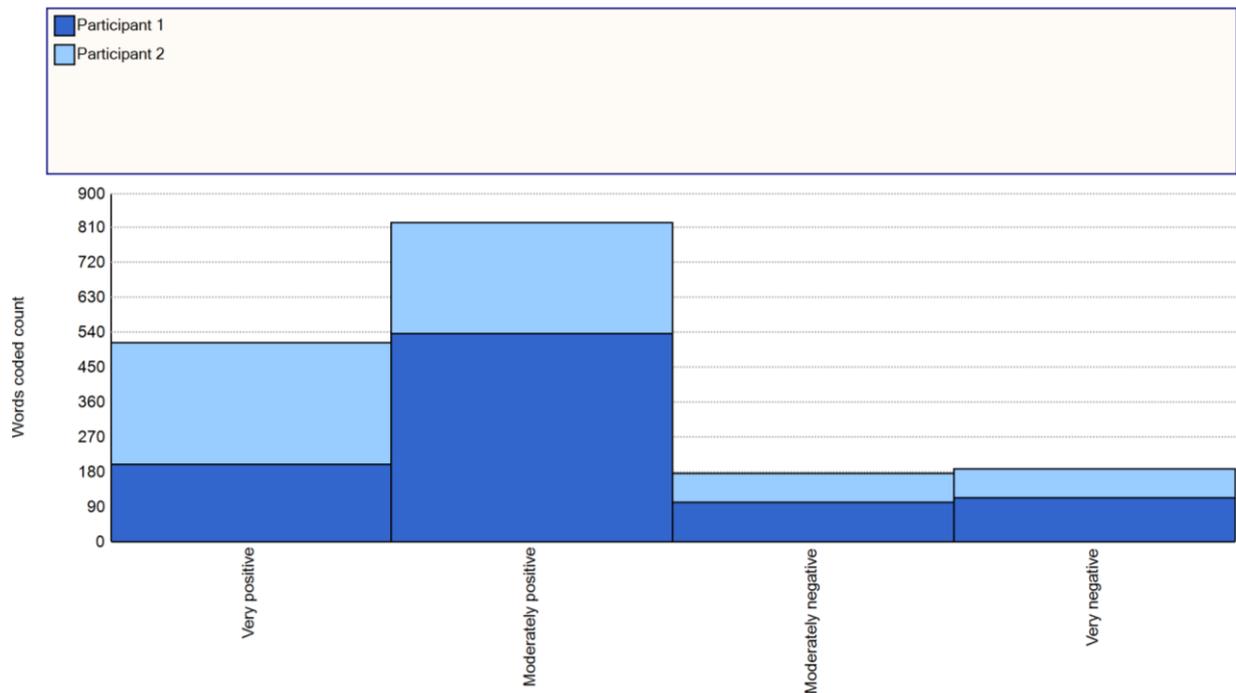
Figure 4-19 Word Count for Each of the Sentiment Categories for Each of the Participants.

Figure 4-19 shows the word count for each of the sentiment categories for each of the participants. Expressed as a percentage, of the first participant's opinions 39.14% were very positive while 60.86% of the second participant's opinions were very positive. For the moderately positive sentiments, 64.85% and 35.15% of Participant 1's and Participant 2's comments were moderately positive. 57.8% and 60.75% of Participant 1's comments expressed very negative and moderately negative comments respectively. On the other hand, 42.2% and 39.25% of Participant 2's comments expressed very negative and moderately negative comments respectively.

The word cluster analysis that supported the distribution of the above sentiments established a similarity of 0.9324 based on Pearson's correlation coefficient.

The sentiments analysis and summary based on the 20 study variables is as summarized in the following table. Table 4-28 expresses word count based on the theme, the construct, and the question that was answered.

Table 4-28 Sentiment Analysis

Root Construct	VP	MP	MN	VN
Technological anxiety (TECA)	24	86	24	44
Resistance to change (RTC)	0	70	34	90
Facilitating conditions (FAC)	69	137	0	0
Perceived ease of use (PEOU)	13	0	0	0
Perceived usefulness (PU)	34	0	0	0
Relative advantage (RAD)	28	46	0	31
Services quality (SERQ)	9	0	0	0
System quality (SYSQ)	0	13	0	0
Information quality (INFQ)	0	26	0	0
Compatibility(COM)	28	32	0	0
Trialability (TRI)	32	27	0	0
Observability (OBS)	0	44	43	0
Complexity (COMX)	28	40	39	0
Perceived enjoyment (PE)	0	87	0	0
Social influence (SINF)	0	55	0	0
Self-efficacy (SE)	10	73	20	0
Data privacy (DP)	71	0	0	21
Perceived Trustworthiness (PT)	37	50	13	0
Perceived security (PS)	86	10	0	0
Personal Innovativeness (PIN)	42	29	0	0

Table 4-28 shows a summary of word distribution for Very Positive (VP), Moderately Positive (MP), Very Negative (VN), and Moderately Negative (MN) Sentiments. Table 34 also shows that, over 60% of their expressed views about TECA were positive with less than 40% being negative. The constructs that had exclusively positive sentiments are FAC, PEOU, PU, SYSQ, INFQ, PE, PS, TRI, and PIN. Resistance to Change, Relative Advantage, Observability, Complexity, Self-efficacy, and Perceived Trustworthiness had 63%, 30%, 49.43%, 36.5%, 19.4%, 22.8%, and 13% of the negative sentiments expressed against each of the constructs. Based on the sentiments, Perceived Ease of Use, Perceived Usefulness, Services Quality, System Quality, Information Quality, Compatibility, Trialability, Perceived Enjoyment, Perceived Innovativeness, and Perceived Security positively predicted or supported the intention to use mobile educational online/mobile Government services. However, the results show that Resistance to Change is the major barrier to the use of such services and factors as

data privacy and self-efficacy, and this can explain the resistance to use the mobile or e-government services.

4.5.2.1 Phase 2: Education Sector

A single participant returned the online survey tool and she is currently serving as the Group Applications Director at the Ministry of Education. Regarding sentimentality, the participant was polarized in opinions since negative (very negative and moderately) opinions accounted for 23.72% while the positive sentiments accounted for 76.28% of her opinions. Her word cloud summary is as shown in the figure below.

Figure 4-20 The Word Cloud Summary of the Qualitative Data obtained from the Third Participant.

In Figure 4-20, The Word Cloud chart shows the most frequently used words. The Chart suggests Important Views Hidden in the Data. The figure showing a hierarchical breakdown of the keywords suggests that systems in the context of education alongside the use of modern technologies are quite influential. The diagram visualizing the hierarchy of the coded references of the most frequent words is as shown in Figure 4-21.

Figure 4-21 The Hierarchical Chart Associated with words of third Respondent

Figure 4-21 shows The Hierarchical Chart Associated with words that the third Respondent commonly used in answering the interview Questions. The key words revolve around system, data, mobile application, services, online activities, security, emerging technology, and the education sector. Regarding systems, the respondent identified trustworthy, online, and government systems. Most of the trustworthy systems are modern systems that are either legacy or mobile e-governance system. The visualization is quite complex although the chart below summarizes the most critical components. Figure 4-22 shows the tree map visualizing the hierarchical relationship of the words that she (third respondent) used to express her opinions.
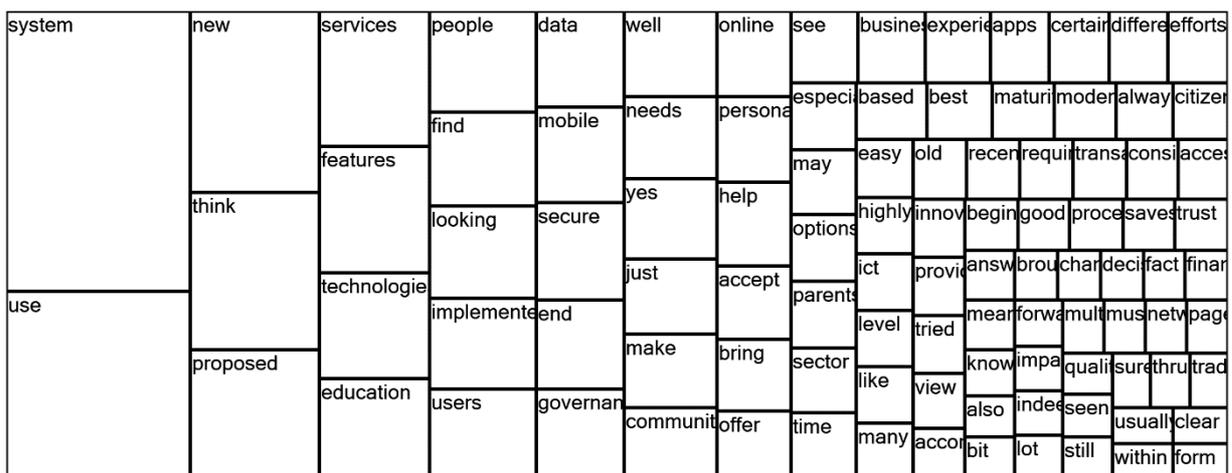
Figure 4-22 The Tree Map Visualizing the Hierarchical relationship of the words of the third respondent

116

4.5.2.2 Sentiments Analysis (Education)

The very positive sentiments found in her comments are summarized as follows.

Table 4-29 The very positive sentiments of participant 3

<Files\\Participant 3> - 10 references coded [20.68% Coverage]
Reference 1 - 0.40% Coverage
Well, I think the system is very useful and easy to use.
Reference 2 - 1.23% Coverage
Yes, I found the proposed online/ mobile e-Governance services very useful to me and they save time and effort.
Reference 3 - 5.00% Coverage
Yes, it is very useful and seems to be better than traditional systems.
Reference 4 - 1.41% Coverage
I find exploring the features very useful and straightforward.
Reference 5 - 0.83% Coverage
But I think we are still in the beginning phase because not all educational organizations have adopted such initiatives.
Reference 6 - 3.99% Coverage
I think it is very easy to use not because I am a technical, but it offers end-users with an end-user's manual, so they can navigate through the entire system features and functionalities.
Reference 7 - 1.01% Coverage
The system you are proposing is using the (HTTPS) which is very secure to handle all financial and personal data transactions.
Reference 8 - 1.55% Coverage
Well, I have a concern with using mobile apps for financial transactions because not all the Apps are like those offered by the banks, as you know they are highly secure via using certain protocols.
Reference 9 - 4.05% Coverage
Some technologies are highly secure because they have been in the market for so long. If we are talking about the government systems, I don't really think we reach the maximum level of trust because not all educational organizations have implemented a trustworthy system based on best practices, we are still at the beginning.
Reference 10 - 1.21% Coverage
The modern technologies can also bring accountability, responsiveness and transparency.

Table 4-30 The very negative sentiments.

<Files\\Participant 3> - § 2 references coded [7.69% Coverage]
Reference 1 - 4.05% Coverage
Some technologies are highly secure because they have been in the market for so long. If we are talking about the government systems, I don't really think we reach the maximum level of trust because not all educational organizations have implemented a trustworthy system based on best practice, we are still at the beginning.
Reference 2 - 3.63% Coverage
I think it should be protected from the security breaches but again in my view I don't think I would trust to pass personal data over the mobile platforms and especially when doing a payment online because i had bad experiences before so i am a bit reluctant on this aspect.

The general sentiments expressed about the intention of using technology in the education sector and how it will be perceived are summarized in the following table.

Table 4-31 Sentiment Analysis Summary

Root Construct	VP	MP	MN	VN
Technological anxiety (TECA)	12	0	0	0
Resistance to change (RTC)	0	56	0	0
Facilitating conditions (FAC)	0	16	0	0
Perceived ease of use (PEOU)	0	16	0	0
Perceived usefulness (PU)	19	0	0	0
Relative advantage (RAD)	13	0	0	0
Services quality (SERQ)	0	0	0	0
System quality (SYSQ)	0	0	0	0
Information quality (INFQ)	0	0	0	0
Compatibility (COM)	0	0	0	0
Trialability (TRI)	9	0	0	0
Observability (OBS)	18	42	0	0
Complexity (COMX)	35	0	0	0
Perceived enjoyment (PE)	0	0	0	0
Social influence (SINF)	0	0	0	0
Self-efficacy (SE)	0	42	32	0
Data privacy (DP)	55	0	0	0
Perceived Trustworthiness (PT)	54	0	0	54
Perceived security (PS)	0	51	16	51
Personal Innovativeness (PIN)	10	44	0	0

Table 4-31 shows word distribution for Very Positive (VP), Moderately Positive (MP), Very Negative (VN), and Moderately Negative (MN) Sentiments. The perceptions on TECA, RTC, FAC, PEOU, PU, RAD, TRI, COMX, DP, and PIN had 100% positive sentiment on intention to use mobile and e-government services in Education. The attributes of Service Quality, System Quality, System Quality, Information Quality, and Compatibility were neutral, while Self-Efficacy, Perceived Trustworthiness, and Perceived Security had 43.24%, 50%, and 57% negative sentiments. The most important predictors of the intention to use online or mobile government health services are data privacy and perceived trustworthiness although the latter has serious implications, especially where users perceived the system as not credible and lacking integrity. The Quality constructs had no influence on intention to use the mobile/online health systems, while social influence constructs such as Perceived Enjoyment and Self-efficacy also had weak influence on Intention to Use the mobile or online health technologies.

4.4.2 Chapter Summary

The aim of this exploratory study was achieved, to develop and validate a citizen-centric oriented model, which examines factors that affect people's acceptance of eGovernance services within government public sector organizations such as health and education. Twenty variables were operationalized using the questionnaire item scores provided by 341 participants from the education sector and 204 from the health sector in UAE. 20 variables were operationalized, which were not normally distributed. The correlation analysis indicated that the 20 variables were multicollinear, and so they were reduced into 7 latent variables.

The data collected from the education sector indicated biased response patterns to the questionnaire (caused by the respondents mainly endorsing either 4 or 5 on the 5-point item scales) the frequency distributions of the variables were strongly negatively skewed, and most were significantly correlated with each other.

With respect to educational online/mobile Government services, a PLS-SEM model was constructed using the 7 latent variables, and its construct validity, convergent validity, discriminant validity, and internal consistency reliability was established. The general hypothesis that guided this study was supported. The seven variables were found to be statistically significant ($p < 0.05$) predictors of the intention to use educational online/mobile Government services, either individually, or when composited into new variables. The reduced variances caused by the biased response patterns, however, meant that the PLS path coefficients between the variables could be attenuated, or misleadingly low.

The strongest positive predictor of *intention to use* ($\beta = 0.388$) was performance expectancy, a composite variable consisting of a multitude of perceptions, including Perceived ease of use, Perceived usefulness, Relative advantage, Services quality, System quality, Information quality, Compatibility, Trialability, and Observability. Trust on system was a significant negative predictor of *intention to use* ($\beta = -0.114$). The negative coefficient implied that the participants perceived that a high level of agreement to use educational online/mobile Government services was associated with a low level of trust of the system.

With respect to online/mobile Government health services, a PLS-SEM model was constructed using the 7 latent variables, and its construct validity, convergent validity, discriminant validity, and internal consistency reliability was established. Three latent

variables were found to be statistically significant ($p < 0.05$) predictors of the intention to use online/mobile Government health services. The strongest positive predictor of Intention to use ($\beta = .884$) was Social influence, a construct consisting of the scores for Perceived enjoyment, Social influence, and Self-efficacy. Social influence was followed in order of importance by Facilitating conditions ($\beta = 0.373$) which measured the participants' expectations regarding the Government's support for online/mobile health system initiatives. Performance expectancy was a weaker predictor ($\beta = 0.119$) which measured a multitude of perceptions, including Perceived ease of use, Perceived usefulness, Relative advantage ,Services quality, System quality, Information quality, Compatibility, Trialability, and Observability. The participants perceived, however, that agreement to use online/mobile Government health services was not associated with trust of the data or the system.

The scores for Intention to use did not vary significantly with respect to gender, age, and education. Consequently, it was not necessary to determine if the results of PLS-SEM varied with respect to these demographic variables.

Chapter 5 The eGOVERNANCE PROPOSED SYSTEM

5.1 Introduction

The Information and Communication Technology (ICT) become an indispensable tool to answer users' questions, which consequently led governments to realize the benefits offered by internet and technological advancements to deliver such services. Education and Healthcare sectors are seeing a lot of transformation and innovation. While these advancements are very positive, access to information, internet and availability of online services offered through mobile applications as well as digital literacy are essential to utilize the full potential of ICT's usage. In general, the overall broadband service has increased globally but a major divide persists. Involvement of citizens such as eParticipation in the decision-making process, engagement, availability and accessibility of online mobile platforms can support the improvements in social welfare, agriculture, healthcare and education. There have been increased efforts to utilize e/mServices for the benefit of all.

5.2 The eGovApp and Online Evaluation system

The main idea behind creating such a system is to address a real-world problem related to e-Governance and digital services implementations. Many eGovernance project implementations around the world assume that such projects are an IT related problem; however, the literature revealed that adoption and acceptance of ICT by government entities is an evolutionary method. The government organizations face extreme difficulties to recognize the latest changes in the ICT and are exposed to high risks that include e-Governance implementation projects failure, delays and significant loss of major investments. It is worth mentioning that governments must lay a considerable emphasis on realizing strategic ICT visions that help to make different forms of experience. With the absence of validated best practices and clear guidance, it is essentially important that governments make efforts towards transforming the traditional commonly known form "static" to "dynamic" proactive governments. Such efforts include embracing technology advancements, engagement of citizens, fulfilment of citizens' demands, and continued provision of seamless access to government services.

This research recognizes the transformation model of government through organic evolution that occurs incrementally through a set of progression stages starting from the automation of services to the integration of all systems and services between government organizations. The developed systems support decision-makers and officials involved in

implementation of e-Governance projects. Such tools include intelligent online web-based applications and a mobile App called eGovAPP for management, performance monitoring, services and systems assessment, initiatives evaluation, communications, services quality management of government organizations in the health and education sectors. The government organization receives credentials to login into the system, fill in required details pertinent to the list of defined electronic/ mobile services with specified formats such as G2G, G2C, G2B and G2E, automation level (Information, Interactive, Transactional), identification of the security level (Public Access, Secured), timeline projected for implementation.

The system allows government entities to perform a self-assessment against a compiled list of assessment models. These assessment models encompass 7 domains derived from the proposed research technology acceptance and include online/ smart services automation, services usability, services satisfaction, awareness and services outreach levels, quality requirements, online/ smart quality of services requirements and services' integration. The system calculates assessment scores according to an assessment matrix module and shows results on interactive graphical dashboard screens. The system enables users to conduct online transactions, services rating, engage in a dialogue with government entities, post concerns on services and provide feedback. For reporting results, a jQuery and JavaScript were used to create interactive charts thorough data pulled directly from the database and triggered into the charting library for plotting a chart that visualizes results in an intelligent format like column, bar, pie and stacked charts. Further parts of this chapter describe additional features about the developed systems that will assist to improve government entities' responsibility, accountability, public services delivery, performance, efficiency, convenience and better accessibility.

5.3 The Benefits of the systems

The impacts of eGovernance include citizens, governments and public organizations. Such impacts require a considerable effective transformation process to articulate eGovernance strategic plans, vision, national agendas, desired outcomes, defined deliverables, policies, key goals, and priorities.

The following sections display the eGovernance effects on citizens from citizen-centric perception, impact on governments and organizations.

5.4 The eGovernance System Architecture

The system architecture provides a formal description represented in conceptual diagrams that outline different layers of a system, namely front-end layer, business layer services and backend layer.
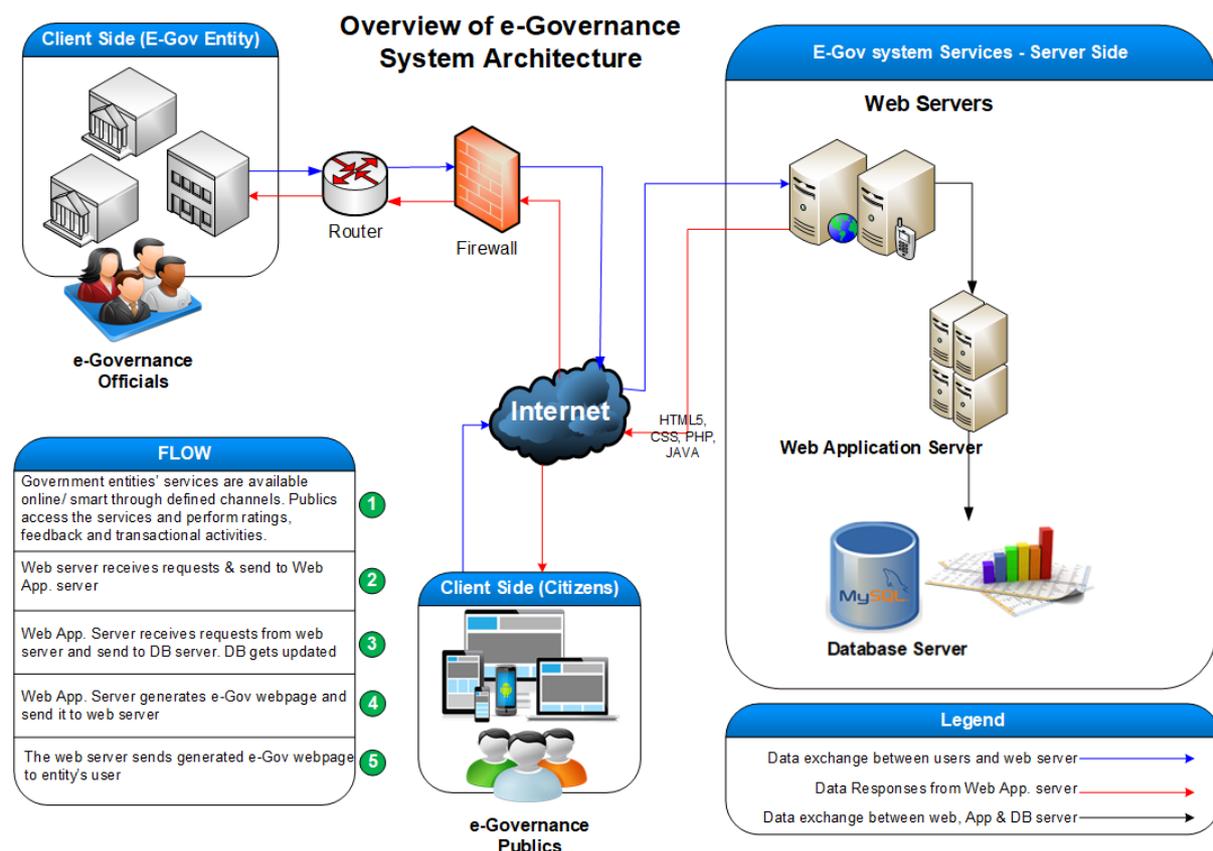
Figure 5-1 The e-Gov System Architecture overview

A system programmer, software engineers and systems administrators refer to system architecture to elicit a conceptual understanding of the parts of system components and their relationships to each other. It remains as a blueprint that provides a brief explanation of the general requirements and rationale for the application of new systems. Figure 5-1 shows high-level three tiered client/server architecture of the system and technology used to implement the

proposed solution and shows how they are integrated. This tiered architecture realizes scalability, flexibility, robustness and resolves common recurring design and development issues. The front-end, which is the interface layer, enables end-users to interact and communicate with the system while the business logic layer handles the control of functionalities and manages the connection of data flows. This layer forms a scalable and protective shield for the data layer. Any potential future amendments or definition of new rules occurs at this layer without affecting other layers.

The data layer stores, indexes and manages all information that is retrieved and passed to the business logic layer and ultimately presented to end-users at the front-end layer. More specifically, the client side represents the front end of the client application. The end-user's requests operate at this level and all communications run through the system's components outlined in the architecture. A high-level workflow of end-users is depicted in the figure, which shows data exchange among several active network devices and the back-end side. The end-users access the system through graphical user interfaces (GUIs) and multiple database views provided through defined accessible channels e.g. online and mobile platforms. The workflows represent business logic programs that access the back-end and operate in the middle between the front-end and back-end. The Database Structure, Schema and Dashboard Snippets can be found in Appendix A.

5.4.1 The Model View Controller Architecture

In general, the system includes three key modules such as front-end which has the GUIs, business logic and database. During the past years, systems' development was very traditional, and developers had to make all coding to produce applications without any consideration of future code reuse, in other words reusability of Object-Oriented Programming (OOP) utilization which has become nowadays widely used by numerous enterprises. Responding to the public's enormous requirements while maintaining a high-level of quality requires alignment with modern emerged technological advancements and overall compliance with the government's strategies. To avoid problems of low flexibility, scalability and complexity in the object-oriented programming languages such as Java, which is the language used to implement the proposed research system, the Model View Controller (MVC) model is utilized to divide the whole system into model, view and controller, which promotes the system's quality, efficiency, security, flexibility and reusability.

The model view controller (MVC) is a system architecture pattern used to implement graphical user interfaces (GUIs). Figure 5-2 shows the MVC three-tier architecture, which involves two servers and one client machine. This architecture is divided into model (Database Server), view (Client Machine) and controller (Application Server). As depicted from Figure 5-2, the model includes a database server, which handles all the repository interaction with the controller. The view handles the presentation of programs' contents to clients while the controller is acting as a mediator between the other two tiers and passes communications as per end-users' action.
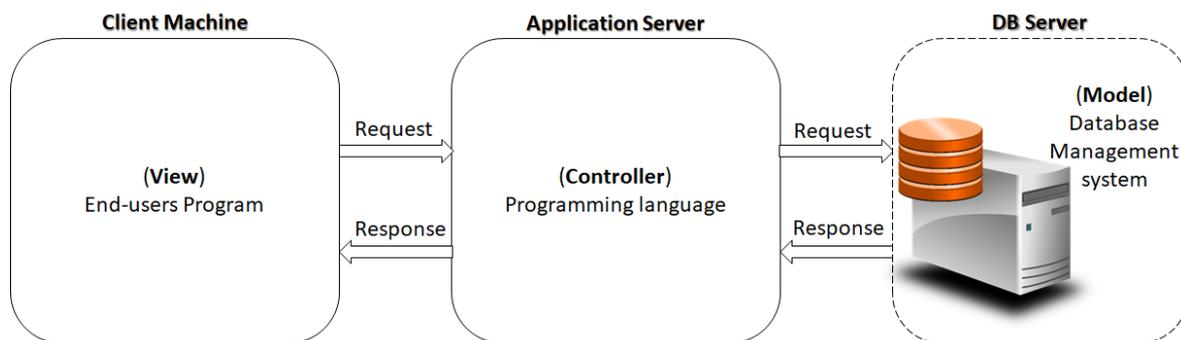
Figure 5-2 The Three-Tier Model View Controller (MVC)

In addition, the end-users communicate with the controller in the form of a request. Typically, these requests are received and served by the controller in the form of responses. These communicated responses include retrieval of information from the database by the controller. This architecture provides significant advantages such as:

- Highest levels of system's security as the end-users are prevented from initiating any requests and communications with the database side. This is more secure as compared to the two tier and single tier architectures.
- All embedded modules are maintainable. For instance, GUIs modifications are done at the client side which makes database maintenance easier to manage. All potential modifications in the database side occur without affecting other system modules.
- High availability of services which means if any tier of the architecture stops working at a time, other tiers continue running and functioning.
- Fast communications and processing of end-users' requests without compromising system's operations and performance.

5.4.2 The e-Governance Network Architecture
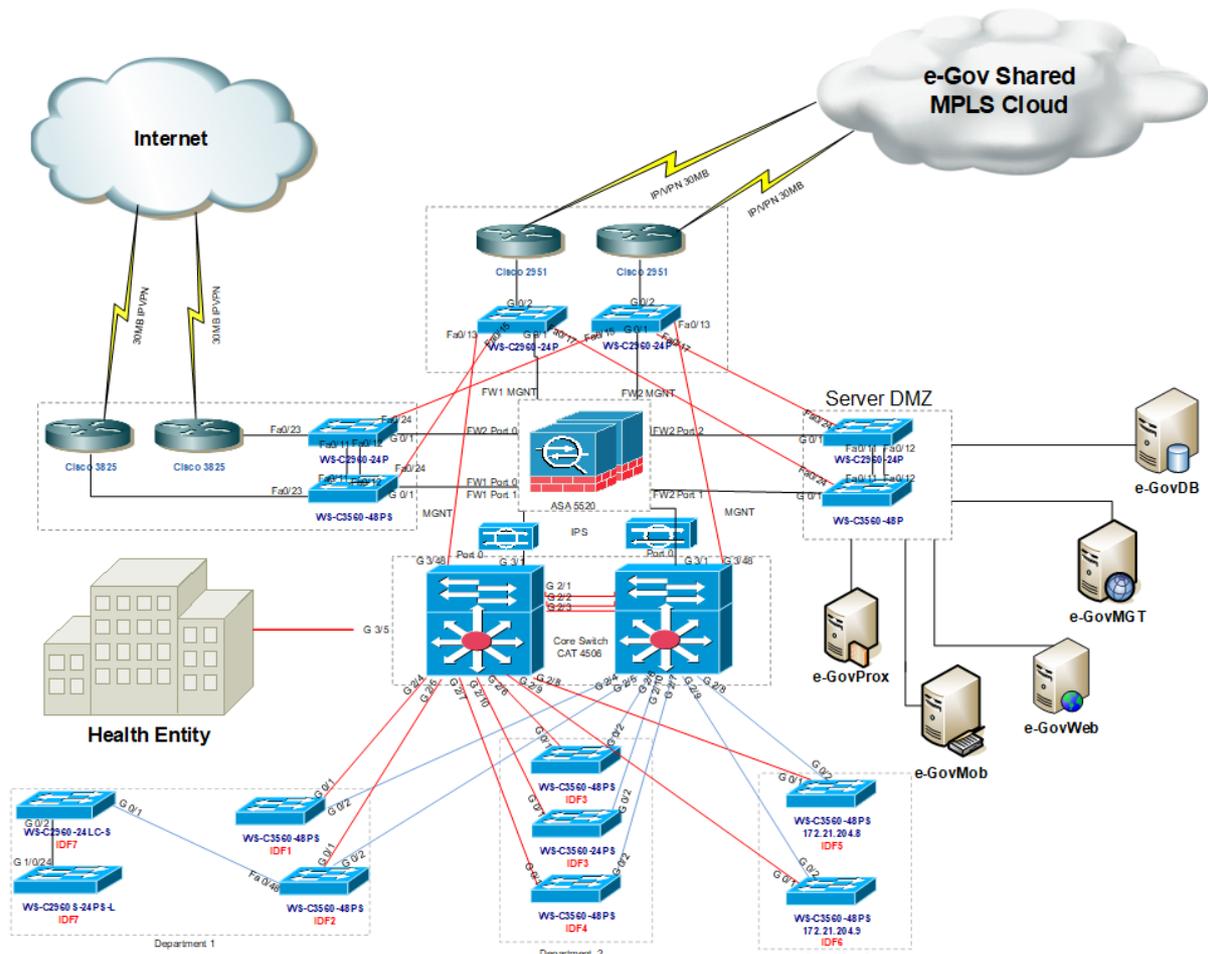
Figure 5-3 eGovernance Network Overview Diagram

The technological progress in the infrastructure and electronic networks areas changed many aspects of our life especially at the corporate levels. Many organizations ensure adoption of new technologies to secure their valuable business assets. Figure 5-3 shows the conceptual network architecture diagram, which provides the ability to link between government agencies, allowing them to exchange data using government-encrypted encryption indicators. Thus, government entities can deploy and use online services. It provides the appropriate design and specifies required software and hardware requirements where all servers, network components and storage systems are configured with no single point of failure and provide high-availability and redundancy at all levels. Additionally, this architecture provides featured benefits including the following:

- Provide secure Internet connectivity to all government entities through an Internet service provider, allowing higher productivity. This service provides a unified connection to the Internet by reducing vulnerability of intrusion attacks and preventing security vulnerabilities.

126

- Establish a new network link between government entities using shared Multiprotocol Label Switching (MPLS), which is a protocol for communication, speeding up and shaping traffic flows in the networks.

- Handling end-users reported incident cases and requests.

- Handles application of best network and security standards across government networks that include firewalls, intrusion protection (IPS), and threat management, anti-virus, SPAM, encryption, and application firewalls.

- Separate handling of major cases from other cases.

- Monthly reports on service level agreements.

- Update the multi-protocol switch connector using metadata indicators.

- Flexible maintenance of network components e.g. add / remove firewall settings.

- The proposed e-Gov Network architecture is in line with UAE's vision 2021, which aims to make UAE one of the best countries in the world, bring happiness to citizens and residents, and provide easy and fast services to people around the clock.

- Provide government organizations with safe, convenient and on-demand access to a range of digital services through a secure network architecture.

Accessing the online services requires that end-users have trust in the government systems and feel comfortable in using them. The design and security aspects include network, infrastructure and application, which consider the implementation of commonly known security principles such as availability, confidentiality and integrity of data. In e-Governance, the privacy and security aspects influence end users' willingness to use offered services. Figure 6-4 shows the proposed e-Governance secured infrastructure, which aims to provide a platform for government services through a secure electronic environment to help streamline government process, integrate services and improve overall quality and performance measures.

5.4.3 The Proposed e-Gov Secured infrastructure
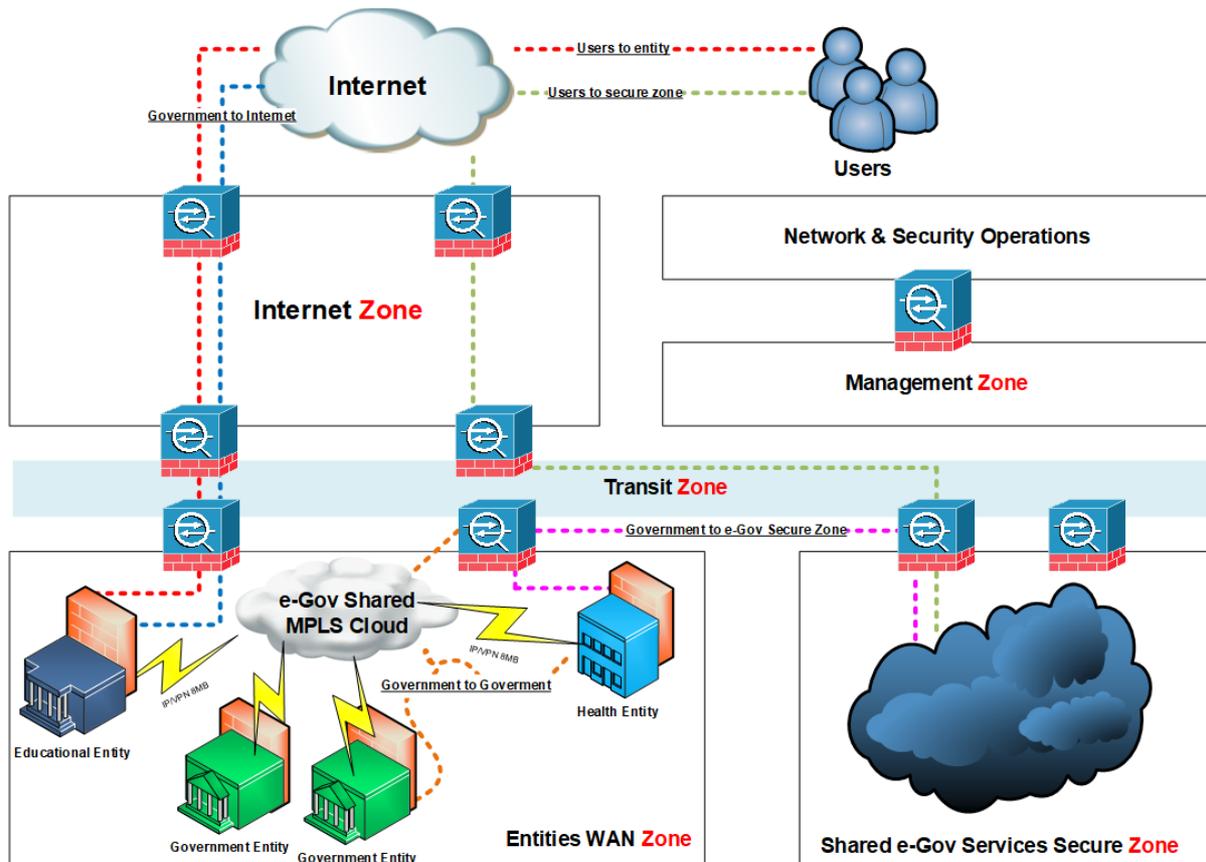
Figure 5-4 eGovernance Secured Infrastructure

The infrastructure gap remains wide around the world, and in many places, it is broadening. Many countries reformed their practices by tapping into the key drivers of successful planning and design related to infrastructure environments. One of the important drivers includes robust governance which aims to make the government's leadership more capable of supporting organizations to execute the rule of law, achieve transparency, effective planning of projects against clear objectives and consistent regulatory models.

Additionally, the cyber-crimes, threats and risks are persistently finding new ways to reach potential targets as they increasingly affect the online and offline world. Targeted cyber-attacks are aimed at individuals, corporations and even governments. Those targeted attacks play a key role in causing disruption of services and loading government entities with additional managerial and financial burdens. On the other hand, the UAE has established national agendas, which aim to make UAE the world's first country in the quality of airport services, infrastructure and enhancing quality of electricity and telecommunications and to become the world's leading provider of smart services. The national agendas established numerous key performance indicators (KPIs) and primarily focused on networked readiness, which relates to telecommunications and ICT sectors. The readiness ensures that ICT infrastructure is scalable

and meets the government entity's future expansion demands. In addition, the readiness indicator measures the actual preparedness of UAE to capture opportunities provided by the ICT to promote competitiveness. The network and infrastructure setups must align with country's national agendas to ensure success and achievement of targeted results. Figure 5-4 shows the proposed e-Gov secured infrastructure design diagram as a novel solution to prospective security threats and risks. It is very useful in terms of allowing government entities to exchange information, develop applications, solutions and e-government services using the network's secured infrastructure.

As depicted in Figure 5-4, the senior management in cooperation with the concerned teams (Network and Security) shall periodically monitor processes of the network infrastructure around the clock, ensuring to apply necessary actions in the event of errors or ICT security violations. The teams perform managing and handling incidents, monitor the network traffic flows, log security and network tickets and submit monthly reports on the overall network performance.

This solution aims to provide a secured infrastructure design for government services to operate through a secured electronic environment where security threats are prevented using multiple distributed zones. Each zone is connected through solid network components such as core switches, routers and enforced firewalls to guarantee the highest levels of security, encryption and network traffic flows. In addition, the solution also provides a strategic support for the implementation of e-Governance projects, which include execution of online and smart government services initiatives. Furthermore, the solution design includes MPLS cloud which helps to link government entities through a unified electronic network that can provide ICT services at high levels of speed, security, efficiency and performance without any compromise to quality of services and data losses.

On the other hand, Figures 5-3 and 5-4 outlined earlier offer government entities a protection shield for their systems, which includes database, front-ends systems and overall data layers. These are some of the possible solutions that encompass security, infrastructure and network aspects, which scale enormously large to meet futuristic demands. These solutions help to establish new forms of government organizations that are flexible with scale, agile, lean, and citizens-focused.

In our opinion, the agile methodology offers great potential to reduce the overheads as high as 95%, through fostering the advanced technologies, which include hardware and applications components that deliver effectiveness in the areas of security, integrity, reliability, data privacy and encryption. The agile methodology is illustrated in Appendix C.

5.5 The e-Governance Deployment Environments

It is not astonishing that government organizations recognize pressure to deliver high-tech systems and innovative applications, and constantly improve the public's experience as they strive to get ahead of competition among other government organizations. Some government organizations outsource their ICT systems to leading IT companies to manage their services while most organizations have their own dedicated internal IT resources who look after the implementation and management of all ICT related activities. In addition, the public's expectations motivate the government's constant innovations and adoption of citizens-centric development methods to deliver value faster and maximize benefits.

Over the past decade, the practices of system development to publish applications from development to production environment suffered many technical challenges due to several limitations situated in deployment resources, where a limited number of these resources restrain fundamental abilities to develop, test and deploy targeted systems. Figure 5-5 shows a sequence diagram of the three tiers model pertinent to e-Gov deployment environments. It shows a workflow of the deployment process, which is treated as a crucial part of a development workflow lifecycle.
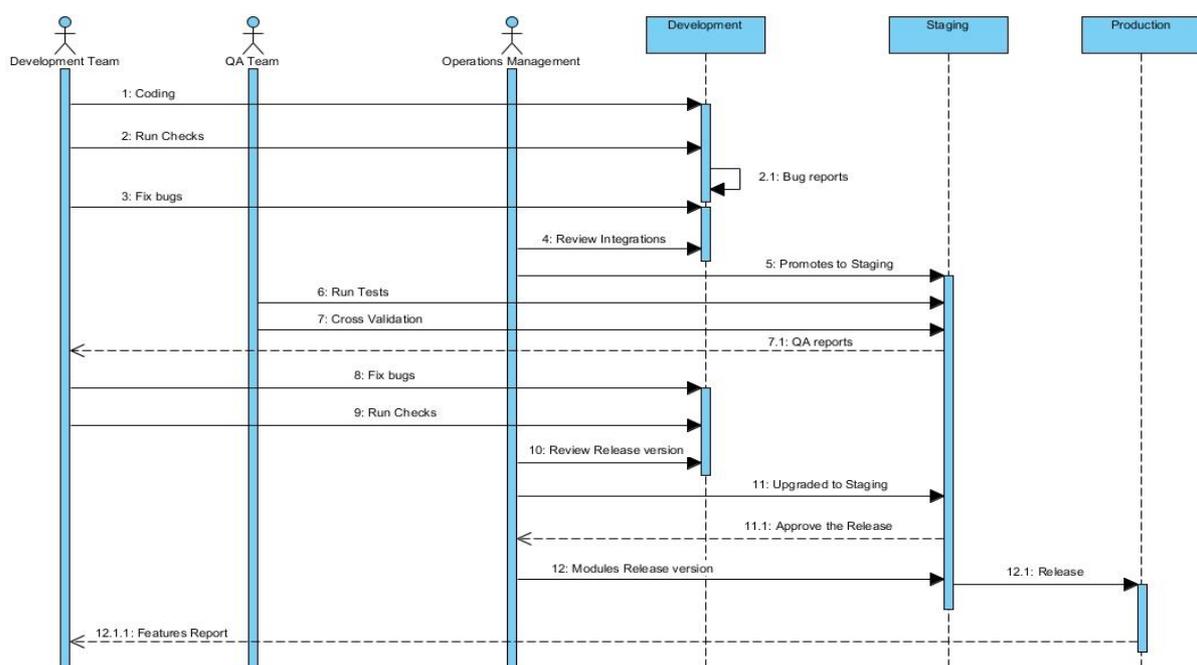
Figure 5-5 Overview of the Three Tiers of e-Gov Deployment environments

Figure 5-5 illustrates the different tiers with associated components. The first tier is the development tier, which is the working environment for development teams to build systems, make changes to code, combine and validate the activities of the entire implementation project so it can be tested before being promoted to the next environments.

5.5.1 The Development Environment

The technological advancements have enabled societies to increase efficiencies in the delivery of government critical services. However, as the dependency on information and services has increased, its vulnerabilities to an emerged set of security risks have also increased. Such threats can affect the confidentiality, integrity and availability of information services relied upon by government entities and citizens. The protection is essential but at the same time deployment of an effective and adequate approach requires a wider scope of management to manage the ICT ecosystems more efficiently. This includes identification and adoption of practical information infrastructure that supports governments' critical services. The government organisations' infrastructures should consider inclusion of applications deployment environments and ensure enforcement of all security controls, policies and standards.

Figure 5-6 shows an illustration of the development environment with associated tiers and components. The physical hardware and information assets are part of the organization infrastructure that supports the ongoing functions and delivery of critical business services. The delivery of citizens-centric and high-quality applications at a much accelerated pace, requires government organizations to pay significant attention to adopting reliable development of continued practices, which help them speed up deployment and delivery of applications' features without compromising performance and quality factors.
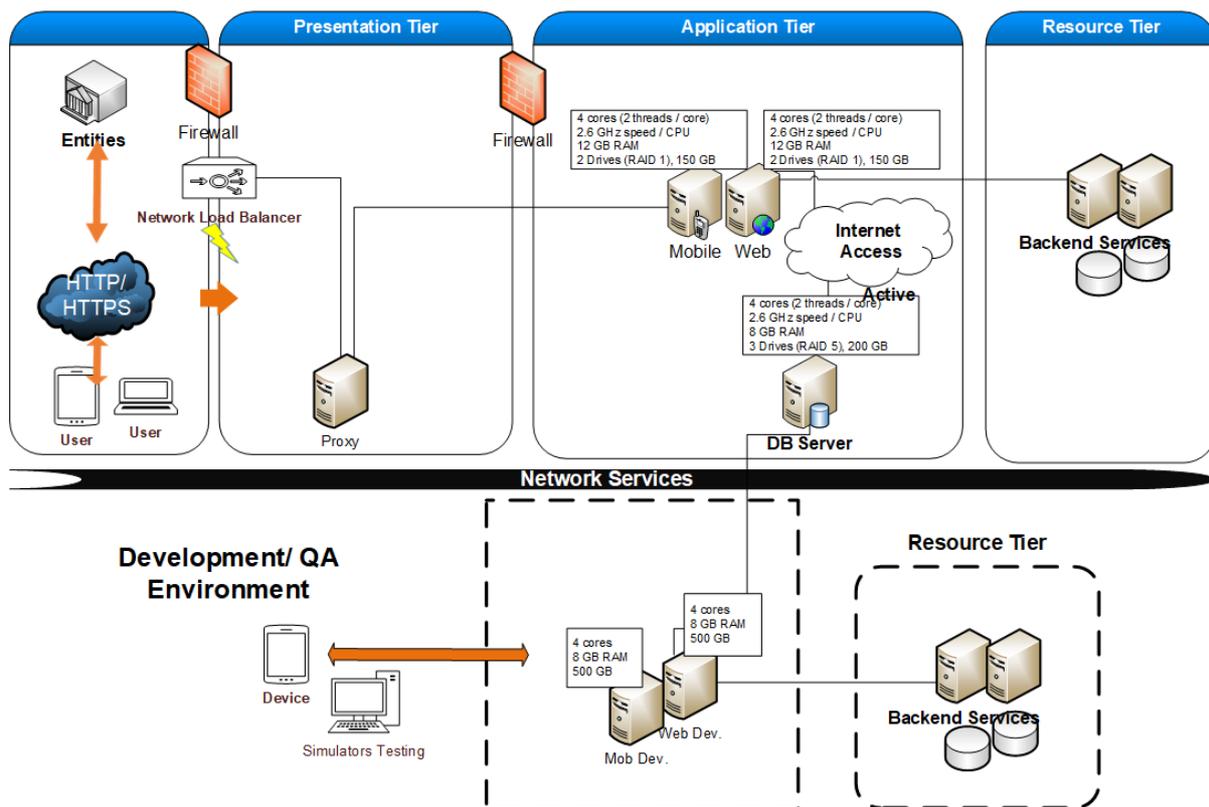
Figure 5-6 Illustration of a Development Environment

In Software Engineering (SE), the continued practices are part of systems development activities and include continuous integration, delivery and deployment. The development environment encompasses these concepts where each concept offers significant benefits. The benefits of continuous integration include supporting government organizations to have frequent and shorter release lifecycle, enhancing systems' quality, increasing development teams' productivity and enabling automation of systems development and testing. Continuous delivery ensures the system passes all the quality checks, tests and configurations across the multiple tiers, which include presentation, application and repository tier. On the other hand, there are other environments that could possibly be added within the development, which include integration, testing and User Acceptance Test (UAT) environments. For instance, the integration environment helps the development team to integrate the government systems with other government entities' systems through Application Programming Interface (API) that is a set of programming protocols and tools used to specify interactions among the systems' components.

Developers can plug different government systems together using dedicated APIs that offer a set of dedicated URLs to send requests and retrieve data responses seamlessly without users' interventions and presentational overheads at Graphical User Interfaces (GUIs). Once the system is developed to an agreed stage, then it is released to the testing and UAT environments

132

situated within the development environment. The involved testing team ensures the integration of systems' components, integration with other systems functions, quality of application, open and review bugs fixes. The UAT also involves end-users of government organizations to be part of the internal testing process, as they will verify the quality of the application, send business issues to fix and send change requests to fit their business requirements. Overall, the development environment reassembles the production environment accurately.

The deployment workflow helps to manage the implementation of applications from the initiation phase, which includes development, staging and up until the last stage that is production. Figure 5-5 demonstrates a solution, which provides an enterprise-deployment workflow process that helps the development team to sequence systems' updates and roll them out across multiple environments. This also serves the government organizations well for citizens-centric and efficient systems developments.

5.5.2 The Staging and Production Environments

As demonstrated in Figure 5-7, the staging and production environments and the main idea behind the staging environment is to simulate as much as the production environment as possible. The staging environment is used to assemble and review new versions of systems before it rolls out to the production environment.
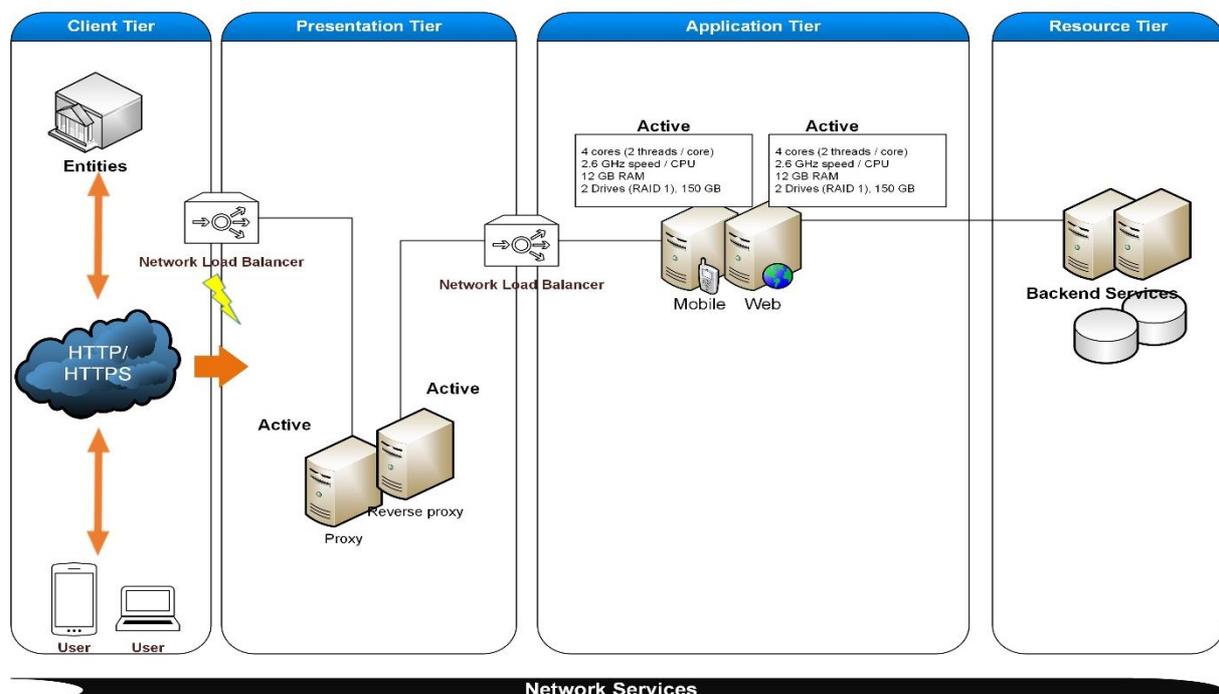
Figure 5-7 Illustration of Staging and Production environments

Once all the configurations, integrations, changes and features are implemented and considered acceptable and stable, they are merged and deployed to the staging environment. At the staging environment, this is where the quality assurance work kicks in as they ensure all code, test the changes run against the production environment, and validate them so they work properly when released on live production. In addition, the staging environment provides a final Quality Assurance (QA) zone segregated from other environments.

The illustration of the staging and production environments in Figure 5-7 shows the utilization of High-Availability (HA) deployment of four application delivery controllers (ADCs) with two nodes (Servers) running services simultaneously. The e-Governance system uses the clustering configurations for providing HA of government services without compromising the quality or interrupting data communications. We used the Active-Active, which is a concept of clusters configurations for managing organizations' data communications and provision of network solution for the overall business assets. The main idea behind such a concept is to achieve a Fail-Over and Load Balancing. The load balancers are a set of devices that distribute the network workloads across all servers to prevent any single server (i.e. mobile, web) from being overloaded. The more servers that are available to serve, the more improvement in management of systems' data communications, response time and throughputs.

All of our presented environments offer practical solutions to government organizations while promoting a lifecycle of deployment approaches for establishing, developing, maintaining and continuously improving the delivery of systems' services to the public seamlessly. In addition, the main purpose of these environments is to help governments improve the development, testing and release of entities' digital services through using best practices and solid deployment workflow processes.

5.6 The e-Governance Application platforms

In contrast to popular and common beliefs that mobile applications are only a collection of applications on smart mobile devices that will take over all other technologies in the upcoming years, we believe that mobile applications are an extension to the e-government model but not necessarily a replacement.

5.6.1 The Client Application

The client application is implemented through the Java programming language using the Android Studio, which is the Integrated Development Environment (IDE) for the Android platforms development. The client application is different from the server application however; they both use similar communication methods such as Hypertext Transfer Protocol (HTTP) protocol. The connection with the e-Governance application is through PHP language using GET and POST methods. The central database of the e-Gov application is MySQL and PHP are used to fetch the data results from the database. The application is designed to be fully responsive and compatible not only with mobile devices but with all different web browsers, platforms and operating systems that typically use standard web technologies such as JavaScript, HTML5 and CSS. The PHP model supports multiple databases options, provides a high level of security, and supports the restrictions on the MVC models.

The mobile and web application versions allow clients to exchange the data through HTTP as well as Secure Hypertext Transfer Protocol (HTTPS) protocols. The application hosted at the government organization requires provision of secure sessions with platforms. Hence, government organizations must consider the installation of Secure Socket Layer (SSL) certificates at the web server for initiations of secure sessions with multiple web browsers. The SSL is a cryptographic method designed to secure the data transmission over the internet between the clients' devices, which include desktop computers, mobile phones and the destination servers to secure the connections, critical sensitive data making it hard for any possible cyber-attacks or ransomware security breaches.

The e-Gov application utilizes the ".htaccess", which is a configuration file supported by web servers and contains certain commands known by servers to tell how they should perform in specific instances. The instance includes redirection of HTTP to HTTPS of a web system, password protection, robots' tags and directives. Furthermore, the file offers the capability to restrict the end-user's access to certain files, objects and directories when the application is live and published on the internet. In addition, the file is used for managing the exceptional handling with defined parameters for processing custom web errors rather than standard errors. This is crucial especially when government users access government entities' services through the application and some web errors occur due to many technical and security concerns, which lead the end-users to revoke their access and their willingness to visit or use public services.

The application enables the applications' users to store their data offline then synchronize with system server when they are online. This method allows the users of the application to store the data locally if disconnected from internet connection. The data stored locally include uploading information pertinent to government services automations, services prioritizations, initiatives, e-Governance assessment reporting documents, assessment data files, supporting documentations and attachments. The system's users connect to the internet via a cellular network or Wi-Fi connection and synchronize the data as well as access to the system through a login interface. Prior to the authorization stage, which is the process that confirms the set of activities the users authorized to perform according to allocated permission rights, the users must first pass system's authentication process requirements.
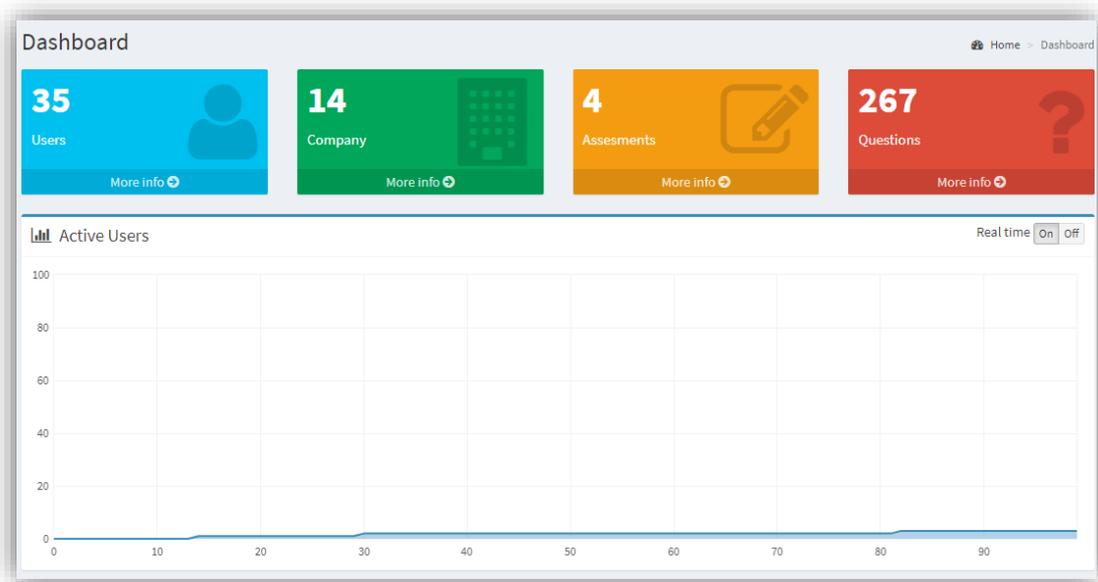
Figure 5-8 Live Traffic module of Real-Time Active Users' Data flow

Figure 5-8 describes the live traffic module that shows what is happening on the system in a real-time manner. The main idea behind such a module is to show the access and visits of users into the system. The live traffic is basically a real-time feature that will reflect the total volume of users' access data on a frequency update trend. The updates of each trend appear on an interface as new visits or access of users to the system. The update interval can be customized according to the system's admin preferences and needs from the menu settings. From the technical perspective, there are three key parameters used to operate the functionalities of this module, which include geolocation, IP address and time. The geolocation shows the specific city and region of the exposed IP address that is accessing the system whereas the IP address is the actual source address that classifies the identity of users. The time is used to show the number of hits as relative time. The key advantages of the live traffic module include, the constant monitoring of active users' access and login to the system, preventing hack attempts while executing JavaScript codes at the server levels, helping system admin to manage the access of users to the system i.e. block certain users who could potentially cause some security threats or block certain IP addresses that utilize bandwidth usage.

Figure 5-9 Users' Satisfaction Indicator Module Map

5.6.2 System Evaluation

With respect to system's evaluation that measure the usability and acceptance of the developed system, Figure 5-9 shows the users' satisfaction indicator map is an interactive tool that instills the values of people's happiness and measures their experience and satisfaction levels with government services provided by concerned entities in health and education sectors. This tool works through eliciting users' feedback and views ratings by asking them about their impressions about the provided services of each government entity. To evaluate the system, the users were asked to provide a response based on a 5-point Likert type scale for measurement of their interaction and happiness with the developed system. The users' responses used to generate the overall happiness level of digital services provided by government organizations. The users' satisfaction indicator map achieved the following set of key values:

a) Achieve responsibility, accountability and transparency.

b) Achieve basic characteristics of good governance by listening to people's needs, providing robust systems and effective procedures, effective strategic leadership, providing culture based on the openness and focus on people's needs for services.

c) Achieve the people's needs as per the national and international requirements.

d) Establish a competitive spirit among the government entities to constantly leverage the outputs of the digital services in the health and education domains.

138

e) Encourage people to become involved and enable their participation in effective decision-making processes by giving them opportunities provide inputs and feedback to enhance certain areas of interest.

The declining of the public's satisfaction with the government public services and its consequences in the economy and society has pushed governments globally to adopt new paradigms of public administration as well as adopting good governance.
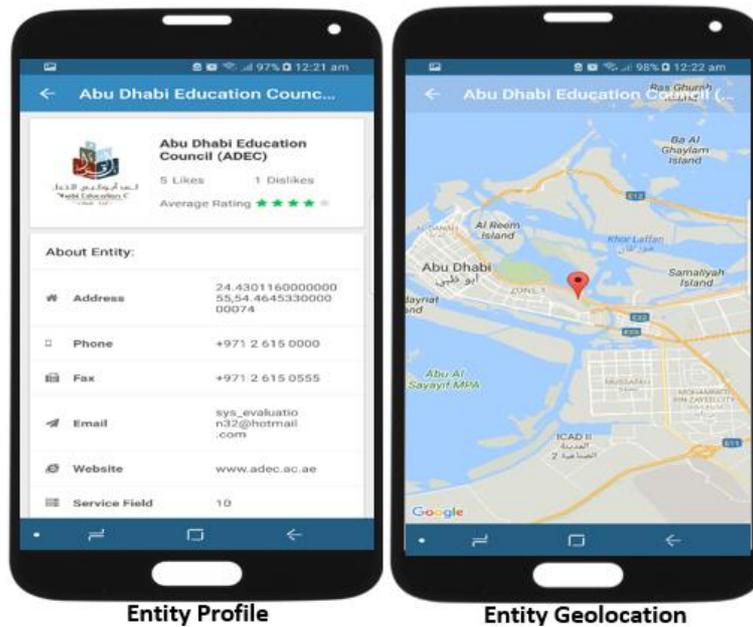
Entity Profile   **Entity Geolocation**
Figure 5-10 Geolocation of Government Entities

Apart from the users' satisfaction interactive indicator map features, there are many other features that the system offers including the display of government entities' profile and geolocation as depicted in Figure 5-10. This helps the users to navigate through each government entity's location and profile. For instance, in some situations where a client's transaction is held due to certain corporate process or technical issues, the client can easily use the entity's profile details and communicate with them through the given email address and telephone contacts.
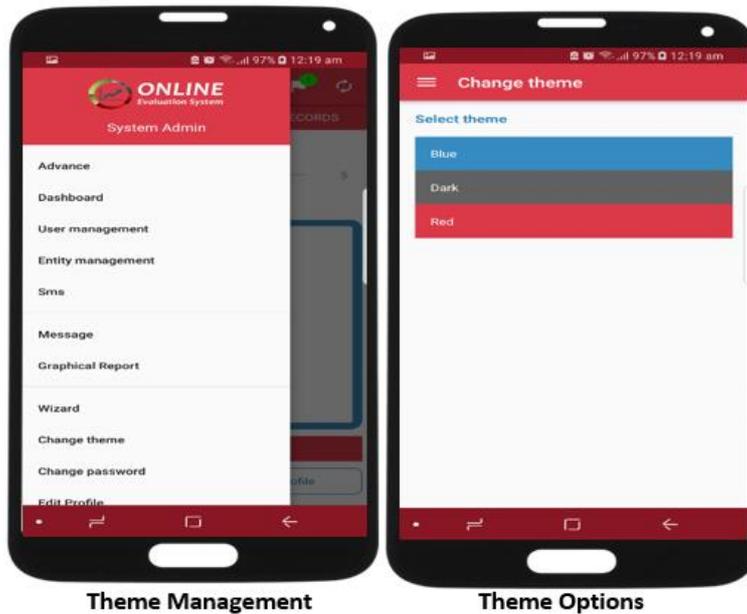
Figure 5-11 Theme Settings options for supporting People with determination

The accessibility should be considered at the initial stages of a system's development as part of the primary design process. Figure 5-11 shows implementation of text and visual features to support all the system's users including the category of people with disabilities or special needs.
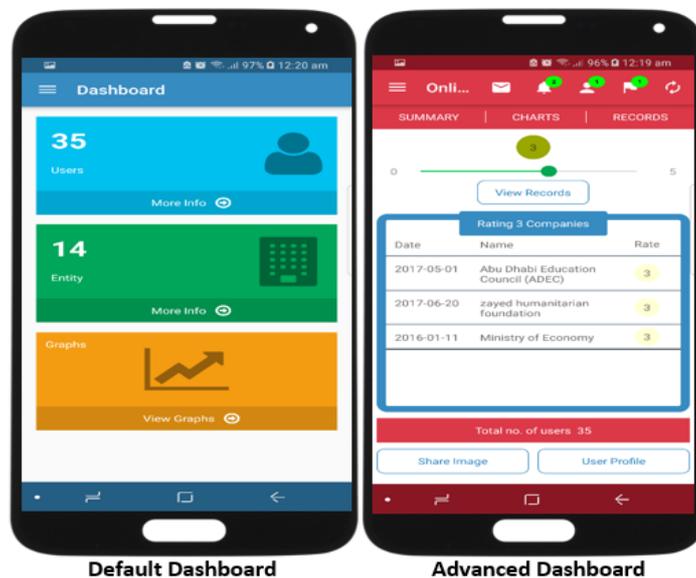
Figure 5-12 Default and Advanced Dashboards with Side Menus

Figures 5-12 and 5-13 show the default and advanced intelligent responsive dashboard with side menu options that allows users to track and monitor performance metrics of government organizations which include the ratings of services and the public's reviews about certain services.

Pre-Synchronization **Post-Synchronization**
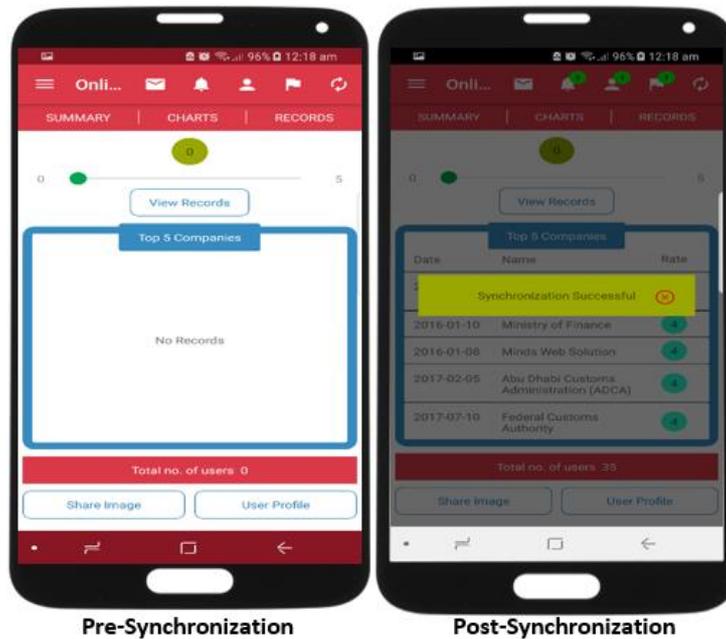
Figure 5-13 Data Synchronization

A data synchronization mechanism has been implemented as part of the web and mobile systems feature which keeps the local and server data in synchronization. The data synchronization method supports multiple end-users to easily update the data while the system is offline. The backend holds the data that changes overtime, the local storage backend basically holds a subset of the master data, the synchronization pattern sends the updated data from the local storage to the server backend and vice versa. At the server side, the data is updated in a "last overrides earlier updates" technique while maintaining the relationship between the detail entities and records of master data.

Email Management **Entities emails directory**
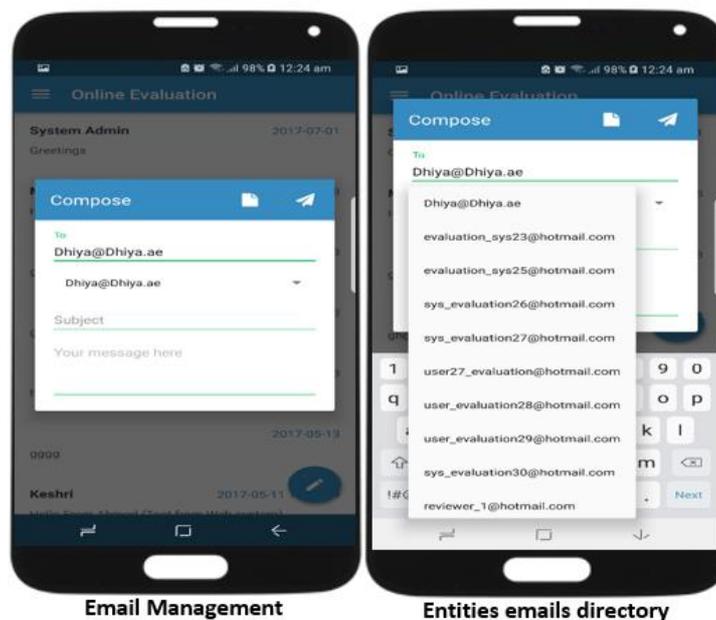
Figure 5-14 Communication with Entities using the email module

Figure 5-14 shows the feature of the inbox for communications which helps the government organizations and public engage through a dedicated communication channel inside the mobile

141

App. This centralized inbox provides a huge engagement opportunity for the system users not only for seamless communications but also to retain new system users who have opted out of notifications. For every government's push campaign or announcement that is addressed to opted-in users, the system admin can tailor the announcement to the App inbox that allows users to access the services content at their own convenience.

Figure 5-15 Query mechanism for users and entities

Mobile app users are constantly utilizing the search function as part of their mobile app experience. More specifically, a good search User Experience (UX) must be fast, effective and fun at all times. Figure 5-15 depicts the query mechanism for users and entities which considers the navigation and journey of the users as part of the main functionalities of the system. The look and feel shows the simplicity of the designed interfaces while showing the main dashboard on top of the page. The full-width search bar is displayed prominently to draw audience attention and gives them an obvious outlet to make swift queries. On the other hand, the system has an embedded power BI engine that provides intelligent dashboard to decision makers. This dashboard is fully customizable as per the users' needs as described in Appendix C.

Figures 5-16, 5-17 and 5-18 show the intelligent reporting feature that empowers the mobile users to capture information and generate a report in a few clicks.
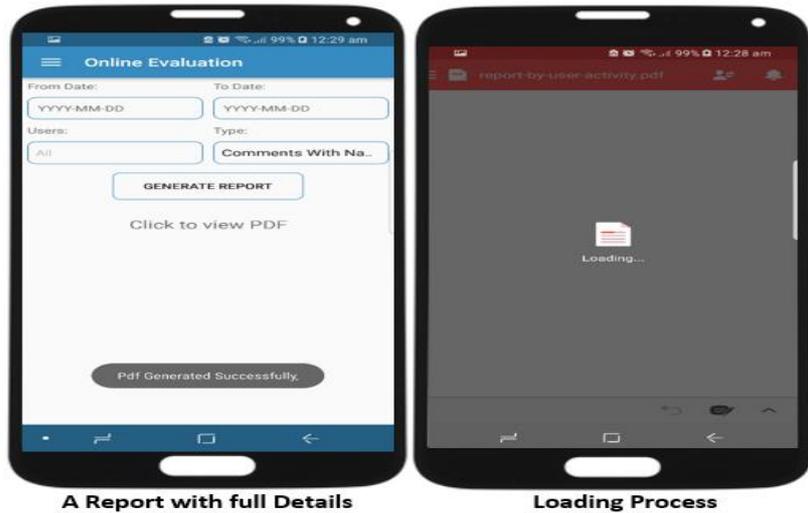
A Report with full Details   **Loading Process**

Figure 5-16 Generation of Reports using Data Export facility
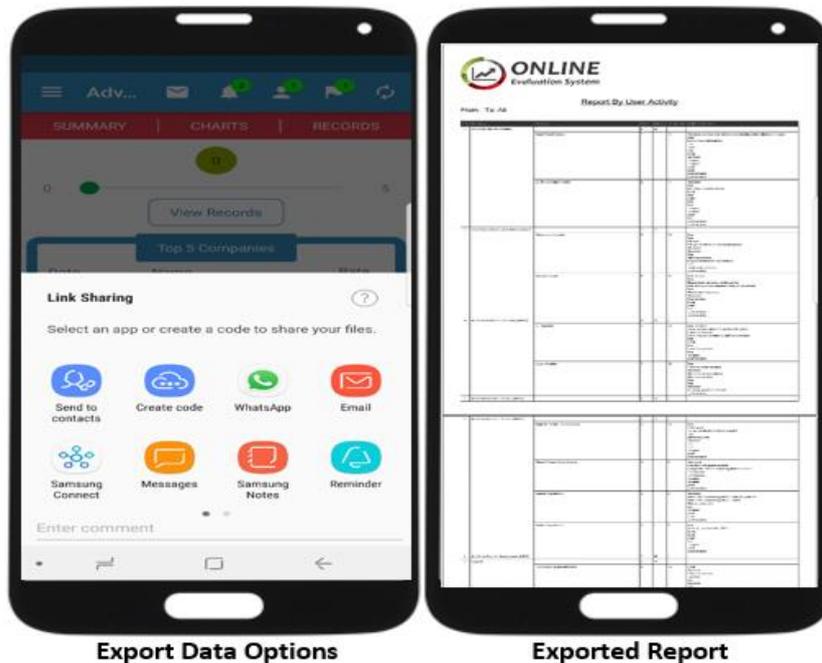
Export Data Options   **Exported Report**

Figure 5-17 Illustration of Data Export with a Report Sample

This feature allows the system admin to custom build the reports of interest ranging from the basic to advanced report with full details. The exported results can be used for further analysis and studies which include sentiment analysis as it exports the user's perspectives, ratings, reviews and opinions about the government services. The report can be exported in any sort of format such as PDF, Text, Excel workbooks and CSV. In addition, the report can be shared through an enormous number of communications and media channels on the mobile devices.

Summary Report   Full Summary Details

Figure 5-18 Summary Report

5.6.3 The Server Application

The e-Gov application will run on a web server and connect to the central database tier. The tiers will be hosted on the government datacentre platform through a telecom services provider, which provides all hosting services to government, public, business and corporate enterprises. The server application connects to the central database and invokes the Representational State Transfer (RESTful) Web Services, which is a predominant web service model and architectural style for building web services that are fast performance, reliable, scalable, maintainable and extensible.
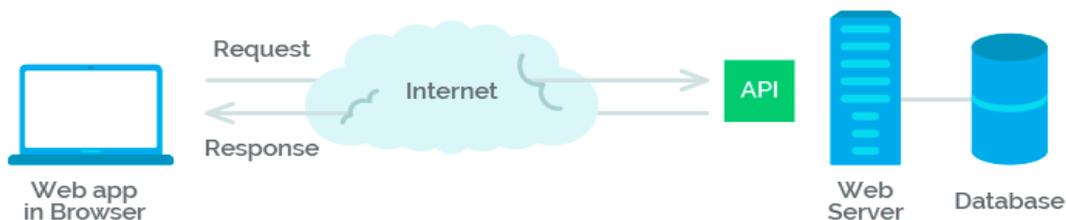
Figure 5-19 An overview of the e-Gov system RESTful API

Figure 5-19 depicts the operation of a RESTful API. The back end server has a RESTful API, which enables the client to generate and initiate client-side requests through mobile/ web system to the API. The server application will query the database to pass and store all the clients' data. The server application is scalable and can handle a large number of users as it has been designed to fit the government's design needs and future expansion. The PHP5, JavaScript was used to develop the core of server application, whereas the HTML5 and CSS3 was used to implement the system's GUIs.

Figure 5-20 Dashboards for entities' ranking, entities' ratings and entities' likes /dislikes

Figure 5-20 shows dashboards for entities' ranking, rating and number of likes/ dislikes as perceived by the system users. The top ranking shows top government organizations in terms of services delivery, similarity the entities' ratings and entities' likes/ dislikes as perceived by the users.
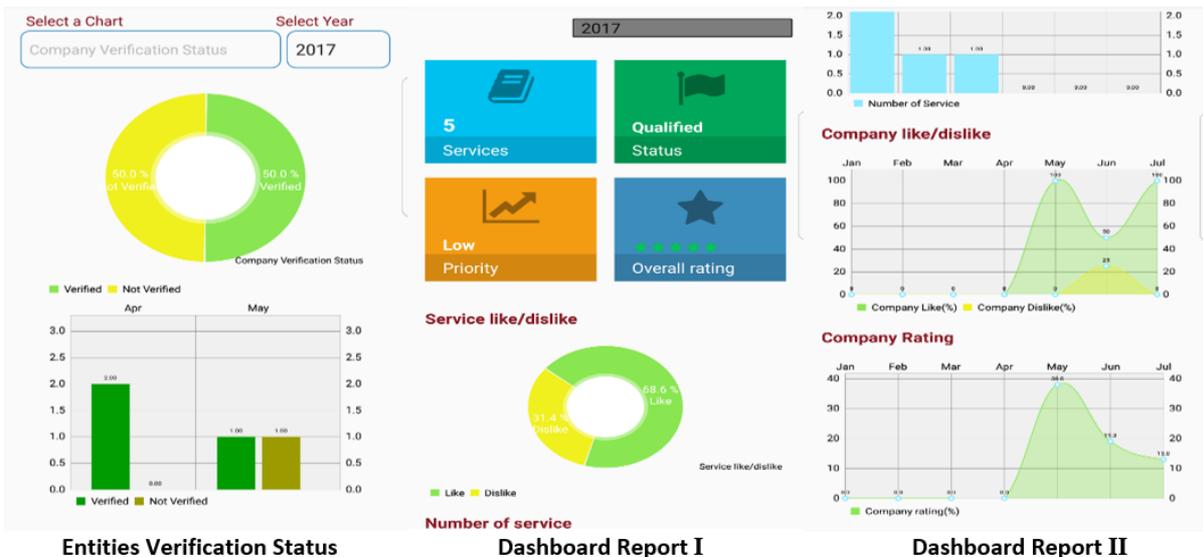
Figure 5-21 Dashboards Sample Reports

Figure 5-21 shows the dashboard of a government entity that illustrates full report details featuring the number of entities' verification status, services likes/dislikes, dashboard showing entities' services status of assessment and overall ratings. Figure 5-22 shows the entities' verification status in a year along with users' verification status. This report can be customized as per the needs to show a comparison of verification status among different years. The system is very flexible and allows all sorts of chart types such as donut, pie, line, bar, histogram, scatter plot and bubble charts to visualize the data into useful insights.

145
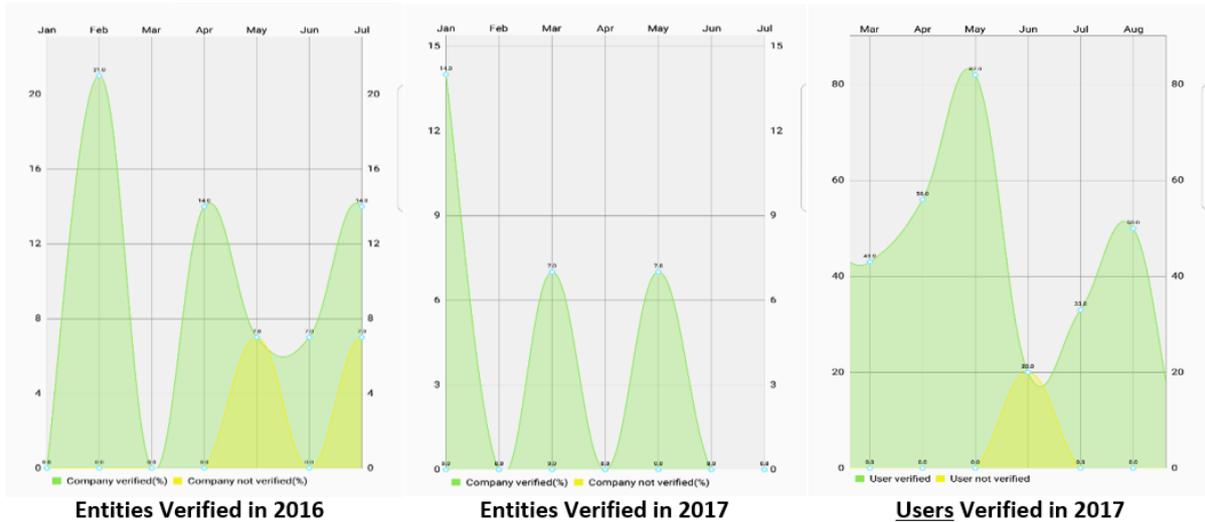
Figure 5-22 Dashboard for entities and Users Verification

5.7 The Authentication and Authorization Features

The e-Gov system offers a two-way authentication processes to allow users to login and access into the system. The first includes the utilization of reCAPTCHA depicted in Figure 5-23, which is a service designed by Google to prevent bots, and fraudsters from gaining access and performing denied and illicit actions on organizations' web systems.
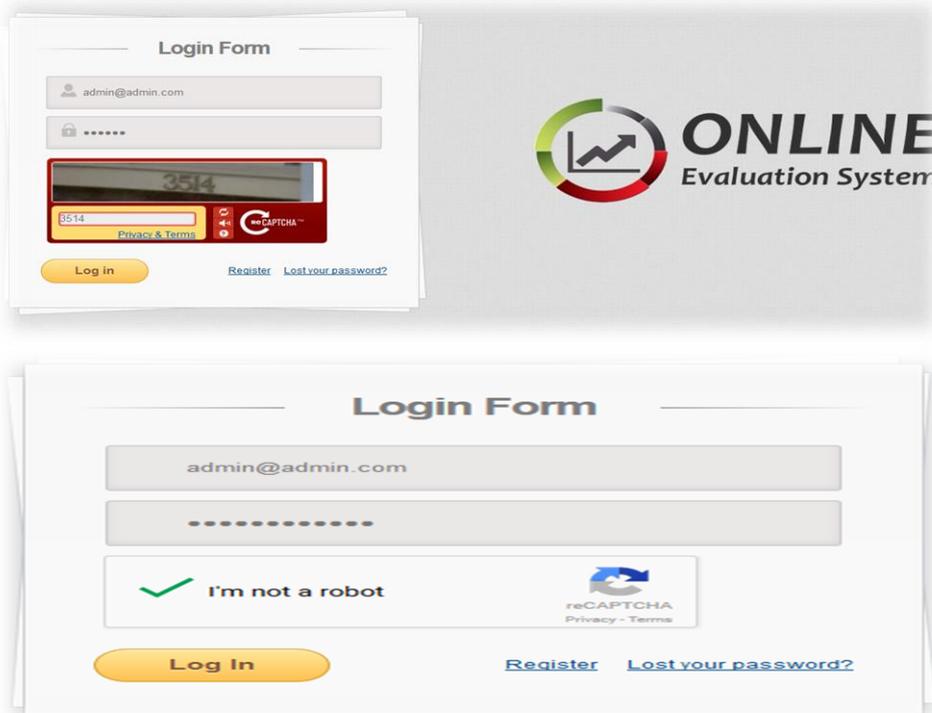
Figure 5-23 The system login interface using the reCAPTCHA technique

The latest version of the reCAPTCHA API service used in the system for authentication scheme. This service helps to protect web and mobile systems from spam and abuse as it uses an advanced risk analysis method to validate human users and bots apart. The API service imposes several challenge features such as text annotations, semantic annotation of images,

146

numbers identifications, audio and visual representations as part of authentication process verifications. The reCAPTCHA technique is applied during the first stage of the system implementation as per the government organizations involved in the study that include health and education.

The second authentication is through an intelligent login module shown in Figure 5-24, which enables an enormous number of users to avail government services and complete online transactions securely. The implementation of such an intelligent login module comes in the context of our efforts to achieve the UAE's vision 2021 and to enhance the overall models of government's electronic and smart services, which the country aims to achieve.
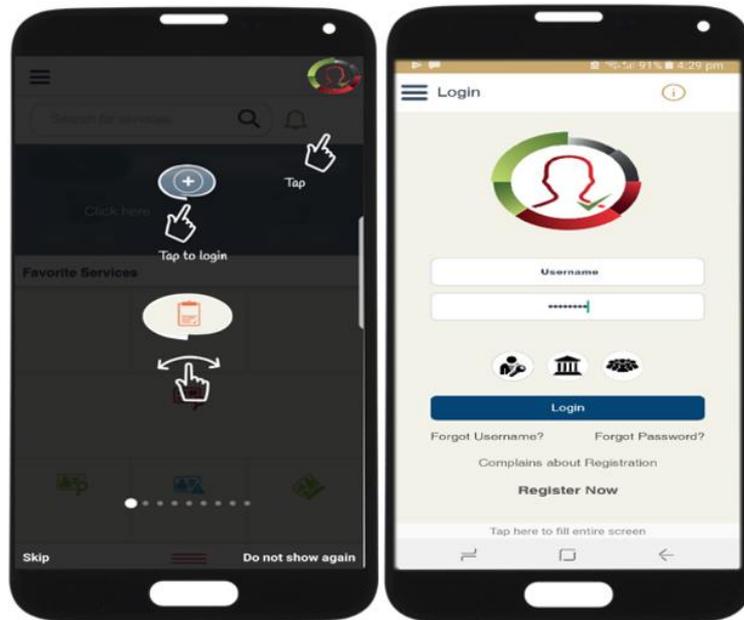
Figure 5-24 The intelligent login module with a walkthrough technique

Figure 5-25 shows the intelligent login module interface, which is one of the system's techniques that enable the citizens and overall end-users to have a unique account to easily access the government entities' services that include electronic and mobile channels through a secure platform. To verify the users' account, users will provide their Emirates ID which contains their verified personal details. The system utilized the Emirates ID API service to enable the verification process of the accounts. The steps require users to provide Emirates ID with the following mandatory information that includes active mobile phone number, email address, username and password credentials. The users who don't have Emirates ID can register through the given links that also allow them to update and retrieve passwords.
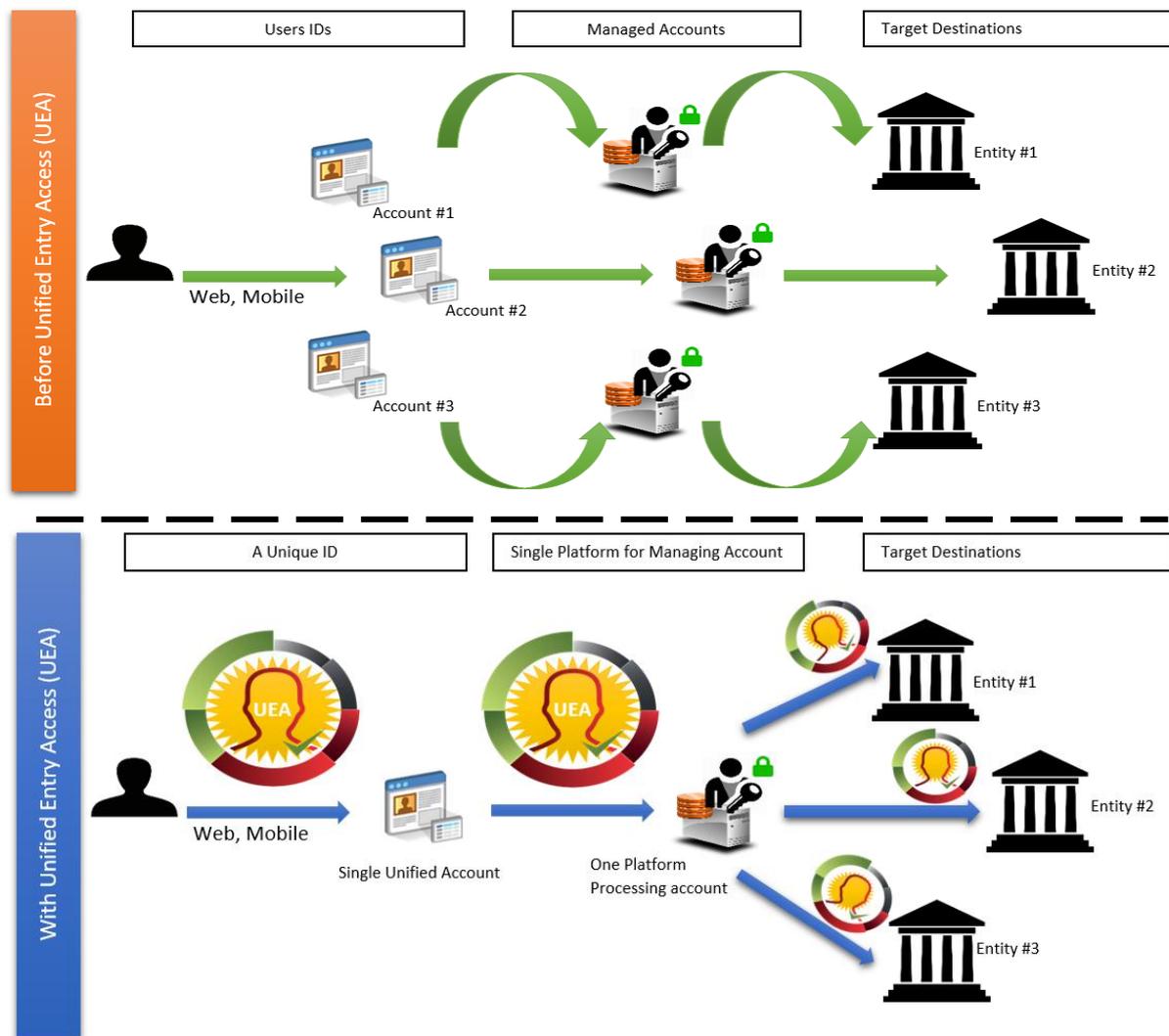
Figure 5-25 Pre and Post use of UEA Technique

Figure 5-25 shows an illustration of pre and post use of Unified Entry Access (UEA) and further illustration can be found in Appendix B. This unique scheme provides a seamless authentication process that enables users to use a single account to access various government entities' online services. The intelligent login module holds many benefits that include, enabling system users to have a UEA for digital government services and transactions over the Internet, so that each person will have a unified identification number used to facilitate access to online services, completion of transactions, review government services, raising comments and/or complaints, reporting technical concerns about deployed government entities' services. Furthermore, it allows easy access to all services provided by government agencies and align with the Government's objectives that aim to achieve the concept of inclusive and interconnected government. In fact, using UEA will improve the user experience and provide high-quality of enhanced electronic/ mobile services, providing a satisfying customer experience, reflecting happiness and achieve the ultimate objectives of e-Governance.

5.8 Chapter Summary

This chapter introduced the proposed intelligent web and mobile e-Gov system called the online evaluation system. The system allows government entities to perform a self-assessment against a compiled list of assessment models. These assessment models encompass 7 domains derived from the proposed research technology acceptance and include online/ smart services automation, services usability, services satisfaction, awareness and services outreach levels, quality requirements, online/ smart quality of services requirements and services' integration. Several different technical aspects have been covered in this chapter, including the client application, server application and the backend repository. This chapter also discussed the benefits of both systems such as web system and mobile application, the impacts of e-Governance, social Impact, economic Impact, e-Gov system architecture, model view controller architecture, e-Gov network architecture, deployment environments, development environment, staging and production environments, application platforms, and the security and privacy procedures that have been followed in the design stages.

Chapter 6 CONCLUSION AND FUTURE WORK

6.1 Conclusion

In general, this work proposes the use of intelligent approaches to improve the delivery of government services to citizens. We worked towards improving the quality of healthcare and education through a novel model including the UTAUT with external constructs, namely, perceived security, perceived enjoyment, perceived trustworthiness, personal innovativeness, data privacy, social influence, technology anxiety, resistance to change, self-efficacy, facilitating conditions, and constructs measured for quality including the system, services and information.

This research was inspired by the crucial need for a new pathway that could reduce the burden to the UAE government and simultaneously enhances the quality of citizens' lives. The increased number of citizens' demands for meaningful participation in decision-making processes triggered the proposal of this sort of governance model to enable people to take part in the government's decisions that impact their lives.

This research used a mixed-method approach that included a quantitative survey questionnaire and qualitative semi-structured interviews, which involved the distribution of questionnaires to healthcare and education sector participants. The model implemented a quantitative research method, including data collection and interpretation, and subsequent qualitative analysis to explain unexpected results from the quantitative study. PLS-SEM was chosen to explore the relationships between the variables in the proposed model. The general hypothesis tested by PLS-SEM was that the 20 variables, either individually or when composited into new variables, would be statistically significant predictors of the intention to use online/mobile eGovernment services. The developed model helped to predict the intention to use and adoption of health and education eGovernment services.

The study outlined a specific focus on the role of smart services in both sectors and included a case study of the UAE because of its federal monarchy's interest in smart services, eGovernance, and artificial intelligence.

The key aim of this research was achieved by investigating the factors that affect people's acceptance of eGovernment services within the fields of education and health. The research concluded with a new, refined governance acceptance model that addressed all the factors impacting individuals' acceptance of eGovernment services. Furthermore, the research achieved the main objectives by developing the novel eGovernance acceptance model for education and health; assessing, validating and evaluating the acceptance of the model in healthcare and education sectors; and applying the model as a roadmap for eGovernment services adoption and implementation of new government services initiatives and the development of intelligent web-based and mobile applications to centralize government services, as well as the continued evaluation of government entities' eGovernance implementation performance, e/mServices and ranking purposes.

6.2 Aims & Objectives Accomplished

The introductory chapter outlined the aims and the associated objectives of this study. By merging these with the research and development activity undertaken across the various chapters, a summary of accomplishments can be formally defined as follows :

OBJECTIVES	CHAPTERS	ACCOMPLISHMENTS
• To develop a novel eGovernance acceptance model for the education and the health sectors.	Ch. 2 Ch. 3	• Explored existing technology e-Governance models' key independent constructs. • Defined a collection of constructs and incorporated them into the proposed acceptance model. • Examined the role of Partial Least Squares – Structural Equation Modelling to explore the relative strengths and directions of the relationships between the constructs.
• To assess, validate and evaluate the acceptance of the proposed technology acceptance model.	Ch. 4	• Applied PLS-SEM technique to measure the relationships between latent variables and determined path analysis. • Applied quantitative and qualitative research methodology with different statistical techniques to evaluate and validate the fitness of the developed model. • Demonstrated general hypothesis tested by PLS-SEM that the 20 variables, either individually, or when composited into new variables, found statistically significant predictors of the intention to use educational online/ mobile e-Government services.

		• Determined the requirements that are expected of the e-Governance systems.
• To develop intelligent systems dedicated to decision makers and officials, for the purpose of evaluating and monitoring performance of government entities. • To apply Machine Learning techniques for improving the delivery of government services and measuring government entities' performance and ranking as perceived by the citizens. • To apply the proposed model as a roadmap for eGovernance services' adoption and implementations where new initiatives can be evaluated.	Ch. 5	• Defined the technical functional and non-functional system features. • Designed the physical architecture, secure system infrastructure, network architecture, system components and mobile app core functionalities. • Developed wireframes of the systems. • Applied recommendation system modules and collaborative filtering techniques as part of the system enhancement features. • Developed both e-Governance systems including the web and mobile. • Deployed both systems at health and education sectors for testing, evaluation and adoption purposes.

6.3   Limitations and Future work

This research has the followings limitations. Firstly, this research considered only two domain areas that is healthcare and education. The digital services including electronic and mobile services cover many other areas such as telecoms, agriculture, oil industry, municipal services and many more. These are also vital areas to look at from the eGovernance project's implementation especially across the world. Secondly, the data was collected from UAE region only and excluded the rest of the middle east countries. The revealed results should be quantitatively/ qualitatively compared with other countries for benchmark and comparative analysis purposes. Besides, the developed intention to use model in this research could be used in other regions such as the middle east or across the world as it has been designed to fit many countries considering the delivery of eGovernance services. Thirdly, this research was cross-sectional and not longitudinal. Therefore, it is uncertain whether the intention to use eGovernance services was impacted by the individuals' expectations. Fourthly, this research focused on Government to Citizen (G2C) and Government to Government (G2G) and excluded the Government to Business (G2B) and Government to Employees (G2E). However, since most of the governments' initiatives in healthcare and education sectors are currently directed mainly towards individuals rather than business and employees, the focus of this research on G2C is timely and more valuable to governments.

In summary, the outcomes of this research suggest several directions for future research. Firstly, future research could test the validity of the developed model in other areas of interest and outside UAE. Also, the developed model can be used in the private sector where digital services are of concern using mobile services. Secondly, the emerging challenges in the contemporary computing world is big data and the computational power required to analyse it to obtain information needed for different applications. We suggest considering big data from eGovernance's perspective and solve problems using algorithms that fit datasets of specific properties and size. Thirdly, since this research developed an intelligent system that applied filtering techniques which suggest items based on historical taste and as such the system is vulnerable to sparsity, cold start, and scalability problem. Future research could investigate the effects of sparsity on the system's performance of services rating prediction and top-N recommendations. Also, to run an evaluation using some of the well-known machine learning algorithms to find the most effective one for the available dataset.

Appendix A: Database Structure, Schema and Dashboard Snippets

ci_sessions

Column	Type	Null	Default	Comments
session_id	varchar(40)	No	0	
ip_address	varchar(16)	No	0	
user_agent	varchar(150)	No		
last_activity	int(10)	No	0	
user_data	text	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	session_id	1213	A	No	

tbl_action

Column	Type	Null	Default	Comments
id	int(11)	No		
user_id	int(11)	No	0	
action_date	timestamp	No	CURRENT_TIMESTAMP	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	15	A	No	

tbl_admin

Column	Type	Null	Default	Comments
id	int(11)	No		
username	varchar(255)	Yes	*NULL*	
password	varchar(255)	Yes	*NULL*	
show_password	varchar(255)	Yes	*NULL*	
name	text	Yes	*NULL*	
name_ar	text	Yes	*NULL*	
phone	varchar(255)	Yes	*NULL*	
email	varchar(255)	Yes	*NULL*	
address	text	Yes	*NULL*	
user_type	int(11)	Yes	*NULL*	1:admin;2:company;3:users
user_id	int(11)	Yes	0	
company_id	int(11)	Yes	0	
verified	int(11)	Yes	0	
is_first	int(11)	Yes	1	
created_date	varchar(50)	Yes	*NULL*	

Indexes

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tbl_assessment

Column	Type	Null	Default	Comments
id	int(11)	No		
company_id	int(11)	No		
assessment_module_id	int(11)	No		
question_type_id	int(11)	No		
question_sybtype_id	int(11)	No		
question_id	int(11)	No		
answer_id	int(11)	No		
date	varchar(255)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	245	A	No	

tbl_assessment_models

Column	Type	Null	Default	Comments
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name	varchar(255)	Yes	*NULL*	
name_ar	varchar(255)	Yes	*NULL*	
status	int(11)	Yes	*NULL*	
created_date	varchar(255)	Yes	*NULL*	
created_by	int(11)	Yes	*NULL*	
modified_date	varchar(255)	Yes	*NULL*	
modified_by	int(11)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	4	A	No	

tbl_bar_chart_options

Column	Type	Null	Default	Comments
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title	varchar(500)	Yes	*NULL*	
status	int(11)	No	0	

Indexes

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tbl_comment

Column	Type	Null	Default	Comments
id	int(11)	No		
comment	text	No		
company_id	int(11)	Yes	*NULL*	
service_id	int(11)	No		
comment_by	int(11)	No		
date	varchar(255)	Yes	*NULL*	
seen	int(11)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	399	A	No	

tbl_company_detail

Column	Type	Null	Default	Comments
id	int(11)	No		
company_type	int(11)	Yes	0	
company_logo	varchar(255)	Yes	*NULL*	
company_name	varchar(255)	Yes	*NULL*	
company_address	varchar(255)	Yes	*NULL*	
company_phone	varchar(20)	Yes	*NULL*	
company_fax	varchar(20)	Yes	*NULL*	
company_email	varchar(255)	Yes	*NULL*	
company_website	varchar(255)	Yes	*NULL*	
company_details	text	Yes	*NULL*	
rep_name	varchar(255)	Yes	*NULL*	
rep_email	varchar(255)	Yes	*NULL*	
rep_phone	varchar(20)	Yes	*NULL*	
idcard_no	varchar(255)	Yes	*NULL*	
rep_id_card	varchar(255)	Yes	*NULL*	
trade_license	varchar(255)	Yes	*NULL*	
regd_cert	varchar(255)	Yes	*NULL*	
service_field	varchar(255)	Yes	*NULL*	
score	float	Yes	0	
rate	double	Yes	0	
verified	int(11)	Yes	0	
created_date	varchar(50)	Yes	*NULL*	
verified_date	varchar(50)	Yes	*NULL*	
recommendations	text	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	16	A	No	

tbl_company_location

Column	Type	Null	Default	Comments
id	int(11)	No		
lat	varchar(255)	No		
lng	varchar(255)	No		
company_id	int(11)	No		
name	varchar(255)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
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tbl_company_servicetype

Column	Type	Null	Default	Comments
id	int(11)	No		
title	varchar(500)	No		
status	int(11)	No		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	33	A	No	

tbl_company_type

Column	Type	Null	Default	Comments
id	int(11)	No		
title	varchar(255)	No		
status	int(11)	No		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	3	A	No	

tbl_evaluate_service

Column	Type	Null	Default	Comments
id	int(11)	No		
company_id	int(11)	No	0	
service_id	int(11)	No	0	
evaluate_by	int(11)	No	0	
evaluate_id	int(11)	No	0	
date	varchar(22)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	45	A	No	

tbl_like

Column	Type	Null	Default	Comments
id	int(11)	No		
company_id	int(11)	Yes	*NULL*	
company_like	int(11)	Yes	*NULL*	
company_dislike	int(11)	Yes	*NULL*	
service_id	int(11)	Yes	*NULL*	
service_like	int(11)	Yes	*NULL*	
service_dislike	int(11)	Yes	*NULL*	
liked_by	int(11)	No		
date	varchar(20)	Yes	*NULL*	
seen	int(11)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	372	A	No	

tbl_message

Column	Type	Null	Default	Comments
id	int(11)	No		
subject	varchar(500)	Yes	*NULL*	
message	text	Yes	*NULL*	
date	varchar(255)	Yes	*NULL*	
receiver_id	varchar(255)	Yes	0	
sender_id	varchar(255)	Yes	0	
message_id	int(11)	Yes	0	
sender_soft_delete	int(11)	Yes	0	
sender_delete	int(11)	Yes	0	
receiver_soft_delete	int(11)	Yes	0	
receiver_delete	int(11)	Yes	0	
is_read	int(11)	Yes	0	
is_draft	int(11)	Yes	0	
attachment	varchar(255)	Yes	*NULL*	
ext	varchar(50)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	122	A	No	

tbl_model_submission

Column	Type	Null	Default	Comments
id	int(11)	No		
company_id	int(11)	No		
model_id	int(11)	No		
date	varchar(255)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	24	A	No	

tbl_priority

Column	Type	Null	Default	Comments
id	int(11)	No		
name	varchar(255)	No		
min_score	int(11)	No		
max_score	int(11)	No		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	6	A	No	

tbl_question

Column	Type	Null	Default	Comments
id	int(11)	No		
name	varchar(255)	No		
question_type	int(11)	No		
sub_type	int(11)	No		
status	int(11)	No		
created_date	varchar(50)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	42	A	No	

tbl_question_options

Column	Type	Null	Default	Comments
id	int(11)	No		
name	varchar(500)	No		
value	int(11)	No		
question_id	int(11)	No		
status	int(11)	No		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	101	A	No	

tbl_question_subtype

Column	Type	Null	Default	Comments
id	int(11)	No		
type_id	int(11)	Yes	*NULL*	

159

name	varchar(255)	Yes	*NULL*	
name_ar	varchar(255)	Yes	*NULL*	
status	int(11)	Yes	*NULL*	
created_date	varchar(255)	Yes	*NULL*	
created_by	int(11)	Yes	*NULL*	
modified_date	varchar(255)	Yes	*NULL*	
modified_by	int(11)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	17	A	No	

tbl_questiontype

Column	Type	Null	Default	Comments
id	int(11)	No		
model_id	int(11)	Yes	*NULL*	
name	varchar(255)	Yes	*NULL*	
name_ar	varchar(255)	Yes	*NULL*	
status	int(11)	Yes	*NULL*	
created_date	varchar(255)	Yes	*NULL*	
created_by	int(11)	Yes	*NULL*	
modified_date	varchar(255)	Yes	*NULL*	
modified_by	int(11)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	13	A	No	

tbl_rating

Column	Type	Null	Default	Comments
id	int(11)	No		
point	varchar(255)	Yes	*NULL*	
company_id	int(11)	Yes	*NULL*	
service_id	int(11)	Yes	0	
user_id	int(11)	Yes	*NULL*	
comment	text	Yes	*NULL*	
date	varchar(20)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	94	A	No	

tbl_service_evaluation_options

Column	Type	Null	Default	Comments

id	int(11)	No		
title	varchar(255)	Yes	*NULL*	
short_tag	varchar(255)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	5	A	No	

tbl_services

Column	Type	Null	Default	Comments
id	int(11)	No		
name	varchar(500)	Yes	*NULL*	
description	text	Yes	*NULL*	
in_operation_since	varchar(255)	Yes	*NULL*	
attachment	varchar(255)	Yes	*NULL*	
ext	varchar(10)	Yes	*NULL*	
verified	int(11)	No	0	
verified_seen	int(11)	No	0	
company_id	int(11)	No	0	
seen	int(11)	No	0	
created_date	varchar(50)	Yes	*NULL*	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	45	A	No	

tbl_status

Column	Type	Null	Default	Comments
id	int(11)	No		
name	varchar(255)	No		
min_score	int(11)	No		
max_score	int(11)	No		

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	2	A	No	

tbl_user

Column	Type	Null	Default	Comments
id	int(11)	No		
name	varchar(255)	Yes	*NULL*	
phone	varchar(255)	Yes	*NULL*	
email	varchar(255)	Yes	*NULL*	
address	varchar(255)	Yes	*NULL*	

photo	varchar(255)	Yes	NULL	
identity_card	varchar(255)	Yes	NULL	
idcard_no	varchar(255)	Yes	NULL	
qr_name	varchar(255)	Yes	NULL	
verified	int(11)	Yes	NULL	
verified_date	varchar(50)	Yes	NULL	
created_date	varchar(50)	Yes	NULL	
user_details	text	Yes	NULL	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	34	A	No	

tbl_user_log

Column	Type	Null	Default	Comments
id	int(11)	No		
userid	int(11)	Yes	NULL	
last_login	datetime	Yes	NULL	
current_login	varchar(255)	Yes	NULL	

Indexes

Keyname	Type	Unique	Packed	Column	Cardinality	Collation	Null	Comment
PRIMARY	BTREE	Yes	No	id	2604	A	No	

Admin / Entity/ User Login:

```php
public function check_admin()
{
    $ip = $_SERVER['REMOTE_ADDR'];
    $date = date('Y-m-d');
    if (isset($_POST['username']) && !empty($_POST['username']) && isset($_POST['password']) && !empty($_POST['password'])) {
        $username = $_POST['username'];
        $password = $_POST['password'];
        if ($this->adminmodel->checkLogin( $username , $password )) {
            $this->adminmodel->addLoginStatus();
            redirect("dashboard");
            //redirect('index.php/tasks/list_tasks');
        } else {
            $msg = "Access Denied | User / Password Not Matched ! ";
            $this->session->set_flashdata('msg_fail', $msg);
        }
    }
    redirect($_SERVER['HTTP_REFERER']);
}
```

Register New User / Entity

```php
public function register(){
    if(!($_POST)){
        $this->load->view('register');
    }else{
        if($this->input->post('password')==$this->input->post('re_password')){
            $id = $this->adminmodel->registerNewUser();
            if($id>0){
                $msg = "Welcome ,Your acount has been registered successfully !";
                $this->session->set_flashdata('msg_success', $msg);
                redirect('admin/complete_registration/'.$id);
            }else{
                $msg = "Error, Please try again !";
                $this->session->set_flashdata('msg_fail', $msg);
                redirect('admin/register');
            }
        }else{
            $msg = "Password and re-password hasnot been matched !";
            $this->session->set_flashdata('msg_fail', $msg);
            redirect('admin/register');
        }
    }
}
```

```php
public function registerNewUser(){
    if($this->input->post('type')==2){ // company
        $companydata = array('company_name'=>$this->input->post('name'),
                             'company_email'=>$this->input->post('email'),
                             'created_date'=>date('Y-m-d'));
        $this->db->insert('tbl_company_detail',$companydata);
        $company_id = $this->db->insert_id();
        $user_id = 0;
    }else{ // user
        $userdata = array('name'=>$this->input->post('name'),
                          'email'=>$this->input->post('email'),
                          'created_date'=>date('Y-m-d'));
        $this->db->insert('tbl_user',$userdata);
        $user_id = $this->db->insert_id();
        $company_id = 0;
    }
    $data = array('name'=>$this->input->post('name'),
                  'username'=>$this->input->post('email'),
                  'password'=>md5(trim($this->input->post('password'))),
                  'show_password'=>$this->input->post('password'),
                  'email'=>$this->input->post('email'),
                  'user_type'=>$this->input->post('type'),
                  'company_id'=>$company_id,
                  'user_id'=>$user_id,
                  'created_date'=>date('Y-m-d'));
    $this->db->insert('tbl_admin',$data);
    $id = $this->db->insert_id();
    return $id;
}
```

Admin Dashboard

1. **Get Active Users Data:**

```php
public function getSessionRandomData(){

    $expire_stamp = date('Y-m-d H:i:S', strtotime("-5 min"));
    //echo $expire_stamp;exit;
    $res = $this->db->query("select * from tbl_action where action_date >= '$expire_stamp'")->result_array();
    echo count($res);

}
```

Desc: This function will give the total active users available on runtime

2. **Entities Verified / Not Verified:**

```php
public function getYearVerifiedData($year=null){
    for($i=1;$i<=12;$i++){
        if($i<=9){
            $yeari = '0'.$i;
        }else{
            $yeari = $i;
        }
        $from_date = $year.'-'.$yeari.'-01';
        $to_date = $year.'-'.$yeari.'-32';
        $total = $this->getTotalCompanyByRange1($from_date,$to_date);
        $ver = $this->getVerifiedByDateRange($from_date,$to_date);
        $data['_'.$i] = ($total>0) ? number_format(($ver/$total)*100) : 0;
    }
    return $data;
}
```

Desc: This function preparesdata for % of **verifiedcompany** of individual month of selected year.

```php
public function getYearNotVerifiedData($year=null){

    for($i=1;$i<=12;$i++){
        if($i<=9){
            $yeari = '0'.$i;
        }else{
            $yeari = $i;
        }
        $from_date = $year.'-'.$yeari.'-01';
        $to_date = $year.'-'.$yeari.'-32';
        $total = $this->getTotalCompanyByRange1($from_date,$to_date);
        $nver = $this->getNotVerifiedByDateRange($from_date,$to_date);
        $data['_'.$i] = ($total>0) ? number_format(($nver/$total)*100) : 0;
    }
    return $data;

}
```

Desc: This function preparesdata for % of **not-verifiedcompany** of individual month of selected year.

3. **User Verified / Not Verified:**

```php
public function getYearVerifiedUserData($year=null){
    for($i=1;$i<=12;$i++){
        if($i<=9){
            $yeari = '0'.$i;
        }else{
            $yeari = $i;
        }
        $from_date = $year.'-'.$yeari.'-01';
        $to_date = $year.'-'.$yeari.'-32';
        $total = $this->getTotalUserByRange1($from_date,$to_date);
        $ver = $this->getVerifiedByDateUserRange($from_date,$to_date);
        $data['_'.$i] = ($total>0) ? round(($ver/$total)*100) : 0;
    }
    return $data;
}
```

Desc: This function preparesdata for % of **verifieduser** of individual month of selected year.

```php
public function getYearNotVerifiedUserData($year=null){

    for($i=1;$i<=12;$i++){
        if($i<=9){
            $yeari = '0'.$i;
        }else{
            $yeari = $i;
        }

        $from_date = $year.'-'.$yeari.'-01';
        $to_date = $year.'-'.$yeari.'-32';
        $total = $this->getTotalUserByRange1($from_date,$to_date);
        $nver = $this->getNotVerifiedByDateUserRange($from_date,$to_date);
        $data['_'.$i] = ($total>0) ? number_format(($nver/$total)*100) : 0;
    }
    return $data;

}
```

Desc: This function preparesdata for % of **not-verifieduser** of individual month of selected year.

Advance Dashboard:

```php
public function advance(){
    $data['title'] = 'Advance Dashboard';
    $sub = ' limit 10';
    $data['rating_var'] = 'all';
    $data['data'] = $this->dashboardmodel->getValidCompanies($sub);
    $this->load->view('partials/advance',$data);
}

public function getValidCompanies($sub = ''){
    return $this->db->query("select * from tbl_company_detail where verified='1' order by rate desc $sub")->result_array();
}
```

Get list of entities according to rating

```javascript
$("#show_records").click(function(){
    var rating = $("#rating").val();
    $.ajax({
        url:"<?php echo base_url(); ?>dashboard/advance_search",
        data:{rating:rating},
        method:"post",
        success:function(resp){
            $("#company_list").html(resp);
            $("#box-title").text(rating + ' RATED COMPANIES');
        }
    });
});
$("#reload").click(function(){
    location.reload();
});
```

```php
public function advance_search(){
    $data['rating_var'] = $this->input->post('rating');
    $data['data'] = $this->dashboardmodel->getValidCompanies();
    echo $this->load->view('partials/advance_company_list',$data);
}

public function getValidCompanies($sub = ''){
    return $this->db->query("select * from tbl_company_detail where verified='1' order by rate desc $sub")->result_array();
}
```

Recommendation algorithms:

```php
<?php
if(!empty($service_field)){

  $sql = $this->db->query("SELECT * from tbl_company_detail where id NOT IN ($id1,$company_id) and service_field = $service_field")->result();
  $count = count($sql);
  if($count == 0){
    $query = $this->db->query("SELECT * from tbl_company_detail where id NOT IN ($id1,$company_id) limit 1")->result();
  }
  else{
    $query = $this->db->query("SELECT * from tbl_company_detail where id NOT IN ($id1,$company_id) and service_field = $service_field limit 1")->result();
  }
}

else{

  $query = $this->db->query("SELECT * from tbl_company_detail where id NOT IN ($id1,$company_id) limit 1")->result();
}

?>
```

Result of query gives the list of recommendations.

Assessment for entities:

```php
public function performEvaluation(){
    $data['model_id'] = $this->input->get('model');
    $submission_status = $this->assessment_model->checkModelSubmissionStatus($data['model_id']);
    if($submission_status==1){
        $data['page'] = "made_evaluation";
    }else{
        $data['page'] = "make_evaluation";
    }
    $data['title'] = "Make Self Evaluation of Model -> <strong>".$this->assessment_model->getModelNameById($data['model_id']).'</strong>'
    $data['types'] = $this->assessment_model->getQyestionTypesFromModel($data['model_id']);
    $this->load->view('dashboard/index',$data);
}
```

```php
public function getCompletedPercentage($model_id=null){
  $cid = $this->session->userdata('company_id');
  $type = $this->db->query("select * from tbl_questiontype where model_id in ($model_id)")->result_array();
  if(count($type)>0){
    foreach($type as $t){
      $type_arr[] = $t['id'];
    }
    $type_ids = implode(',',$type_arr);
  }else{
    $type_ids = 0;
  }
  //echo $type_ids;exit;
  $totalQuestions = $this->db->query("select * from tbl_question where question_type in ($type_ids)")->result_array();
  $totalAnser = $this->db->query("select * from tbl_assessment where assessment_module_id in ($model_id) and company_id=$cid")->result_array();
  if(count($totalQuestions)!=0){
    $per = (count($totalAnser)/count($totalQuestions))*100;
    return number_format($per,2);
  }else{
    return number_format(0,2);
  }

}
```

Desc: Calculate the total (%) of completion of selected assessment of logged in entity.

```
public function calculateFinalScore($model_id=null,$cid=null){
    //echo $cid;exit;
    $totalScore = $this->calculateTotalScore($model_id);
    $gotScore = $this->calculateTotalSocoreGot($model_id,$cid);
    return ($totalScore!=0) ? ($gotScore/$totalScore)*100 : 0;
}

public function calculateTotalScore($model_id=null){
    $qids = $this->getQuestionIdsOfModel($model_id);
    $res = $this->db->query("select sum(value) as value from tbl_question_options where question_id in ($qids)")->row();
    return $res->value;
}

public function calculateTotalSocoreGot($model_id=null,$cid=null){
    $cid = ($cid==null) ? $this->session->userdata('company_id') : $cid;
    $ans_ids = $this->db->query("select * from tbl_assessment where assessment_module_id in($model_id) and company_id=$cid")->result_array();
    if(count($ans_ids)>0){
        foreach($ans_ids as $a){
            $ans_ids_arr[] = $a['answer_id'];
        }
        $aids = implode(',', $ans_ids_arr);
    }else{
        $aids = 0;
    }
    $valueData = $this->db->query("select sum(value) as value from tbl_question_options where id in ($aids)")->row();
    return $valueData->value;
}
```

```
public function getStatus($finalScore){
    $res = $this->db->query("select * from tbl_status where min_score <= $finalScore and max_score >= $finalScore")->row();
    return (count($res)>0) ? $res->name : '';
}
```

Desc: Get status of individual module of logged in company and below image shows the status table (tbl_status).

+ Options

	id	name	min_score	max_score
☐ Edit Copy Delete	1	Disqualified	0	49
☐ Edit Copy Delete	2	Qualified	50	100

```
public function getPriority($finalScore){
    $res = $this->db->query("select * from tbl_priority where min_score <= $finalScore and max_score > $finalScore")->row();
    return (count($res)>0) ? $res->name : 'Not Qualified';
}
```

Description: Get the priority of the entity according to individual module of logged in entities. And below table data are priority distribution according to score or individual module.

+ Options

	id	name	min_score	max_score
☐ Edit Copy Delete	1	Low	50	60
☐ Edit Copy Delete	2	Medium	60	70
☐ Edit Copy Delete	3	Normal	70	80
☐ Edit Copy Delete	4	High	80	90
☐ Edit Copy Delete	5	Highest	90	100
☐ Edit Copy Delete	6	Not Qualified	0	50

167

User Module

```php
public function getAverageRating($cid=null){

    $totalPoint = $this->getTotalRatingPoint($cid);
    $totalRater = $this->getTotalRater($cid);
    return $avg = ($totalRater!=0) ? round(($totalPoint/($totalRater*5))*100) : 0;

}
public function getTotalRatingPoint($cid=null){
    $res = $this->db->query("select sum(point) as point from tbl_rating where company_id=$cid")->row();
    return ($res->point!= '') ? $res->point : 0;
}
public function getTotalRater($cid=null){
    $cid = ($cid == null) ? $this->session->userdata('company_id') : $cid;
    $res = $this->db->query("select user_id from tbl_rating where company_id=$cid")->result_array();
    return count($res);

}
```

Desc: Above functions calculate the average rating of the entity.

```php
public function getCompanyTotalLike($cid=null){
    $res = $this->db->query("select * from tbl_like where company_id=$cid and company_like=1")->result_array();
    return (count($res));
}
```

Description: Get total no of likes for individual entity.

```php
public function getCompanyTotalDislike($cid=null){
    $res = $this->db->query("select * from tbl_like where company_id=$cid and company_dislike=1")->row();
    return count($res);
}
```

Desc: Get total no of dislike for individual entity.

```php
public function getComments($id=null){
    return $this->db->query("select * from tbl_comment where service_id = $id")->result_array();
}
```

Description: Get list of comments for individual services.

Database Schema

tbl_assessment_models
- id INT(11)
- name VARCHAR(255)
- name_ar VARCHAR(255)
- status INT(11)
- created_date VARCHAR(255)
- created_by INT(11)
- modified_date VARCHAR(255)
- modified_by INT(11)
- Indexes

tbl_questiontype
- id INT(11)
- model_id INT(11)
- name VARCHAR(255)
- name_ar VARCHAR(255)
- status INT(11)
- created_date VARCHAR(255)
- created_by INT(11)
- modified_date VARCHAR(255)
- modified_by INT(11)
- Indexes

tbl_assessment
- id INT(11)
- company_id INT(11)
- assessment_module_id INT(11)
- question_type_id INT(11)
- question_sybtype_id INT(11)
- question_id INT(11)
- answer_id INT(11)
- date VARCHAR(255)
- Indexes

tbl_services
- id INT(11)
- name VARCHAR(500)
- description TEXT
- in_operation_since VARCHAR(255)
- attachment VARCHAR(255)
- ext VARCHAR(10)
- verified INT(11)
- verified_seen INT(11)
- company_id INT(11)
- seen INT(11)
- created_date VARCHAR(50)
- Indexes

tbl_question_subtype
- id INT(11)
- type_id INT(11)
- name VARCHAR(255)
- name_ar VARCHAR(255)
- status INT(11)
- created_date VARCHAR(255)
- created_by INT(11)
- modified_date VARCHAR(255)
- modified_by INT(11)
- Indexes

tbl_like
- id INT(11)
- company_id INT(11)
- company_like INT(11)
- company_dislike INT(11)
- service_id INT(11)
- 5 more...
- Indexes

tbl_company_type
- id INT(11)
- title VARCHAR(255)
- status INT(11)
- Indexes

tbl_model_submission
- id INT(11)
- company_id INT(11)
- model_id INT(11)
- date VARCHAR(255)
- tbl_company_detail_id INT(11)
- Indexes

tbl_admin
- id INT(11)
- username VARCHAR(255)
- password VARCHAR(255)
- show_password VARCHAR(255)
- name TEXT
- name_ar TEXT
- phone VARCHAR(255)
- email VARCHAR(255)
- address TEXT
- user_type INT(11)
- user_id INT(11)
- company_id INT(11)
- verified INT(11)
- 4 more...
- Indexes

tbl_company_detail
- id INT(11)
- company_type INT(11)
- company_logo VARCHAR(255)
- company_name VARCHAR(255)
- company_address VARCHAR(255)
- company_phone VARCHAR(20)
- company_fax VARCHAR(20)
- company_email VARCHAR(255)
- company_website VARCHAR(255)
- company_details TEXT
- rep_name VARCHAR(255)
- rep_email VARCHAR(255)
- rep_phone VARCHAR(20)
- idcard_no VARCHAR(255)
- rep_id_card VARCHAR(255)
- trade_license VARCHAR(255)
- regd_cert VARCHAR(255)
- service_field VARCHAR(255)
- 7 more...
- Indexes

tbl_company_servicetype
- id INT(11)
- title VARCHAR(500)
- status INT(11)
- Indexes

tbl_question
- id INT(11)
- name VARCHAR(255)
- question_type INT(11)
- sub_type INT(11)
- status INT(11)
- created_date VARCHAR(...)
- Indexes

tbl_question_options
- id INT(11)
- name VARCHAR(500)
- value INT(11)
- question_id INT(11)
- status INT(11)
- Indexes

tbl_company_location
- id INT(11)
- lat VARCHAR(255)
- lng VARCHAR(255)
- company_id INT(11)
- name VARCHAR(255)
- Indexes

tbl_user_log
- id INT(11)
- userid INT(11)
- last_login DATETIME
- current_login VARCHAR(255)
- tbl_admin_id INT(11)
- Indexes

tbl_comment
- id INT(11)
- comment TEXT
- company_id INT(11)
- service_id INT(11)
- comment_by INT(11)
- date VARCHAR(255)
- seen INT(11)
- tbl_admin_id INT(11)
- Indexes

tbl_user
- id INT(11)
- name VARCHAR(255)
- phone VARCHAR(255)
- email VARCHAR(255)
- address VARCHAR(255)
- photo VARCHAR(255)
- identity_card VARCHAR(...)
- 10 more...
- Indexes

tbl_message
- id INT(11)
- subject VARCHAR(500)
- message TEXT
- date VARCHAR(255)
- receiver_id VARCHAR(255)
- sender_id VARCHAR(255)
- message_id INT(11)
- 8 more...
- Indexes

tbl_service_evaluation_options
- id INT(11)
- title VARCHAR(255)
- short_tag VARCHAR(255)
- Indexes

tbl_evaluate_service
- id INT(11)
- company_id INT(11)
- service_id INT(11)
- evaluate_by INT(11)
- evaluate_id INT(11)
- date VARCHAR(22)
- tbl_company_detail_id INT(11)
- 2 more...
- Indexes

tbl_rating
- id INT(11)
- point VARCHAR(255)
- company_id INT(11)
- service_id INT(11)
- user_id INT(11)
- comment TEXT
- date VARCHAR(20)
- tbl_services_id INT(11)
- Indexes

169

Appendix B: Unified Entry Access Systems' Architecture

Unified Entry Access (UEA) Overview

- One account and single sign on between government services.
- Support for multiple trust-levels, multiple authentication methods, multi access channels.

Unified Entry Access (UEA) Authentication Use Cases
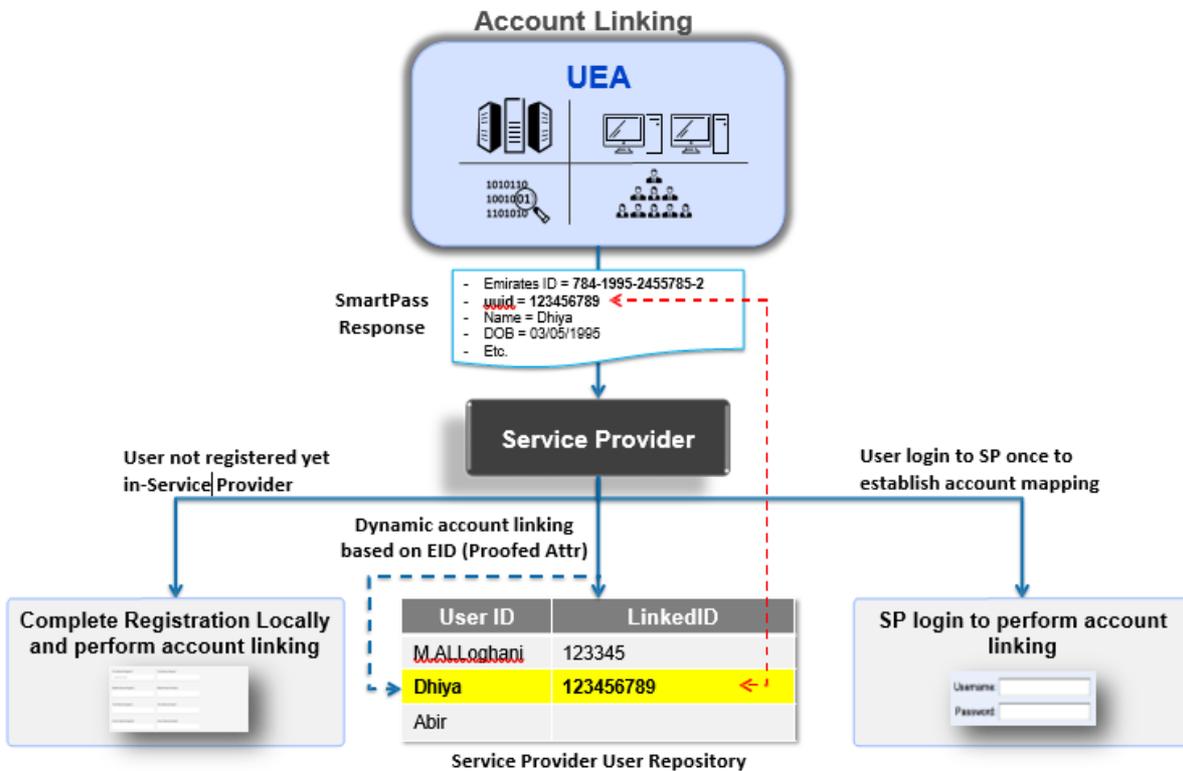
Appendix C: Intelligent System Dashboard & Agile Methodology
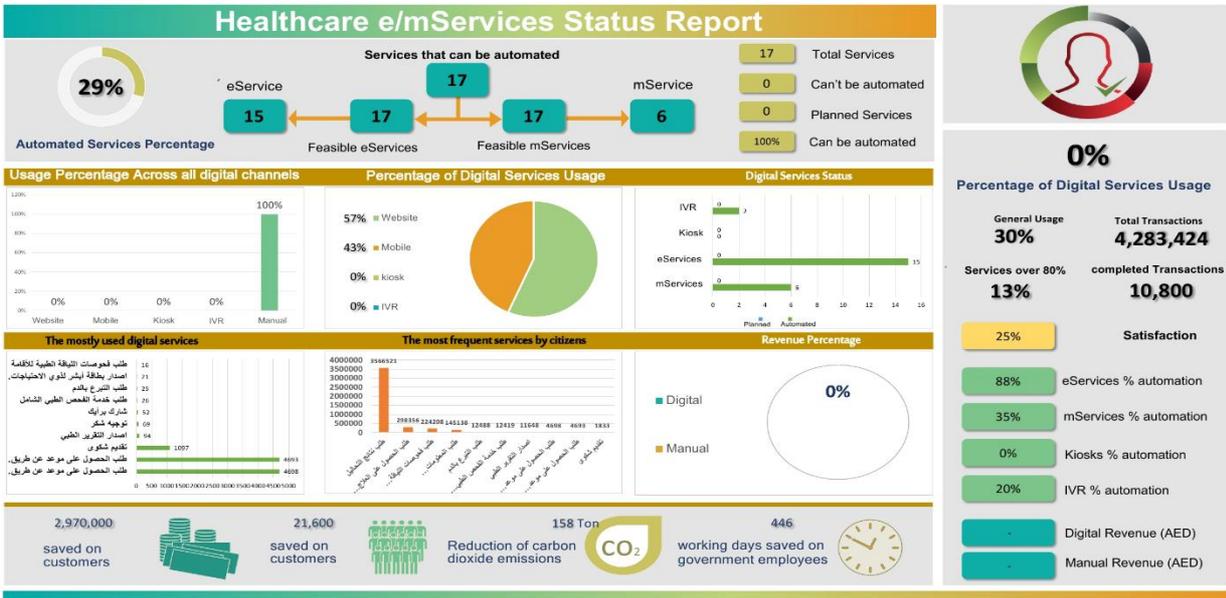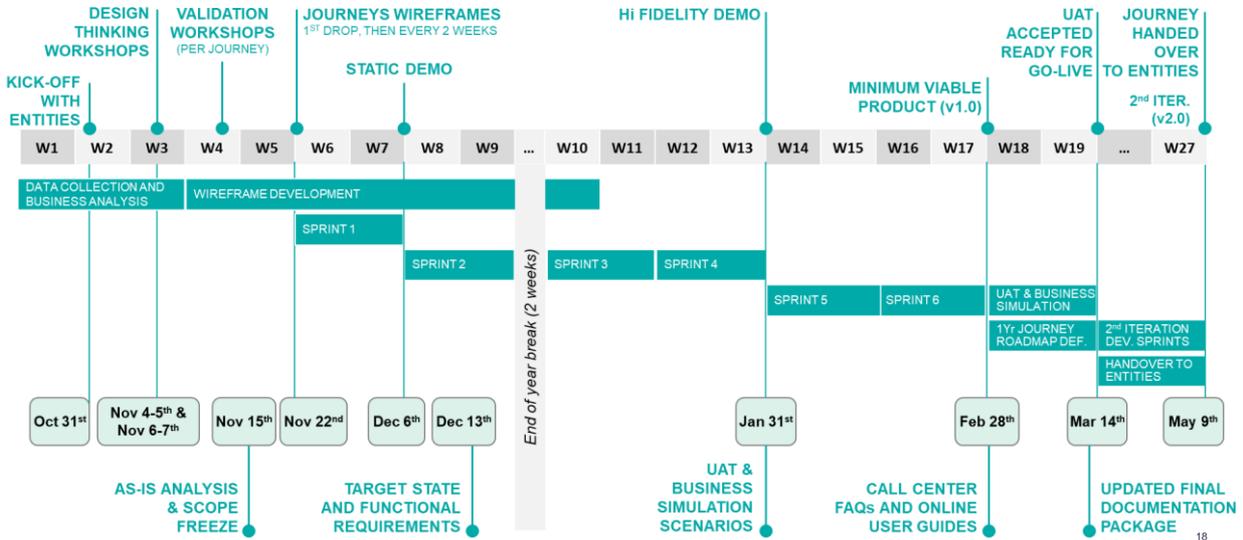
Questionnaire Instrument

PART A: Background Information

Please mark your response from questions 1 to 8 by clicking ☑ for each question.

1. Gender

Please indicate your gender?

☐ Female   ☐ Male

2. Age Group

Please indicate your age range?

☐ 18-20   ☐ 20-29   ☐ 30-39 ☐ 40-49 ☐ 50 years or older

3. Level of Education

Please indicate highest completed level of education?

☐ High School Certificate   ☐ Bachelor's degree ☐ Postgraduate degree ☐ other

4. Occupation

Please specify what is your current job?

☐ Student   ☐ Government Employee   ☐ Non-Government Employee ☐ Own Business ☐ Unemployed

☐ Retired

5. Nationality:

What is your current nationality?

☐ Emirati   ☐ Non-Emirati (Please specify _____)

6. Language:

Please indicate what language you prefer to use when accessing the internet?

☐ English ☐ Arabic   ☐ both ☐ other, please specify _____

7. Usage of Smart Phone

Do you own or have a Smart Phone?

☐ Yes   ☐ No

8. Internet experience:

1. For how long you have been using the internet?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ All of the Time

2. How many times do you use the internet during a week?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ All of the Time

3. How frequently do you visit online/ mobile healthcare systems?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ All of the Time

4. Which of the following channels is the most preferred to use when accessing information?

☐ Websites ☐ Mobile ☐ SMS ☐ Services centre

5. Are you currently a user of an online/ mobile healthcare System?

☐ Yes ☐ No

PART B: Constructs and Measured Items

Perceived Ease of Use (PEOU)

	Strongly Disagree						Strongly Agree
1. The online/ mobile healthcare system does not require a lot of my mental effort. (PEOU1)		1	2	3	4	5	
2. I find the online/ mobile healthcare system to be easy to use. (PEOU2)		1	2	3	4	5	
3. My interaction with the online/ mobile healthcare system is very clear. (PEOU3)		1	2	3	4	5	
4. I find it easy to get the online/ mobile healthcare system to do what I want it to do. (PEOU4)		1	2	3	4	5	
5. I think, it is easy to find information on both online/ mobile healthcare systems. (PEOU5)		1	2	3	4	5	

Perceived Usefulness (PU)

	Strongly Disagree						Strongly Agree
1. Using online/ mobile healthcare system makes it easier for me to get my medical information that I need. (PU1)		1	2	3	4	5	
2. Using online/ mobile healthcare system enables me to save time and efforts. (PU2)		1	2	3	4	5	
3. Online/ mobile healthcare system helps me to search more quickly for information need. (PU3)		1	2	3	4	5	
4. Using online/ mobile healthcare system improves my performance. (PU4)		1	2	3	4	5	
5. Using the online/ mobile healthcare system gives me greater control over my medical details that I need. (PU5)		1	2	3	4	5	

Perceived Security (PS)

	Strongly Disa						Strongly Agre
1. I believe I am not worried about the security. (PS1)		1	2	3	4	5	

173

2. I believe the system is protected from any security breaches. (PS2)			1	2	3	4	5	
3. I feel secure sending personal information thru the system. (PS3)			1	2	3	4	5	
4. I feel safe in making any transaction thru the system. (PS4)			1	2	3	4	5	
5. There is feedback from the system indicating the information is protected. (PS5)			1	2	3	4	5	

Perceived Enjoyment (PE)

1. I believe using the online/ mobile healthcare system is enjoyable. (PE1)	Strongly Disagree		1	2	3	4	5	Strongly Agree
2. I have fun using the online/ mobile healthcare system. (PE2)			1	2	3	4	5	
3. The actual process of using online/ mobile healthcare system is pleasant**.**			1	2	3	4	5	
4. I find using the system a pleasant way to pass time. (PE4)			1	2	3	4	5	
5. I prefer online/ mobile healthcare systems that have multimedia features like videos and animations. (PE5)			1	2	3	4	5	

Perceived Trustworthiness

1. I believe that online/ mobile systems of healthcare are trustworthy. (PT1)	Strongly Disagree		1	2	3	4	5	Strongly Agree
2. I trust using the system to fulfil my medical requirements. (PT2)			1	2	3	4	5	
3. I would characterize the online/ mobile healthcare system as authentic. (PT3)			1	2	3	4	5	
4. I believe that most e-Governance systems implemented for healthcare sector exhibit care, concern and goodwill to the patients. (PT4)			1	2	3	4	5	
5. I would expect to get high performance of e-Governance systems implemented for healthcare sector. (PT5)			1	2	3	4	5	

Personnel Innovativeness (PIN)

1. Among my peers, I am usually the first to try out new systems. (PIN1)	Strongly Disagree		1	2	3	4	5	Strongly Agree
2. I like to explore new systems/ services. (PIN2)			1	2	3	4	5	
3. I like to experiment with new systems launched for healthcare services. (PIN3)			1	2	3	4	5	
4. I find the online/ mobile healthcare systems as convincible approach for getting latest information. (PIN4)			1	2	3	4	5	
5. I like to see and send multimedia thru the new system. (PIN5)			1	2	3	4	5	

Data Privacy (DP)

1. I am worried about using online/ mobile healthcare systems to deliver and receive services which will cause me to lose control over data privacy. (DP1)	Strongly Disagree		1	2	3	4	5	Strongly Agree
2. I don't fear that online/ mobile healthcare system providers shall not disseminate my personal information with others. (DP2)			1	2	3	4	5	
3. I fear that hackers might take control of my information if I use online/ mobile healthcare systems. (DP3).			1	2	3	4	5	

Social Influence (SINF)

1. If related friends to me believe that I should use the online/ mobile healthcare systems for obtaining my medical history information, I will use them. (SINF 1)	Strongly Disagree		1	2	3	4	5	Strongly Agree
2. If health professionals in the hospital think that I should use online/ mobile healthcare systems, I will use them. (SINF 2)			1	2	3	4	5	
3. People who influence my behaviour think I should use the online/ mobile healthcare systems. (SINF 3)			1	2	3	4	5	

Relative Advantage (RAD)

1. The online/ mobile healthcare system is better than traditional paper and forms for admission and treatment purposes. (RAD1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. The online/ mobile learning system is more interesting than other applications. (RAD2)		1	2	3	4	5	
3. Using online/ mobile healthcare system gave me a better experience than I would have otherwise. (RAD3)		1	2	3	4	5	
4. I obtained all information I needed such as medical history, prescriptions by doctors and many more by using online/ mobile healthcare system (RAD4)		1	2	3	4	5	

Compatibility (COM)

1. I find the online/ mobile healthcare system compatible with my needs. (COM1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I believe the online/ mobile healthcare system helps me to learn more about technology while also leveraging my ICT maturity levels. (COM2)		1	2	3	4	5	
3. I prefer to use online/ mobile healthcare system in fixing appointments with a doctor at a hospital. (COM3)		1	2	3	4	5	
4. It doesn't bother me to use online/ mobile healthcare system while I could attend physically at a hospital to perform certain activity. (COM4)		1	2	3	4	5	

Complexity (COMX)

1. Using online/ mobile healthcare system could take up too much of my time when performing many tasks. (COMX1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. When I use online/ mobile healthcare system, I find it difficult to understand and use.		1	2	3	4	5	
3. I find online/ mobile healthcare system complicated to learn.		1	2	3	4	5	

Triability (TRI)

1. I like being able to try out online/ mobile healthcare system before deciding whether I like it or not. (TRI1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. A trial convinced me that using online/ mobile healthcare system was better than following and using normal system procedure. (TRI2)		1	2	3	4	5	
3. I think it is better to experiment with new systems before adopting them. (TRI3)		1	2	3	4	5	

Observability (OBS)

1. I believe other people seemed interested in the online/ mobile healthcare system when they saw me using it. (OBS1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I believe I have no difficulty in telling other patients or people in general about what online/ mobile healthcare system like. (OBS2)		1	2	3	4	5	
3. I was influenced by what I observed as the benefits of using online/ mobile healthcare system. (OBS3)		1	2	3	4	5	
4. The doctor that I frequently visit at the hospital seemed to like using online/ mobile healthcare system. (OBS4)		1	2	3	4	5	

Technology Anxiety (TECA)

1. I hesitate to use new technology for fear of making mistakes I cannot correct. (TECA1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I feel anxious about using online/ mobile health systems for delivering healthcare services. (TEC2)		1	2	3	4	5	
3. I feel worried about unanticipated bugs and errors that might arise out from the system. (TECA3)		1	2	3	4	5	

Resistance to Change (RTC)							
1. I don't want online/ mobile healthcare systems to make any changes in my routine visits and treatment at hospitals. (RTC1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I believe that using online/ mobile health systems to deliver healthcare services a negative idea. (RTC2)		1	2	3	4	5	
3. Although the potential benefits online/ mobile healthcare systems, I do not want to use them. (RTC3)		1	2	3	4	5	
Self-Efficacy (SE)							
1. It is very easy for me to use online/ mobile healthcare systems. (SE1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I am able to use online/ mobile healthcare systems without much effort. (SE2)		1	2	3	4	5	
3. I have the capability to use online/ mobile healthcare systems. (SE3)		1	2	3	4	5	
Facilitating Conditions							
1. I expect that the government to provide necessary resources e.g. internet and network coverage to use online/ mobile healthcare systems. (FAC1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I expect that the government will give high priority to support healthcare technologies initiatives. (FAC2)		1	2	3	4	5	
3. I expect that the government will define the necessary legislations that regulate the provision of online/ mobile healthcare systems. (FAC3)		1	2	3	4	5	
4. I expect that non-government health organizations such as "World Health Organization" to support the new healthcare systems initiatives. (FAC4)		1	2	3	4	5	
5. I expect that technical support will be available for assistance with any difficulties in usage of online/ mobile healthcare systems. (FAC5)		1	2	3	4	5	
Services Quality							
1. I will stop using the online/ mobile healthcare system that makes errors after submission of the services request. (SERQ1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I prefer to use online/ mobile healthcare systems that provide least amount of broken links during the services delivery process. (SERQ2)		1	2	3	4	5	
3. I prefer to use online/ mobile healthcare systems that provide minimum number of scripting errors during the service delivery process. (SERQ3)		1	2	3	4	5	
4. I prefer to use online/ mobile healthcare systems that provide minimum wait time between navigation and next service page. (SERQ4)		1	2	3	4	5	
5. I will move to another online/ mobile healthcare system that provides Single sign-on (SSO) option to access all services. (SERQ5)		1	2	3	4	5	
System Quality							
1. I prefer to have multiple ways of accessing the same information. (SYSQ1)	Strongly Disagree	1	2	3	4	5	Strongly Agree
2. I prefer to use online/ mobile healthcare system that provides effective search engine. (SYSQ2)		1	2	3	4	5	
3. I will move to another online/ mobile healthcare system whenever I faced slow download or upload. (SYSQ3)		1	2	3	4	5	
4. I prefer to use online/ mobile healthcare system that provides special need features (e.g. tones for pressed keys, audio function for displayed text, colour options). (SYSQ4)		1	2	3	4	5	
5. I prefer to use online/ mobile healthcare system that provides various online payment methods (eDirham, VISA, MasterCard, Direct Debit, etc.). (SYSQ5)		1	2	3	4	5	
Information Quality							
1. In my opinion, the service information must be descriptive, meaningful and readable and must follow content standards e.g. plain language. (INFQ1)	Strongly Disa	1	2	3	4	5	Strongly Agre

2. I prefer to use online/ mobile healthcare system that provide me clear and concise information instead of detailed information. (INFQ2)	1	2	3	4	5	
3. I will stop using online/ mobile healthcare system that provides outdated and inaccurate information. (INFQ3)	1	2	3	4	5	

Appendix E: Interview Questions

Important Note:

The listed hereunder questions are the key ones. But this is a Semi-Structured interview and it is expected that further questions shall be added accordingly based on the responses of interviewees.

Demographics

General information:

- Gender
- Age Group
- Level of Education
- Occupation.

General Questions

(PEOU)

- Do you find it easy to use online/ mobile e-Governance systems?

- Do you find the process of using online/ mobile e-Governance systems is clear?

(PU)

- Do you find the online/ mobile e-Governance services very useful to you?

- Do you find the online/ mobile e-Governance services are saving your time and efforts?

(PS)

- Do you feel secure when sending personal information thru online/ mobile e-Governance services?

- Do you find the online/ mobile e-Governance systems protected from any security breaches?

(PE)

- Do you find the use of online/ mobile e-Governance systems more enjoyable than other services and systems?

- Do you prefer to use online/ mobile e-Governance systems that offer services with multimedia features and social networks options? Does it have impact on the spread of e-Governance services?

PT

- Do you trust online/ mobile e-Governance systems?

- Do you find the use of online/ mobile e-Governance system authentic tool over traditional alternatives?

(PIN)

- Do you like to see and interact with new services offered when using online/ mobile e-Governance systems? Does it have impact on the use and spread of e-Governance services?

(DP)

- Do you find the use of online/ mobile e-Governance systems is financially secure?

- Do you have any concern about data privacy when interacting with online/ mobile e-Governance systems is financially secure? Please state why if answer is yes?

(SINF)

- Does peer pressure or recommendations have impact on using the online/ mobile e-Governance systems?

(RAD)

- Do you find using online/ mobile e-Governance systems more useful than conventional approaches?

- Do you find using online/ mobile e-Governance systems more effective than traditional approaches?

(COM)

- Do you find using online/ mobile e-Governance systems well-matched with your needs?

- Do you find using the online/ mobile e-Governance systems more supportive tool of learning and it leverages ICT maturity levels?

Appendix F: List of Publications

1. **M. Alloghani**, Predicting End-User Adoption to Mobile Services. *Journal of Data Analysis and Information Processing*, 6, 2018, pp. 15-29. DOI: 10.4236/jdaip.2018.62002.

2. **M. Alloghani**, A. Hussain, D. Al-Jumeily, A. J. Aljaaf, and J. Mustafina, "Gamification in e-Governance: Development of an Online Gamified System to Enhance Government Entities Services Delivery and Promote Public's Awareness," *In Proceedings of the 5th International Conference on Information and Education Technology (ICIET '17)*. ACM, New York, NY, USA, 2017, pp. 176-181. DOI: https://doi.org/10.1145/3029387.3029388

3. **M. Alloghani**, A. Hussain, D. Al-Jumeily, A. Aljaaf and N. AlShamsi, "Development of an Interactive System to Enhance Strategic Planning Process and Quality of Aviation Operations Using Balanced Scorecard: A UAE Case study," *2017 10th International Conference on Developments in eSystems Engineering (DeSE)*, Paris, 2017, pp. 201-205, DOI: 10.1109/DeSE.2017.15

4. **M. Alloghani**, A. Hussain, D. Al-Jumeily, P. Fergus, O. Abuelma'atti and H. Hamden, "A mobile health monitoring application for obesity management and control using the internet-of-things," *2016 Sixth International Conference on Digital Information Processing and Communications (ICDIPC)*, Beirut, 2016, pp. 19-24. doi: 10.1109/ICDIPC.2016.7470785

5. **M. Alloghani**, "Development of a cross-platform mobile eGovernment system for suppliers (A case study from UAE)," *International Conference on Computer Vision and Image Analysis Applications*, Sousse, 2015, pp. 1-4. doi: 10.1109/ICCVIA.2015.7351882

6. **M. Alloghani**, A. Hussain, D. Al-Jumeily and O. Abuelma'atti, "Technology Acceptance Model for the Use of M-Health Services among Health-Related Users in UAE," *2015 International Conference on Developments of E-Systems Engineering (DeSE)*, Dubai, 2015, pp. 213-217. doi: 10.1109/DeSE.2015.58

7. **M. Alloghani**, D. Al-Jumeily, A. Hussain (2016) Apps for education: Development of a Virtual Role-Play Simulation App for Academic Teachers and Students, *EDULEARN16 Proceedings*, p. 2201

8. **Alloghani M.**, Al-Jumeily D., Baker T., Hussain A., Mustafina J., Aljaaf A.J. (2019) Applications of Machine Learning Techniques for Software Engineering Learning and Early Prediction of Students' Performance. In: Yap B., Mohamed A., Berry M. (eds) Soft Computing in Data Science. SCDS 2018. Communications in Computer and Information Science, vol 937. Springer, Singapore

9. **Mohamed Alloghani**, Thar Baker, Dhiya Al-Jumeily, Abir Hussain, Ahmed J. Aljaaf and Jamila Mustafina, Early Detection and Prediction of Lung Cancer using Machine Learning Algorithms Applied on a Secure Healthcare Data System Architecture. In: Brij Gupta, Michael Sheng (1st Ed.) Machine Learning for Computer and Cyber Security: Principles, Algorithms, and Practices. CRC press, 2019, pp. 232-257.

10. **M. Alloghani**, D. Al-Jumeily, A. Hussain, A. J. Aljaaf, J. Mustafina and E. Petrov, "Healthcare Services Innovations Based on the State of the Art Technology Trend Industry 4.0," *2018 11th International Conference on Developments in eSystems Engineering (DeSE)*, Cambridge, United Kingdom, 2018, pp. 64-70. doi: 10.1109/DeSE.2018.00016

11. **M. Alloghani**, A. J. Aljaaf, D. Al-Jumeily, A. Hussain, C. Mallucci and J. Mustafina, "Data Science to Improve Patient Management System," *2018 11th International Conference on Developments in eSystems Engineering (DeSE)*, Cambridge, United Kingdom, 2018, pp. 27-30. doi: 10.1109/DeSE.2018.00012

12. **M. Alloghani**, D. Al-Jumeily, A. Hussain, A. J. Aljaaf, J. Mustafina and E. Petrov, "Application of Machine Learning on Student Data for the Appraisal of Academic Performance," *2018 11th International Conference on Developments in eSystems Engineering (DeSE)*, Cambridge, United Kingdom, 2018, pp. 157-162. doi: 10.1109/DeSE.2018.00038

13. E. Petrov, **M. Alloghani**, A. Hussain, D. Al-Jumeily, J. Mustafina, L. Slavina, "Quality Improvement of Educational Systems: Using iPads and Smart Tablets for Autism Learners to Accomplish Class Activities," *The Journal of Scientific Study*, vol. 5, issue 6, 2017, pp. 117-120, DOI: 10.17354/ijssSept/2017/025

14. E. Petrov, J. Mustafina and **M. Alloghani**, "Overview on Modern Serious Games for Regional and Minority Languages Promotion," *2017 10th International Conference on Developments in eSystems Engineering (DeSE)*, Paris, 2017, pp. 120-123, DOI: 10.1109/DeSE.2017.48

15. E. V. Petrov, J. Mustafina, **M. Alloghani**, L. Galiullin and S. Y. Tan, "Learning Analytics and Serious Games: Analysis of Interrelation," *2018 11th International Conference on Developments in eSystems Engineering (DeSE)*, Cambridge, United Kingdom, 2018, pp. 153-156. doi: 10.1109/DeSE.2018.00037

16. A. J. Aljaaf, D. Al-Jumeily, H. M. Haglan, **M. Alloghani**, T. Baker, A. J. Hussain and J. Mustafina, "Early Prediction of Chronic Kidney Disease Using Machine Learning Supported by Predictive Analytics," *2018 IEEE Congress on Evolutionary Computation (CEC)*, Rio de Janeiro, Brazil, 2018, pp. 1-9. doi: 10.1109/CEC.2018.8477876

17. E. Maklakova, J. Mustafina, C. Gataullina, L. Slavina, E. Petrov, **M. Alloghani**, G. Kalinina, G. Aydayeva (2018), Multilingual Education: Success and Failure of Educational Reforms (Case Study: Former French colonies in Africa), *EDULEARN18 Proceedings*, Spain, 2018, pp. 8814-8820, DOI: 10.21125/edulearn.2018.2055

18. Aljaaf A.J., Mallucci C., Al-Jumeily D., Hussain A., **Alloghani M.**, Mustafina J. (2018) A Study of Data Classification and Selection Techniques to Diagnose Headache Patients. In: Alani M., Tawfik H., Saeed M., Anya O. (eds) Applications of Big Data Analytics. Springer, Cham.

19. J. Mustafina, L. Galiullin, D. Al-Jumeily, E. Petrov, **M. Alloghani** and A. Kaky, "Application of Learning Analytics in Higher Educational Institutions," *2018 11th International Conference on Developments in eSystems Engineering (DeSE)*, Cambridge, United Kingdom, 2018, pp. 163-168. doi: 10.1109/DeSE.2018.00039

20. A. J. Aljaaf, D. Al-Jumeily, T. Asman, A. Hussain, T. Baker, **M. Alloghani** and J. Mustafina, "H-Diary: Mobile Application for Headache Diary and Remote Patient Monitoring," *2018 11th International Conference on Developments in eSystems Engineering (DeSE)*, Cambridge, United Kingdom, 2018, pp. 18-22. doi: 10.1109/DeSE.2018.00010

21. **M. Alloghani**, Jamila Mustafina, Dhiya Al-Jumeily, Abir Hussain, Thar Baker, Ahmed J. Aljaaf, "A Systematic Review on Application of Data Mining Techniques in Healthcare Analytics and Data-driven Decisions," *5th International Conference on Interactive Digital Media (ICIDM)*, Liverpool, UK, 2018

22. **M. Alloghani**, D. Al-Jumeily, Abir Hussain, Panagiotis Liatsis, Ahmed J. Aljaaf (2019) Performance-Based Prediction of Chronic Kidney Disease Using Machine Learning for High-Risk

Cardiovascular Disease Patients. In: Xin-She Yang, Nature-Inspired Computation in Data Mining and Machine Learning (NICDL2018). Springer

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