CLOUD HEALTH INFORMATION SYSTEM UTILIZATION MODEL FOR THE IRAQI PUBLIC HEALTHCARE SECTOR

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DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

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ABSTRACT

Successful healthcare interoperability in the public sectors is mostly associated with the ability of the service to provide a platform for data sharing among users. With the recent advances in IT, cloud computing can provide an alternative way to access and manage health records based on the use of online software applications for multiple users. The use of cloud computing in the healthcare sector in Iraq is still in its infancy stage. However, the health records of public hospitals in Iraq continue to increase in volume and variety. This has resulted in some major issues in terms of data complexity and low IT integrity. Therefore, examining the role of cloud services for managing these records are essential in Iraq. This research mainly aims to identify the key determinants of cloud health information system utilization and to propose a model for the relationships between variables. To achieve these objectives, the present study uses a mixed-method approach. A qualitative preliminary interview with 30 Iraqi healthcare members was conducted to determine the key factors affecting their utilization of cloud services. The interview results led to certain factors related to organizational structure and system integrity. The effect of these factors on technicians' and physicians' behavioral control and confirmation to utilize cloud services was investigated. Two questionnaires were administrated to 304 physicians and 146 technicians working in Iraqi public hospitals. The collected ordinal data has been analyzed using PLS-SEM approach. The results of the quantitative analysis showed that the effects of system compatibility, complexity, security, and privacy on physicians' confirmation and control were statistically significant. Both confirmation and control had a positive effect on physicians' utilization of the cloud technology in the Iraqi hospitals. Also, the results revealed that hardware modularity, software modularity, Internet network, and training availability were significantly influence the confirmation and control of technicians, while the cost effectiveness factor showed no effect. The study found that confirmation had a positive effect on the technicians' utilization of cloud services while the control had no effect. The finalized tested models are then merged into one final model and validated by a panel of experts. The experts supported that the model is complete and comprehensive and thus valid to apply. It is believed that such finding can help in aiding the current understanding of cloud health systems in managing health data as well as providing the necessary recommendations for policymakers to direct healthcare professionals to continuously consider the use of modern ICT in the workplace.

ABSTRAK

Keupayaan interoperabiliti dalam penjagaan kesihatan yang berjaya bagi sektor awam kebanyakannya dikaitkan dengan keupayaan perkhidmatan untuk menyediakan platform bagi perkongsian data dalam kalangan pengguna. Dengan perkembangan teknologi maklumat (TM) kebelakangan ini, pengkomputeran awan dapat memberikan alternatif untuk mengakses dan mengurus rekod kesihatan berdasarkan penggunaan aplikasi perisian dalam talian bagi pelbagai pengguna. Penggunaan pengkomputeran awan bagi sektor penjagaan kesihatan di Iraq adalah pada peringkat yang awal. Walau bagaimanapun, rekod kesihatan bagi hospital awam di Iraq terus meningkat dari segi jumlah dan kepelbagaian. Hal ini telah mengimplikasikan beberapa isu yang utama dari segi kekompleksan data dan integriti TM yang rendah. Oleh itu, penelitian peranan perkhidmatan awan bagi menguruskan rekod tersebut adalah penting di Iraq. Tujuan utama penyelidikan ini adalah untuk mengenal pasti kekunci penentu atau penentu utama bagi penggunaan sistem maklumat kesihatan awan dan mencadangkan satu model bagi hubungan antara pemboleh ubah. Kajian ini menggunakan kaedah campuran untuk mencapai objektif tersebut. Satu temu bual awal kualitatif telah dijalankan bersama 30 ahli penjagaan kesihatan untuk menentukan faktor utama yang menjejaskan penggunaan sistem perkhidmatan awan. Keputusan daripada temu bual tersebut membawa kepada faktor tertentu yang berkaitan struktur organisasi dan integriti sistem. Kesan dari faktor ke atas kawalan tingkah laku penggunaan juruteknik serta pengesahan bagi pakar perubatan untuk menggunakan perkhidmatan awan telah dikaji. Dua soal selidik telah dikendalikan kepada 304 orang pakar perubatan dan 146 juruteknik yang bekerja di hospital awam Iraq. Data ordinal yang dikumpulkan telah dianalisis menggunakan pendekatan PLS-SEM. Hasil daripada analisis kuantitatif telah menunjukkan bahawa kesan keserasian sistem, kerumitan, keselamatan, dan privasi terhadap pengesahan dan tingkahlaku penggunaan oleh pakar perubatan adalah signifikan secara statistik. Kedua-dua pengesahan dan tingkahlaku penggunaan mempunyai kesan yang positif terhadap penggunaan teknologi awan bagi hospital di Iraq. Selain itu, keputusan menunjukkan bahawa modulariti perkakasan, modulariti perisian, rangkaian Internet, dan ketersediaan latihan mempengaruhi pengesahan dan tingkahlaku penggunaan oleh juruteknik dengan ketara, sementara faktor keberkesanan kos tidak membawa sebarang kesan. Kajian tersebut mendapati faktor pengesahan tersebut memberi kesan yang positif terhadap penggunaan juruteknik dalam perkhidmatan awan sementara faktor tingkahlaku penggunaan tidak memberi kesan. Model yang telah disahkan ini kemudiannya digabung menjadi model akhir, yang kemudiannya disahkan oleh panel pakar. Pakar telah menyokong bahawa model akhir adalah lengkap dan menyeluruh. Dengan itu, model itu adalah sah untuk diaplikasikan. Penemuan sedemikian dipercayai boleh membantu memahami sistem kesihatan secara awan dalam menguruskan data kesihatan serta menyediakan cadangan yang diperlukan bagi penggubal dasar untuk mengarahkan penjagaan kesihatan professional agar dapat mempertimbangkan penggunaan ICT moden di tempat kerja.

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CHAPTER I

INTRODUCTION

1.1 INTRODUCTION

Healthcare systems are generally utilized in the healthcare sector to give adequate support for research activities, teaching, and public services. The effective application of computing in the health sector can make it possible for healthcare professionals to monitor patients' health records (Hatch & Cunliffe 2013) and is used in homes, hospitals, and relevant organizations in many developed countries. Additionally, the goal of health services is to accommodate public requirements such as certain recommendations for food, drugs, and safety policies in order to sustain a healthy environment for different geographical regions.

With this in mind, previous studies have addressed the potential of emerging technologies to improve healthcare service practices by giving more opportunities to perform activities essential for the prevention, detection, tracking, and treatment of disease (Rogers 2010). Thus, information technology (IT) acts as the primary antecedent to provide adequate medical services for the health sector. Recent consideration of IT solutions like electronic health systems has introduced considerable benefits to healthcare organizations, especially in solving typical errors and offering an agile technique to access and process a large number of patients' facts while protecting their health records and providing sufficient storage spaces (Jena et al. 2009).

The speeding up of innovations involving cloud services has resulted in various implications for healthcare distribution. There are many challenges still facing the most recent electronic health systems in terms of client assistance, cost, online connectivity, and disaster recovery (Sultan 2014). Thus, the application of cloud computing in this context can certainly offer a remarkable advantage for the healthcare sector.

Cloud computing services can be considered as a service solution based on the cloud processing that involves managing and processing healthcare records in a distributed health environment (Philipson & Jena 2013). More significantly, cloud services provided to organizations can free it from the responsibility of developing and keeping large-scale IT systems; thus, organizations can focus on their main business procedures while putting into action the promoting application to provide affordable competitive advantages (Byrd & Douglas 2001). Nowadays, making use of cloud services in the health context is a flexible solution to help improve both the performance and the competitiveness of an organization.

However, amidst the progress in applying novel ways of delivering services to ease the work and increase the performance of an organization, it seems that there is a limited understanding the low utilization of cloud services in developing countries (Sant'Anna et al. 2007). This may be due to the cloud computing dynamic configuration that provides a utility—computing—which includes several functionalities that are generally used to manage an organization's data in a ubiquitous, distributed, and pervasive way, as well as to support many systems, applications, and platforms in independent locations. Additionally, cloud computing consists of shared computing services that can be accessed via the internet (Schultze & Wanda 2004); it also provides exceptional features such as ubiquitous network access, self-service, resource pooling, pay-per-use pattern, and rapid elasticity. Moreover, it can help in improving the existing service delivery practices depending on the type of service, which can be classified into SaaS (Software as a Service), PaaS (Platform as a Service), and IaaS (Infrastructure as a Service) as shown in Figure 1.1.

In the health sector, several systems are used. For example, PACS (Picture Archiving and Communication System) is usually used to capture, archive, and display electronic images captured from imaging modalities, while NIC (Nursing Information System) is used to document nursing assessments, interventions, and outcomes. Furthermore, it supports communication within teams and between shifts. This system helps physicians to follow the treatment of patients. CDSS (Clinical Decision Support System) is designed to provide physicians and other health professionals with clinical decision support—that is, assistance with clinical decision making tasks. A working definition has been proposed by the Centre for Health Evidence: "Clinical decision support systems link health observations with health knowledge to influence health choices by clinicians for improved healthcare". LIS (Laboratory Information System) is responsible for receiving and processing lab orders, for internal lab workflow (order processing, specimen registration, and specimen inventory), and for viewing lab results. Many other information systems are also designed for different purposes (Bryant 2016; Theera-Ampornpunt 2012).

HIS is the main channel for the communication of different sub-systems such as PACS, NIS, CDSS, etc. Each HIS has an Electronic Medical Record (EMR): the EMR communicates with all other clinical information systems (such as pharmacy, billing, radiology, and laboratory) and with the outside national health records system through the Electronic Health Record (EHR) that accesses many hospitals' EMRs as part of its HIS. The Cloud Health Information System (CHIS) refers to the use of cloud computing services to support different healthcare information systems by sharing information stored in diverse locations related to the patient's health records or the activities of the health facility (Alharbi et al. 2016).

Reviewing the literature reveals that the majority of studies in cloud computing within organizations focus on the applications of SaaS that are offered to the private and public healthcare sectors, while PaaS is much more related to the engineering of the software to run these services and IaaS is associated with visualization of the platform infrastructure.

This work is more concerned with the services that cloud computing can offer the Iraqi public healthcare sector, where SaaS is beginning to be recognized and used based on service deployment models. These models are offered by private, public, hybrid and community clouds. Each of these models serves certain needs.

Thus, this study emphasizes the role of cloud models in catering for the public or industry group in a shared context. Nevertheless, organizational consideration of cloud model deployment relies on the sensitivity of the data and management requirements.

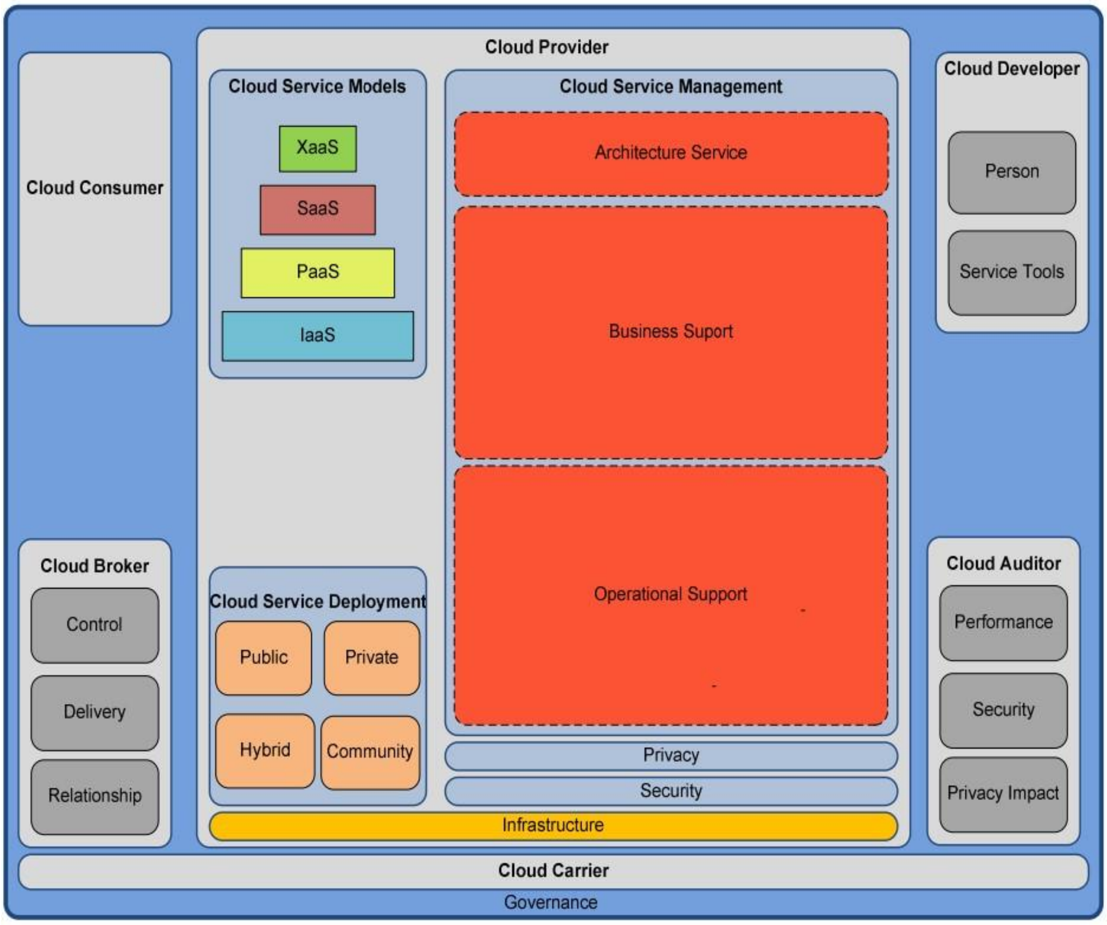

Figure 1.1 Architecture of cloud computing (Amanatullah et al. 2013)

1.2 RESEARCH BACKGROUND

Successful healthcare interoperability in the public sectors is mostly associated with the ability of the service to provide a platform for data sharing among users, processes, procedures, and policies (Steinbart & Nath 1992). In Iraq, it is critical for decision makers to decide the effectiveness of technology utilization in the healthcare sectors. This is due to the lack of evidence about the integrity of IT in healthcare sectors (Petersone et al. 2016). With this in mind, some efforts have been taken by the Ministry of Health in Iraq to deploy specific cloud models to promote health-related practices in different sectors. This includes re-engineering the way the patient and other health data are stored and thus allow healthcare professionals to effectively access and interpret patients' conditions (Venkatesh & Speier 2000). Despite these concerns, there are some obstacles in identifying the current needs of healthcare sectors to accommodate technologies such as distributed and grid computing (Rogers 2004).

Lack of understanding of the healthcare status to deploy these technologies makes it difficult to handle the utilization of new healthcare systems in terms of dynamicity, scaling, and low cost. Furthermore, the current situation in Iraq makes it more difficult to adapt certain technology without prior examination of its suitability in the context of usage. In addition, the healthcare records of public hospitals in Iraq contain different types of data that continue to increase progressively in terms of volume, velocity, and variety. This has resulted in some major issues to the public healthcare sectors from two perspectives, data complexity and low IT integrity. Therefore, managing and maintaining these health records are essential to healthcare institutions.

Furthermore, many previous studies highlighted the need for IT solutions in order to overcome the issues and problems currently facing the Health Information Systems (Mishuris et al. 2016; Zhang et al. 2017), where low levels of technology awareness, social acceptance, and consumer needs are highlighted (Roy et al. 2016). The current development of healthcare technology around the world solved some health data management challenges, but till now, it is not enough to fulfill all the needs (Nissinen & Leino 2016; Park et al. 2015).

It is evident that some countries facing challenges with regards to the technology utilization in their healthcare sectors. For example, in USA many challenges reported in health sector by many scholars (Alexander et al. 2016; Braunstein 2015; Dobrzykowski & Tarafdar 2015; Downing et al. 2016; Koru et al. 2016; Mishuris et al. 2016; Richardson et al. 2015; Serrano et al. 2016), this include the patients' resistance to share their health-related information electronically, coordination issues as some hospitals employed part-time clinicians, and non-qualified trained staff. Furthermore, Adler-Milstein & Jha (2014) mentioned in their study conducted for US hospitals that it is not yet clear enough how to secure the health data across a broad range of hospitals and how some hospitals preferred not to share health data for the security and privacy reasons.

In Australia, UK, Germany, and Finland, scholars (Campion et al. 2013; Kamradt et al. 2015; Kushniruk et al. 2013; McMurray et al. 2015; Rinner et al. 2016; Vest et al. 2014) highlighted some difficulties in obtaining or absence of patients' health history, this includes medication information, test results, and medical histories. Also, there are different types of data and different access ways to health information systems. Additionally, they highlighted the existing challenges that are still facing the healthcare systems in UK such as the technology error in the HIT that need for education and training. In Germany the perceived communication and information sharing with general practitioners (GPs) not to work well in the care process.

In Korea, Park et al. (2015) and Lee et al. (2014) stated that the current issues are that health information system technologies are not widely adopted in the health sector. The adoption of technology needs for the full realization of the new technology benefits. Also, there is a limitation in accessibility for health patient information.

In Taiwan, researchers (Jian et al. 2012; Y. C. (Jack) Li et al. 2015; J.-Y. Wang et al. 2015) highlighted the main limitations such as the patient record exchange among hospitals still has technological and individual barriers including resistance to information sharing. While the major challenge is employees' resistance and also the capabilities of information storage for doctor consolations.

As for the republic of China, Chen & Zhu (2016); Liu et al. (2011); and Zhang et al. (2017) declared the existing challenges and limitations in Chinese health information systems, they found that regional HIE is still at its early stage due to the lack of interoperability standards and implementation guidelines. The healthcare authorities to complete the construction of health exchange during 2022, but still need to improve the effective use and sustainability of completed systems.

In the Malaysian health sector, Latif et al. (2016) found a lack in the interoperability and the collaboration among hospitals as there is no information exchange between hospitals. However, only three hospitals have health information exchange (HIE) system for chronic diseases that are facing the adult population.

In Iran, Ahmadian et al. (2015) and Hekmat et al. (2016) found that hospitals have a poor infrastructure, lack in utilizing HISs due to the resistance to using the technology applications among healthcare professionals and patients, and a lack of information sharing due to the concerns of security and privacy.

As for the middle east countries, Al-Aswad & Brownsell (2013); Alharbi (2017); and Harfoushi et al. (2016) highlighted the current challenges such as the lack of studies and government roles, the lack of understanding on what EHRs and health-related technologies are capable to offer, no national health information exchange, and the lack of implementation and adoption of EHRs does not achieve the desired rate of distribution.

It can be concluded that there are numerous global issues facing the utilization of IT-related systems in healthcare sector and every country has its own challenges that are caused by different causes and needs. Advances in technology gave the opportunity to overcome some problems, but unfortunately, the users are less aware of these opportunities (Serrano et al. 2016; Vest et al. 2011). The technology development offered various solutions that can solve many of the issues currently facing the healthcare systems via different techniques designed to overcome these issues. Thus, cloud computing can be utilized in order to provide a reliable service in managing and maintaining healthcare records. The complexity of the software, hardware and network technologies have increased substantially over the years due to the increase in the number of patients, upgraded facilities and technical compatibilities. This led to heavier reliance on the cloud computing in providing technical assistance to HIS users (Sulaiman et al. 2014). However, understanding of IT hardware and software needs for effective utilization of cloud services is yet to be explored.

The reasons why this research is devoted to the application of cloud services are due to the high software cost, complexity, and inflexibility issues of traditional electronic healthcare records. Therefore, these play a key role in raising the necessity for utilizing low-cost service that offers the healthcare sectors a flexible way to manage and maintain health data remotely. In addition, public healthcare sectors in Iraq are dependent on their own computing infrastructure. Thus, the data resides on-premises and thus makes it under environmental and human threats altogether. The researcher's review of the literature revealed that most previous models constructed to evaluate cloud utilization in healthcare were limited to the context of certain countries. For example, the literature showed that using cloud services vary from one country to another. This can be due to the structural variation which varies from one context to another.

Based on this, Al Hilfi et al. (2013) stated that "Efforts are required to strengthen the quality of data as it moves up the chain from facility to Ministry of Health." Therefore, this study attempts to explore the key determinants of cloud computing services utilization in Iraqi public healthcare sectors.

1.3 PROBLEM STATEMENT

A health information system refers to the utilization of IT-related systems to capture, store, manage, or transmit information related to the health of individuals or activities within the health sector.

In Iraq, the current healthcare system faces numerous challenges to recover from the loss of health workers and political interference, as mentioned by Al Hilfi et al. (2013), who assert the need for efforts to reinforce the quality of data as it moves up the chain from facility to Ministry of Health, as the health facilities are unevenly distributed to meet the country's health needs, and healthcare financing and the role of private healthcare are the issues in the health sector which are currently being addressed tentatively. Furthermore, Hameed et al. (2015) acknowledge the current challenges in providing medical management services faced by the Iraqi healthcare sector due to the inappropriate use of technology in which no procedure for information sharing is in place. Despite the touted advantages of this new technology, Al Hilfi et al. (2013) state that the adoption of up-to-date IT solutions has not been sufficiently addressed in Iraq. Other reasons are mainly associated with the disruptive technology, which was viewed as being not at an acceptable level of maturity, with a lack of industry-specific conformity to standards, and a high level of related risk and cost (Bhattacherjee 2001; Goodhue & Thompson 1995; Zhou et al. 2010).

From this, it can be noted that the use of HIS and services in Iraq has rarely been considered. With the recent advances in IT, cloud computing can provide an alternative way to access and manage health records based on the use of software applications that exist online for multiple users via the internet. Since this new trend in technology has several benefits, it can be immensely beneficial for the health sector in Third World countries (Armbrust et al. 2010; Marston et al. 2011). Meanwhile, Alsaydia and Hameed (2016) recommend full utilization of physical cloud computing systems to improve the efficiency and performance of the cyber-physical services in Iraq.

Many scholars have developed models of cloud computing for different purposes in the healthcare context. These models are designed to fit different needs, environments, and cultures in different countries, including some developed and developing countries, but with no study being conducted in the Iraqi healthcare context. The literature shows that different needs, cultures, and environments make it difficult to apply a particular model in the Iraqi healthcare sector situation, as the models were designed to fit different needs. This assumption is further confirmed by Venkatesh and Zhang (2010), who declare that different cultures need to test the existing theory/model in the context of its usage. As such, ensuring successful utilization of cloud computing in a healthcare context needs careful attention to a number of factors from different perspectives, which may include technical IT factors, characteristics of the organization that is introducing the technology, and the response of individuals within the organization to the new technological tools.

In order to ensure the quality movement of data from Iraqi hospitals to the Ministry of Health, an up-to-date IT solution has been proposed, as cloud computing can offer a reliable solution for medical management services. Because the previous models were developed in other countries for different needs, in this study we aimed to propose and validate a cloud health information system model that can overcome the highlighted problems. Therefore, a preliminary study was conducted to assess the current situation and to determine the key factors associated with the utilization of cloud computing to foster current health information systems in Iraq. The interview results (presented in section 5.2.2 in Chapter V) show that the interviewees have a negative perception of the effectiveness of current technologies to manage and maintain a large volume of health records in a timely manner. The interviewees also acknowledge the lack of access to effective computing to help health professionals perform multiple activities related to sharing and retrieving records. Furthermore, the cultural interferences faced the healthcare workers is one of the main issues currently facing the healthcare sector (Alharbi 2017). Cloud computing can be an effective way to resolve these issues. As such, this study seeks to investigate the main antecedents that may affect healthcare professionals' ability to depend fully on cloud services to manage their health-related activities through the HIS in their workplaces.

1.4 RESEARCH QUESTIONS

This research aims at answering the following question:

1. What are the key determinants of cloud computing services utilization in healthcare information systems?

2. How can the relationships between the identified factors and the cloud health information system utilization be presented?

3. What is the relationship between the organizational structure and system factors, individual factors, and cloud health information system utilization in Iraqi public healthcare sector?

4. How to validate the applicability and usability of the proposed model in the Iraqi public healthcare sector?

1.5 RESEARCH OBJECTIVES

Since the main concern here is to investigate the key determinants of cloud computing utilization in the Iraqi healthcare sector, this study will explore the following:

1. To identify the key determinants of cloud computing services utilization in healthcare information systems.

2. To propose a model for the relationship between organizational structure and system factors, individual factors, and cloud health information system utilization.

3. To investigate the effect of organizational structure and system factors on technicians and physicians' confirmation and behavioral control as well as the individual factors on their cloud health information system utilization in Iraq.

4. To validate the applicability and usability of the proposed model in the Iraqi public healthcare sector.

1.6 RESEARCH SIGNIFICANCE

Different studies have addressed the role of cloud computing in improving the performance and efficiency of the healthcare sector. However, many factors have been investigated in this context, focusing mainly on technological, environmental, and organizational factors. As such, this study seeks to examine the organizational factors that may influence the adoption of a cloud health information system in developing countries. The study serves as a starting point for investigating the adoption of cloud health information system in the Iraqi healthcare sector, aiming to identify the strengths and weaknesses of the organizational factors in this context.

This study provides sufficient understanding of the current organizational structure and of the system characteristics necessary to accommodate individual needs in order to be willing and motivated to utilize cloud computing services. The study also offers a rich view for healthcare decision makers in Iraq of the key factors and micro determinants of cloud computing services' utilization in healthcare information systems. This also offers an alternative way of managing health records. This research will provide new insights into ways to improve cloud health information system utilization, and healthcare performance in general, by offering a model that can be used to analyze the organizational factors affecting the adoption of a cloud health information system in the Iraqi healthcare sector and in other developing countries with the same contextual features.

By understanding the factors enhancing the utilization of a cloud health information system, the system developer can consider these factors during the system development process. Furthermore, the system developer needs to engage physicians and technicians in the development and implementation phases to enhance the system's functionality and usefulness. These practices will help to maintain effective communications between the healthcare providers and ensure the continuity of patient care in Iraq. Therefore, the study model offers the insight that policymakers must identify the positive influential antecedents that affect physician and technician behavior and confirmation, and must ensure that the available system has considered all of these factors for better utilizing the cloud information system in Iraq. Thus, hospital management must channel resources, provide training, and ensure users' engagement before the implementation of a system to achieve better usage in practice.

The findings and recommendations of this study are expected to contribute to the ongoing efforts to develop better cloud system adoption environments and improve the Iraqi healthcare performance, especially for the decision makers and employees within the healthcare sector, by helping them to identify their weaknesses and the current antecedents that, in turn, reduce their utilization of the cloud-based health information systems.

1.7 SCOPE OF THE STUDY

This study focuses on the key components of cloud computing, including Software as a Service (SaaS). According to the Iraqi health compass report by the planning and developing department of the Ministry of Health (MoH Iraq 2016) and the statistics obtained from the Ministry of Health, the total number of public hospitals across Iraq is 260, of which 48 are located in the Kurdistan federal region and 212 in the other 15 governorates under the central Ministry of Health. About 20 percent of public hospitals (39) are located in Baghdad, the capital city of Iraq. In the public sector, the Ministry of Health is the provider of healthcare in Iraq. There is a Directorate of Health (DoH) in each of the 18 governorates (two in Baghdad). Governorates are further divided for administrative purposes into 118 health districts. Each district covers on average between 200,000 and 300,000 people. Primary healthcare is provided through primary healthcare centers and hospitals. However, only four hospitals are considered in this study (Al-Yarmuk General Teaching Hospital, Al-Kindi General Teaching Hospital, Al-Karkh General Hospital, and Baghdad Teaching Hospital) because these hospitals are the main hospitals with high-end IT facilities in Baghdad, and due to the limitation of time and resources and difficulty in obtaining direct contact with department managers.

After identifying the factors from the preliminary interviews, the researcher administered two questionnaires to the physicians and technicians, the responses being analyzed using Partial Least Square - Structural Equation Modeling (PLS-SEM) second generation multivariate analysis. This was mainly to validate and confirm the determinants and to construct a model for utilizing cloud computing to promote health information systems in the Iraqi healthcare sector.

1.8 THESIS ORGANIZATION

The organization of this study followed the standard thesis format, the contents being organized into five chapters.

Chapter One: Introduction. This includes the research background, the research problem statement, research questions, research objectives, the scope of the study, and the study significance.

Chapter Two: Literature Review. This chapter sheds light on the prior literature related to this study context. This includes the definition of concepts, cloud computing services and deployment models, cloud health information systems, barriers, and factors that influence cloud technology usage. Also, previous models for cloud computing in the healthcare sector are discussed briefly, along with their limitations.

Chapter Three: Research Methodology. In this chapter, the methodological phases followed in this study are explained. This includes the research approaches, research design, research strategy, population, sampling technique and sample size, research instruments, data collection procedures, data analysis process and tests used, and the method of validating the finalized model.

Chapter Four: Research Model and Hypotheses Development. In this chapter, the researcher constructs the proposed research models. The chapter starts by defining the chosen theories to support the relationships between constructs. Furthermore, the chapter presents the proposed factors and their correspondence to the context of the study. Finally, the research hypotheses are formulated to be investigated further empirically in the next chapter.

Chapter Five: Results and Discussion. This chapter provides the data analysis and interpretation of the qualitative and quantitative parts of this research. The chapter begins by analyzing the qualitative preliminary interview data, showing the deduced codes and themes. Then, pre-interview findings are briefly discussed. The second part of this chapter presents the quantitative empirical results. It starts by examining the fundamental issue to ensure that the collected data fit with the proposed conceptual models, and the initial steps applied to ensure purity of the data and testing of the hypotheses. Descriptive statistics are reported for each construct. Assessment of the measurement model and structural model are conducted as the main phases of the PLS-SEM approach. Furthermore, validation interview findings are reported.

Chapter Six: Conclusion and Future Works. This chapter discusses the achievement of each research objective and presents the final research model. The academic, theoretical, and practical contributions are discussed, as well as the limitations and recommendations for future works.

1.9 SUMMARY

This chapter has introduced the motivation for examining the key factors affecting the utilization of cloud computing services in the Iraqi healthcare sector. The chapter has also illustrated the current issues associated with health information systems and their use in Iraq. Other major issues related to the organizational structure, system, and individual are highlighted based on the interview data. The interviews yielded several factors in these domains noted from the interviewees. The next chapter will deal with the literature review related to cloud computing models in healthcare sectors in different situations.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

It is commonly perceived that the value of healthcare services is constantly increasing in developing and developed countries and is becoming more challenging to healthcare providers. Consequently, debate about advanced health information systems to reduce healthcare costs and improve overall health quality is necessary in countries like Iraq that are still in the service utilization stage. This has led the researcher to consider the potential of cloud computing as a technological solution to provide the necessary platform for health information technology services to be transformed and managed over the internet. Cloud computing represents a complex combination of services linked together under more equipped servers than those that have been typically used in hospitals and clinics (Gans et al. 2005; Ludwick & Doucette 2009; Starfield et al. 2005). On the other hand, recent transformation in health informatics has led to a search for new ways of driving healthcare information in developing countries. Previous studies (e.g., Carayon et al. 2014; Weaver et al. 2016; Xiao et al. 2014) have examined and explored healthcare professionals' perception of health information systems from the perspective of advanced technology utilization. In addition, there is a growing demand mainly on healthcare providers to provide hardware and software resources and to establish a new avenue to effectively manage sensitive and private medical data from different geographic locations. This has led the researcher in the present study to consider the role of cloud computing in health information systems by demonstrating its tremendous opportunities for the collaborative and personal medical sharing of health information. Healthcare professionals, or perhaps the health corporation, may need to consider the benefits of using a cloud health information system to facilitate medical data management and sharing across departments and members.

It is believed that the effective utilization of cloud health information systems in Iraq will stimulate new opportunities for users to manage and store medical data. However, cloud computing has also introduced a set of challenges in healthcare contexts, which vary from one country to another depending on its current technological state and resources. The researcher sheds light on some of these challenges in terms of cost-effectiveness, software and hardware modularity, compatibility, complexity, training, internet network, privacy, and security. In order to overcome obstacles to utilizing a cloud computing service in the Iraqi healthcare context, the researcher conducted this study to examine how these challenges would drive healthcare professionals' behavior to effectively utilize cloud health information systems.

2.2 CLOUD COMPUTING

Cloud computing is emerging as an important paradigm shift in the way to create, develop, deploy, upgrade, and maintain technological services to process various organizational tasks (Ryan 2014). From the literature, it can be noted that the role of IT in cloud development has always been seen as a technological trend defining the future (Akpan & Vadhanam 2015; Schiering & Kretschmer 2012). Cloud computing has been defined by many previous researchers from different usage perspectives. For example, Rittinghouse and Ransome (2016) describe cloud computing as a service allowing ubiquitous, convenient, on-demand network access to distributed and configurable resources at any time and from any place. This includes sites, servers, storage, applications, and other services that can be rapidly provisioned and released with minimal management and interaction (Juiz & de Pous 2015). Opitz et al. (2012) basically define cloud computing as an on-demand self-service by which users within and without the organization network can gain access to resources and services. On the other hand, Bitzer and Gebretsadik (2013) define cloud computing as both the applications delivered as services on the internet and the hardware and systems software in the data centers that provide services to members and other organizations. It provides the necessary economic foundation to unlimited computing resources that can be obtained using any device, which reduces the need for up-front commitments (Chalse et al. 2013; Mousannif et al. 2013) and allows the opportunity to enhance overall service quality in both developing and developed countries (Akande & Belle 2014). Therefore, the researcher in this study considered the role of the cloud health information system to stimulate healthcare professionals' effectiveness in doing their work. Figure 2.1 shows the cloud computing taxonomy and its main components.

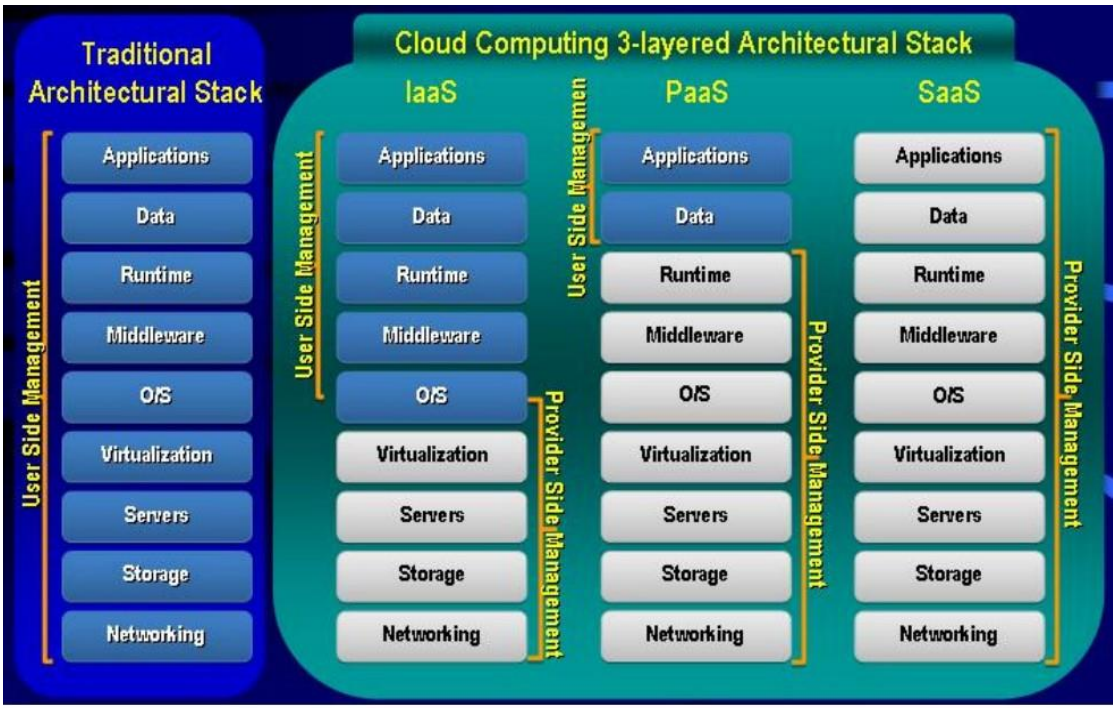

Figure 2.1 Cloud computing taxonomy (Zaharescu & Zaharescu 2012)

2.3 CLOUD COMPUTING SERVICES AND DEPLOYMENT MODELS

There are different categories of cloud computing services, such as infrastructure, platform, application, etc. These services are delivered and consumed in real time over the internet and consists of:

1. Software as a service (SaaS). SaaS is a multi-platform service that uses common resources and a single instance of both the object code of an application and the connected database to support multiple users simultaneously (Qingjin 2011; Xuewen 2008). SaaS, commonly found in the application service provider model, is indicated to provide the main channel for users to interact and use

services in application software distribution (Wang 2009). Examples of SaaS-related services are NetSuite, Oracle, IBM, Microsoft, etc. There are several elements that need to be considered when dealing with SaaS, such as functionality, architecture, usability, and cost (Godse & Mulik 2009). The functionality-related elements consist of certain attributes that are typically called functional modules used to facilitate the tracking of service performance through every stage of usage. These include functionality such as lead creation, lead-to-opportunity conversion, opportunity tracking, etc. In addition, architecture-related factors consist of attribute integration which is mainly used to integrate other applications for them to be more relevant for SaaS products. Usability factors, however, consist of a user interface that involves elements related to its intuitiveness, its ease-of-use for frequently required tasks, and the aesthetic nature of graphical elements. The cost factor consists of the overall cost for implementation of a service.

2. Platform as a service (PaaS). PaaS is the main element for processing and managing data, typically dealt with by service developers, including all the systems and environments comprising the end-to-end lifecycle of developing, testing, deploying, and hosting of sophisticated web applications as a service delivered via the internet (Dikaiakos et al. 2009; Zhang et al. 2010). A key example of a PaaS-related service is Microsoft's Azure. Compared with conventional application development, the PaaS strategy can play a key role by reducing the development time, offering hundreds of readily available tools and services, and quick configuration (Jadeja & Modi 2012).

3. Infrastructure as a service (IaaS). IaaS is the delivery of computer infrastructure as a service. Aside from the higher flexibility, a key benefit of IaaS is the ability to manage services and features (Bhardwaj et al. 2010; Manvi & Shyam 2014). Another important advantage is that it allows upgrading of the current services every time new technology arises. As such, users can achieve a much faster service delivery according to the organizational and personal usage (Dykstra & Sherman 2012). Key examples of IaaS are GoGrid, Flexiscale, distributed technologies, etc.

In this study, however, the researcher is mainly concerned with the application of a cloud health information system to promote healthcare professionals utilizing its services. As such, the researcher only considered the application of SaaS in this study, as healthcare members usually interact and use the system daily.

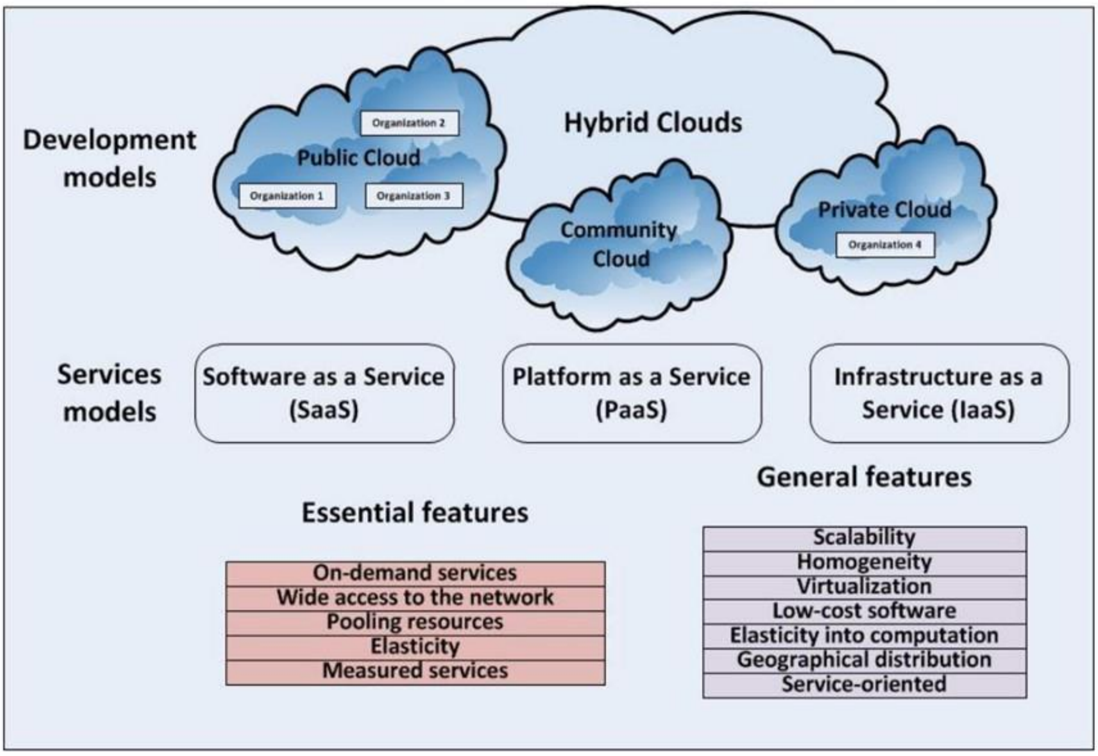

Figure 2.2 Cloud computing elements (Lupşe et al. 2012)

Based on Figure 2.2, there are four main application models of cloud processing: private cloud, community cloud, public cloud, and hybrid cloud. A public cloud is commonly employed by the general community, while a private cloud is exclusively utilized by a single organization and a hybrid cloud is shared by several organizations in a community. Furthermore, the combination of two or more types of cloud computing is believed to increase the quality of service and users' satisfaction. Moreover, cloud infrastructures are used to provide services that can be operated by different independent third parties and/or related organizations. Looking at the hybrid cloud, this study is mostly concerned with the use of cloud health information systems employed by different healthcare providers in Iraq. Here, for example, data can be stored in parallel or distributed over several independent clouds for higher availability and redundancy.

In detail, in public clouds, service providers offer their resources as services to the general public. This offers several benefits to service providers, including no initial investment in infrastructure and shifting risk to the provider's infrastructure. Nevertheless, public clouds lack fine-grained control over data, and network and security settings, which hampers their effectiveness in many business scenarios. In the community cloud, the infrastructure is normally shared among community organizations, which might reside on or off premises. A third party organization might manage the cloud on behalf of the community (Sosinsky 2010).

On the other hand, private clouds (also called internal clouds) are designed for exclusive use in a single organization. A private cloud can be built and managed by the organization itself or by external providers. It has a very high degree of control over reliability, performance, and security. However, private clouds are often criticized for being similar to traditional proprietary servers and do not provide benefits such as no up-front capital costs. The hybrid cloud is a combination of public and private cloud models that aims to cover the limitations of each approach. In a hybrid cloud, part of the service infrastructure runs in a public cloud while the remaining part runs in a private cloud. Hybrid clouds give more flexibility than both private and public clouds. They provide tighter control and more security over application data compared to the use of public clouds. The designers may give more attention when designing a hybrid cloud for splitting between private and public cloud components (Zhang et al. 2010).

2.4 APPLICATIONS OF CLOUD COMPUTING

Our review of the literature reveals that many organizations can benefit from cloud computing, such as government agencies, financial businesses, online entertainment companies, and healthcare providers. Considering our research focus and the current problems in healthcare services offered by Iraqi hospitals to their citizens, the researcher considers the application of a cloud health information system in Iraq. Currently, boosting health-related service quality and minimizing the operational budget are the main aspects that decision makers consider when contemplating the utilization of new technologies in the healthcare industry. In order to achieve this goal, healthcare is intended to offer departmental solutions to encompass a larger strategy at the enterprise level, from standalone systems offering limited and localized alternatives to more integrated and interconnected ones that offer comprehensive and effective solutions to users and providers (Li et al. 2013).

It can therefore be reasoned that an infrastructure for setting up cloud services is an effective solution that shifts the burden of managing and maintaining complex healthcare technical equipment in one facility, consisting of hardware, software, and network infrastructure, to the cloud (Griebel et al. 2015; Kumar et al. 2014). Figure 2.3 shows the application of cloud computing in healthcare.

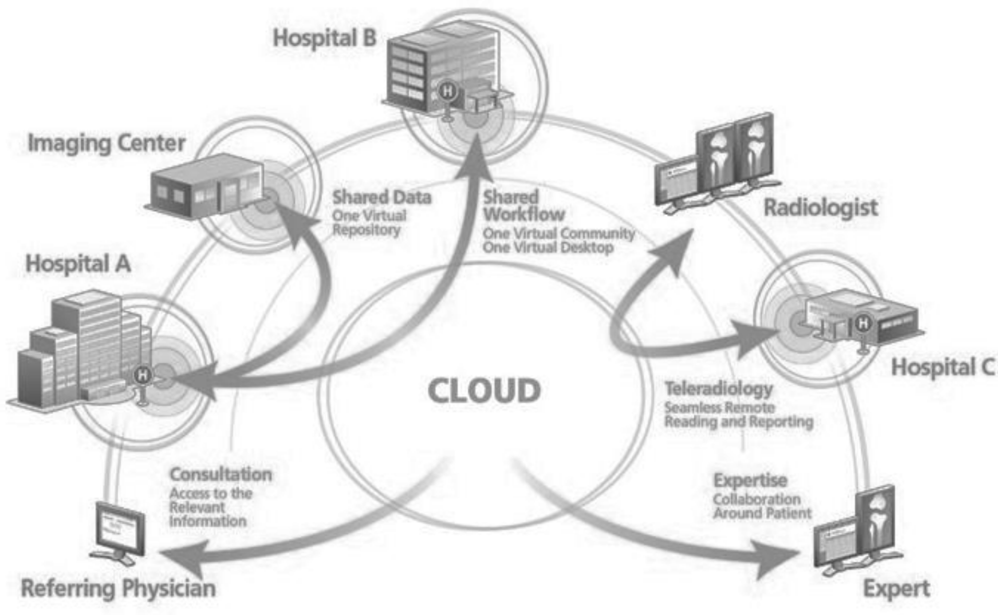

Figure 2.3 Cloud computing in healthcare (Jeff 2013)

It can be noted that cloud information systems provide the necessary platforms for healthcare professionals to communicate and share medical data across departments. More specifically, healthcare information systems provide effective solutions to the high cost of applying and maintaining IT; inadequate exchange of patient data; lack of legal rules mandating the use and protection of electronic healthcare data capture and marketing and sales communications; and absence of healthcare IT design and development standards (Cimler et al. 2014; Lin et al. 2014). In addition, the literature shows that most healthcare systems are built on workflows that consist of paper medical records, duplicated test results, and fragmented IT systems to which majority of medical professionals do not always have access for the information they require when they have to make patient-care decisions quickly (Masrom & Rahimli 2014; Stantchev et al. 2014). Therefore, cloud computing has been found to alter current health management practices in both developing and developed countries.

2.5 CLOUD HEALTH INFORMATION SYSTEM

As cloud computing can support different healthcare information systems by sharing information stored in diverse locations, the utilization of a cloud health information system was studied in this thesis.

Figure 2.4 presents an example of a cloud health information system's working scenario. A private cloud-based infrastructure is commonly used in each healthcare unit. To eliminate the drawback of cloud computing attributed to weak security, Iraqi hospitals have used a private cloud for accessing and managing various health services. All the medical data are stored in a private cloud and all hospital departments can access medical data for a patient when required. As a result, decisions concerning certain medical cases can be taken rapidly. It is assumed that security and privacy aspects may still arise from using a cloud health information system due to the ability of different healthcare members to access and use medical data in a private cloud-based architecture. This is common, because applications and data storage can be found within each private data center of the hospital. In the event that certain medical records of the individual patient are requested by one department from another, the two having different health information systems, they will be sent in real time to the final destination with certain privileges.

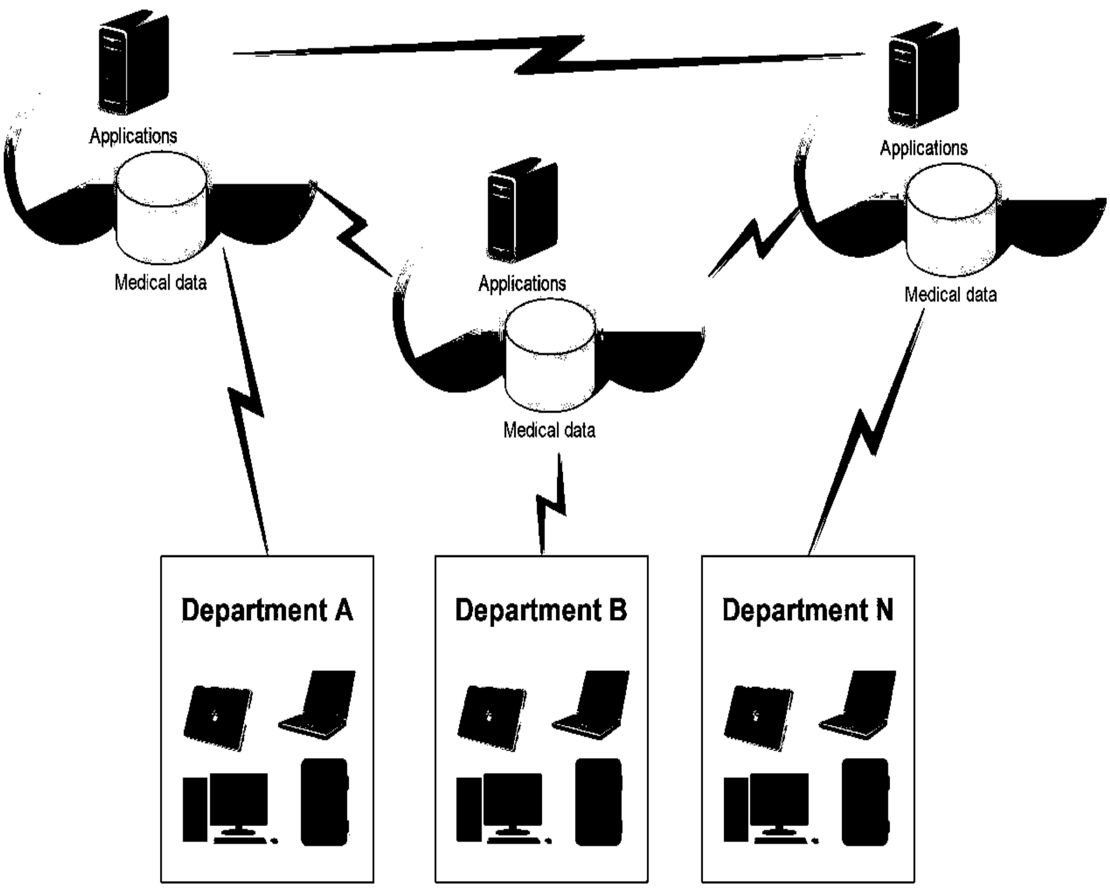

Figure 2.4 Example of cloud health information system

In this study, the researcher is primarily looking at the role of SaaS as the main category of cloud service for healthcare members to share and access medical data, where they are given the ability to use the cloud service applications running on a cloud infrastructure. SaaS is defined as an application model that offers access to health applications such as records management, invoices, pharmacy, laboratory, blood bank, etc. via the internet. As illustrated in Figure 2.1, there are typically three levels in the cloud, being the hardware, system, and application level. A cloud data center is usually placed on two types of server: computation and storage servers. Each server has limited processing capacity, memory size, and I/O capacity. The applications of healthcare are typically found at the SaaS level, providing specific services to healthcare members according to their position and role. Along with this, SaaS in the healthcare domain has received a lot of attention due to its role in facilitating communication between healthcare members and other parties. This is assumed to stimulate effective decisions in medical cases that require careful attention.

The deployment of SaaS services is usually managed by a cloud service provider via a user requesting process (Cusumano 2010). The main reason for considering SaaS components is because they are utilized on top of virtual machines in the cloud computing infrastructure. SaaS can also be managed by a third party (hosted) service provider (Rane 2010; Wang et al. 2008). In healthcare institutions, the utilization of SaaS is considered complete once a user has the necessary means to access services.

SaaS can be described as a combination of different types of component that work together to process users' requests using an application component, integration component, business component, and storage component. However, the functional and non-functional requirements for each component may vary from one department to another, usually depending on the time to process and retrieve a request.

2.6 CLOUD HEALTH INFORMATION SYSTEM IN IRAQ

With the latest development in the healthcare services, Iraqi hospitals are still lacking access and delivery of medical data across departments and regions (Garfield et al. 2003; S. Sharma & Piachaud 2011). Healthcare is mostly facing management issues of medical data especially with the limited availability, recovery, and transfer of medical data (Akunjee & Ali 2002; Sadik et al. 2011). Iraqi hospitals are presently confronted by large quantities of medical data which continually increase due to the number of patients as the consequence of increased in violence recently (Al Hilfi et al. 2013; Burnham et al. 2009). Therefore, technological advances represented by the use of the cloud health information system can offer a reliable means for the healthcare professionals to communicate and share medical data. This is in line with the current movement to fully utilize cloud health systems in Iraqi hospitals that was motivated by the services offered by the cloud platform to resolve these issues.

Iraqi ministry of health declared that hospitals are currently using a cloud services among their HISs. Unfortunately, when the researcher visits some main hospitals, he found that not all hospitals using the cloud services and some main hospitals are currently using it partly to communicate few departments only. This include transferring hospitals' management information to the ministry of health through the health directorate of each city. Furthermore, not all the patient's records are stored to the cloud, especially, the critically sensitive cases. This was reasoned to the privacy and security of the cloud because the cloud services currently provided by a foreigner provider that make it untrusted. Moreover, since 2014, the Iraq start a war against terrorism (ISIS) and almost all the financial expenses were going to the security forces which make it more complicated to get funds to cover all the hospitals with the cloud services. After victory at the end of 2017, the ministries start again to cover their needs, in our case, the ministry of health start again to expand the number of hospitals/departments/medical cases being covered by the cloud services. As such, this study provides the decision makers in the ministry of health about the current needs, obstacles, and micro-determinants that may be considered to fully utilize cloud health information systems in the public sector.

During his visit to four key hospitals in Baghdad city, the researcher observed a certain environment perceive changes, for example, behaviours, attitudes, and challenges facing the current health information systems. The managers of these hospitals expressed their concern about the need to improve the overall service quality by ensuring effective utilization of cloud technology in according to the healthcare goals to provide easy access and share of medical records across departments and regions. Simultaneously, many obstacles are usually caused by inappropriate technology being moved for developing countries, for instance, cloud computing technology. The issues currently facing the Iraqi cloud health information systems can be presented as follow:

- Most of the hospitals/healthcare institutions have small numbers of IT specialists and low IT costs, which may view the cloud computing services as a reasonable alternative service for most of their original health information systems.

- The healthcare staff did not use cloud services well due to the inappropriate training programs, unawareness about the actual benefits, and less technical support for continuing the services.

- The health information systems are being used separately in each hospital and almost no real time synchronization for the health record over the cloud. The main reasons behind the inappropriate utilization of healthcare staff back to the inappropriate use of the health systems, workers trust of the system from privacy and security perspectives, communication reliability for transmitting the data over the cloud, correct use of the systems, lack of control over the provided features, and fears of changing the work routine (Sharma et al. 2010).

- It has been found that healthcare professionals have some lack of skills, expertise, knowledge, human resources, and finance for making the perfect modifications within IT hospital systems. Furthermore, it has been noticed that the methods are usually narrowly focused to specific features of the development procedure when the hospital pursued to modify. Therefore, hospitals are seen to have a limited perspective on the actual future innovation direction.

- Once the researcher discussed informally with one of the IT department supervisors regarding the cloud services, he declared that one of the most important issues faced the IT personnel is that the healthcare staff afraid to change to the new services as they did not have a confidence regarding the privacy of their patients' health records, as well as they used to work with the current systems that provide local network within one hospital rather than sharing through the cloud.

It can be concluded that the focusing on the obstacles and antecedents that may influence the healthcare workers to utilize cloud services for their health information systems is a must be. As such, the researcher in this study was motivated to consider the application of cloud computing in health information systems in order to provide an appropriate environment for balancing healthcare needs and purposes among medical staffs, patients, and other connected departments. In particular, cloud computing is expected to facilitate the exchange of medical records. These capacities can be exemplarily demonstrated through the scenarios of cloud-based healthcare systems targeted to support patients reside in different areas, elderlies, patients experiencing diabetes and epidermis diseases and requiring a physiological control, also to monitor health-related aspects in different regions of Iraq. With value to this, healthcare applications and medical data are meant to be organized and provisioned from the cloud computing environment, where enough storage capacities for medical resources are available. It could even permit central storage for medical data to be shared and distributed across departments. Based on this situation, cloud processing is believed to reduce IT costs for healthcare providers by providing a structured hospital information system to all healthcare members.

2.7 CLOUD HEALTH INFORMATION SYSTEM UTILIZATION

Cloud computing has been addressed as the most satisfactory source for providing effective IT services, where the power of healthcare devices can be utilized more efficiently through highly scalable hardware and software resources. In addition, a cloud HIS can provide promising business agility by using competitive tools and rapid deployment, using parallel batch processing that processes and manages users' requests in real time (Hatch & Cunliffe 2013). Here, the researcher studied how certain organizational structures and system factors may contribute to the utilization of a cloud HIS in Iraqi hospitals by embracing the ideas encapsulated in green computing, since not only are the computing resources used more efficiently, but further, the computers can be physically located in geographical areas that have access to cheap electricity while their computing power can be accessed long distances away over the internet. However, the need to understand the limited use of cloud services in the Iraqi healthcare sector was one of the main drivers in this study. Goodhue and Thompson (1995) and Igbaria et al. (1996) stated that utilization of technology is the core factor that ensures organization stability based on the fit between the technology and the tasks it supports.

Table 2.1 shows a collection of previous studies that have been conducted in different healthcare and non-healthcare contexts. It can be noted that the factors identified in the preliminary phase were associated with healthcare contexts. From the literature, it is evident that factors related to cost-effectiveness, hardware modularity, software modularity, internet network, training, system complexity and compatibility, data security and privacy, confirmation, behavioral control, and technology or cloud computing services utilization are relevant to the context of this study.

Table 2.1 Previous works related to the present study's factors

Reference	Factor	Context of use
Jena et al. (2009)	Cost-effectiveness	Healthcare technology adoption
Laupacis et al. (1992)	Cost-effectiveness	Clinical technology adoption
Philipson and Jena (2013)	Cost	Healthcare technology adoption
Bardhan and Thouin (2013)	Cost	Healthcare information systems
Jiang et al. (2013)	Cost	Telecare medical information systems
Byrd and Douglas (2001)	Hardware modularity	IT personnel
Chiasson et al. (2007)	Hardware compatibility	Healthcare information technologies
Sockolow et al. (2015)	Hardware availability	Health information technology
Elhadi and Sharif (2014)	Hardware availability	e-Health technology
Panda and Rath (2016)	Hardware compatibility	IT capability and organizational agility
Berg (2001)	Hardware compatibility	Information systems in healthcare organizations
Sant'Anna et al. (2007)	Software modularity	System architecture
Schaarschmidt et al. (2013)	Software modularity	Open source software projects
Saxena et al. (2017)	Software modularity	Hybrid business models
Gaynor et al. (2014)	Software modularity	Healthcare applications
Heeks (2006)	Software compatibility	Health information systems
Panda and Rath (2016)	Network	IT capability and organizational agility
Schultze and Wanda (2004)	Network quality	Technological utilization
Hall and Robert (1987)	Network quality	Technological utilization
Steinbart and Nath (1992)	Network	Organizational communication
Petersone et al. (2016)	Training availability	Organizational development
Venkatesh and Speier (2000)	Training availability	Telework
Najaftorkaman et al. (2015)	Training	Health information system
Ibrahim and Perez (2014)	Training availability	Organization
Chopra et al. (2014)	Training availability	Reliability-centered maintenance
Maditinos et al. (2014)	Training availability	e-Business implementation
Rogers (2004)	System compatibility	Health communication

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…continuation

Roberts and Wilson (2002)	System compatibility	ICT applications
Oliveira et al. (2014)	System complexity	Cloud computing adoption
Najaftorkaman et al. (2015)	Data security and privacy	Health information systems
Li et al. (2013)	Data security and privacy	Personal health records
Shrestha et al. (2016)	Data security and privacy	Healthcare system
Gampala et al. (2012)	Data security and privacy	Cloud computing
Chen and Zhao (2012)	Data security and privacy	Cloud computing
Shariati et al. (2015)	Data security and privacy	Cloud computing
Hamlen and Thuraisingham (2013)	Data security and privacy	Outsourcing
Zhou et al. (2010)	Data privacy and privacy	Cloud computing adoption
Revathy et al. (2015)	Data privacy and privacy	Cloud computing
Chen and Zhao (2012)	Data privacy and privacy	Cloud computing
Rao et al. (2014)	Data privacy and privacy	Online data privacy frameworks
Rezaeian et al. (2016)	Data privacy and privacy	Cloud computing
Bhattacherjee (2001)	Confirmation	Information systems continuance
Lee (2010)	Confirmation of expectations	e-Learning
Meyer (1991)	Confirmation	Organizational commitment
Kekwaletswe (2014)	Confirmation of expectations	e-Health
Lam (2015)	Confirmation	e-Health record sharing system
Ajzen and Madden (1986)	Behavioral control	Technology use
Lo (2012)	Behavioral control	Healthcare professionals
Garcia-Smith and Effken (2013)	Behavioral control	Clinical information systems
Ma et al. (2016)	Behavioral control	Electronic medical records
Shiau and Chau (2016)	Behavioral control	Cloud computing classroom
Goodhue and Thompson (1995)	Technology utilization	Technology fit
Phichitchaisopa and Naenna (2013)	Technology utilization	Healthcare information technology
Alharbi et al. (2017)	Internet connection, compatibility, security	IT department decision makers

2.8 PREVIOUS RELATED MODELS

Cloud computing utilization and adoption models in healthcare have been proposed and developed by several researchers to facilitate certain medical purposes. To gain a deeper insight into the current utilization of cloud computing in the healthcare sector, the researcher reviewed the previous models concerning the use of cloud computing in the healthcare sector (see Table 2.2). The most important related models are discussed in this section as an example of different needs, cultures, and environments that make it difficult to apply a particular model in the situation of the Iraqi healthcare sector. This assumption is confirmed by Venkatesh and Zhang (2010), who declared that different cultures need to test the existing theory/model in the context of usage.

For example, Hsieh (2015) utilized a dual factor model to help formulate the relevant concepts from the theory of planned behavior and status quo bias (SQB) to explain healthcare professionals' acceptance and resistance prior to the implementation of the health cloud (see Figure 2.5). The author provides statistical evidence of the effect of perceived behavioral control on users' intention to use that consequently affects their behavior, which contributes to our assumptions about the effect of behavioral control on users' behavior. However, the main limitation of Hsieh's study was the choice of constructs, which was based on prior literature and self-observation of healthcare professionals' behavior. Therefore, the author assumes that there may be other enablers or inhibitors of health cloud usage that need to be studied. Later on, Hsieh (2016) developed a model for cloud health applications among patients in Taiwan. The main aim of his study was to investigate the acceptance and resistance of the patients based on their use of health application-based cloud computing. His study found that patient resistance to using the health cloud is caused by sunk costs, inertia, perceived value, transition costs, and uncertainty. Performance expectancy, effort expectancy, social influence, and facilitating conditions were shown to have positive and direct effects on patients' intention to use the health cloud system. Additionally, Hsieh (2016) found that the relationship between patients' intention to use the health cloud and their resistance to using it had a significant negative effect. His model was based on the use of a dual-factor model to integrate the unified theory of acceptance and use of technology (UTAUT) and the SQB theory, as shown in Figure 2.6. Like other studies, Hsieh's study has some limitations. The main limitation is the selection of the constructs, as this was based on the prior literature and his own observation of patient behavior at the study site. As he stated, there may be other enablers or inhibitors of health cloud usage, and there may also be additional predictors of resistance beyond sunk costs, regret avoidance, inertia, perceived value, transition costs, and uncertainty that should be examined in future research. Also, his study was limited to the patients and cannot be generalized to facilitate the use of cloud health applications since healthcare members are beyond his scope. Overall, Hsieh's study contributes to the existing body of knowledge in terms of narrowing the research gap by examining the causal relationship between intention to use and resistance to the health cloud in Taiwan.

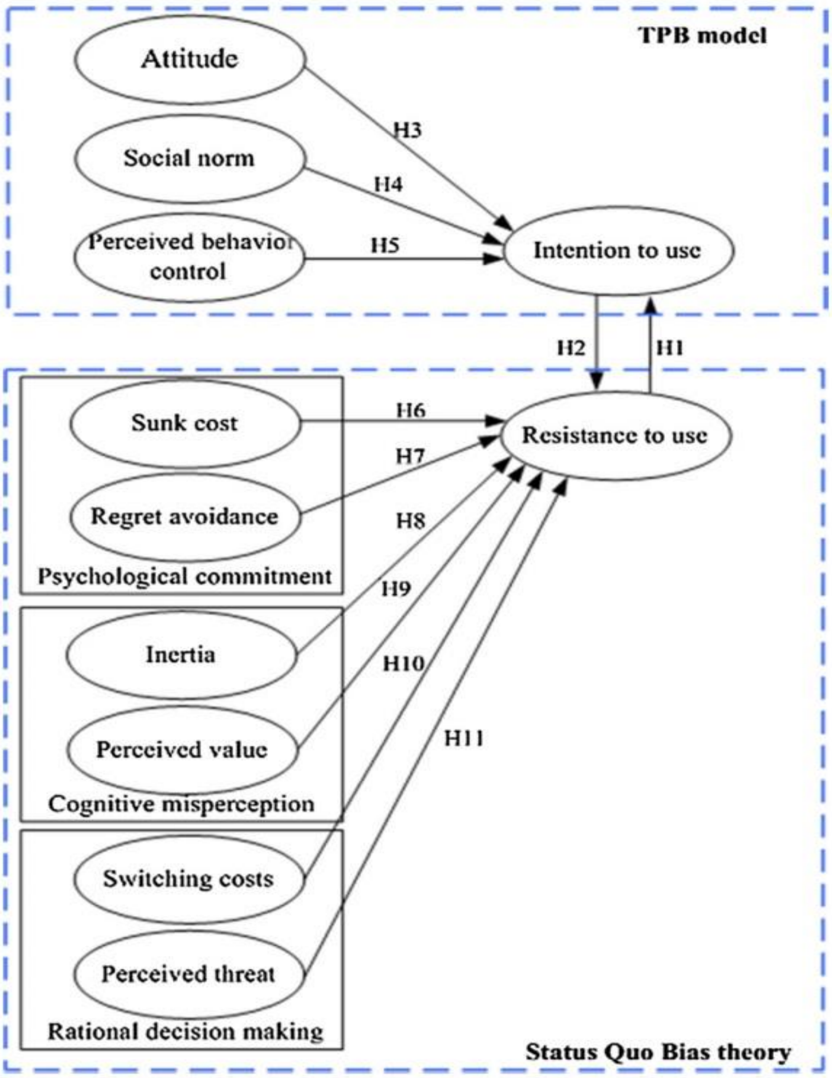

Figure 2.5 Healthcare professionals' use of health clouds by Hsieh (2015)

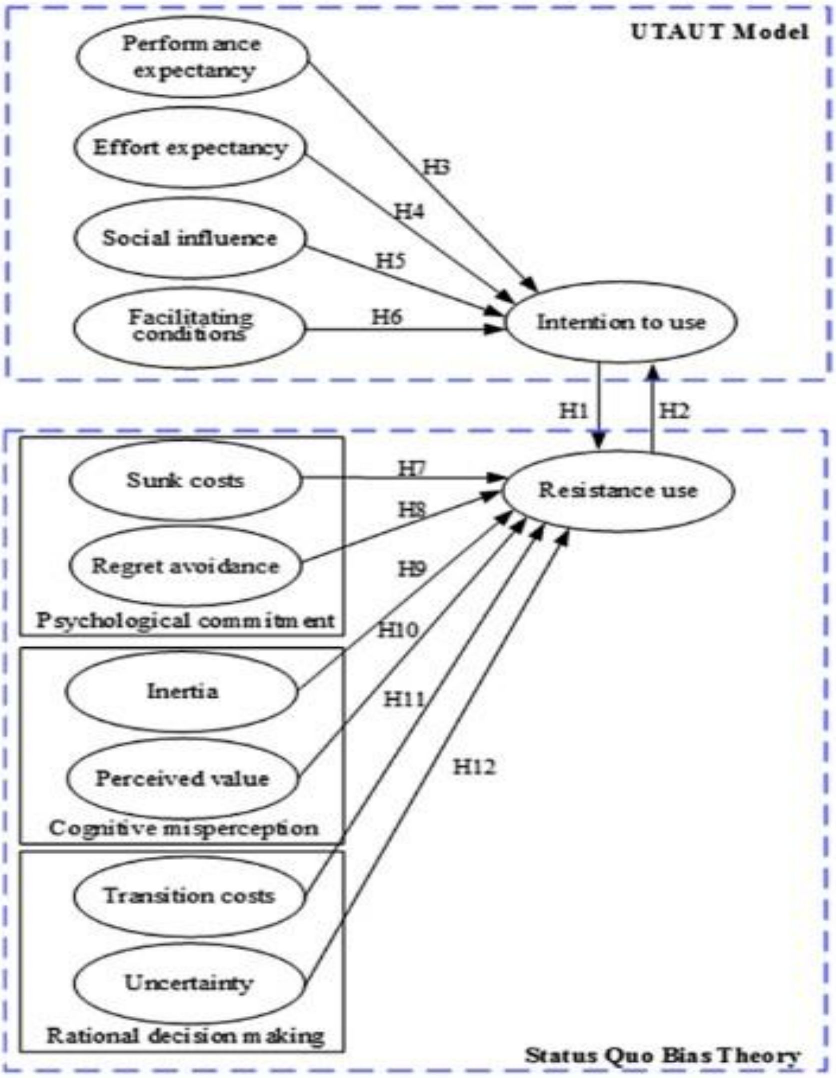

Figure 2.6 Patients' intention to use and resist the cloud health system in Taiwan (Hsieh 2016)

Zhang and Liu (2010) investigated security models and security requirements for healthcare cloud applications. They mainly studied the potential of integrating electronic health records in healthcare clouds, along with determining the security and privacy issues surrounding the access and management of such records. The authors presented an EHR model to promote the current management of security issues in healthcare clouds. However, the study did not consider actual examination of the security model among healthcare professionals.

Lian et al. (2014) conducted a study to determine the key factors affecting the decision to adopt cloud computing in a hospital in Taiwan (see Figure 2.7). They considered the use of a technology-organization-environment (TOE) framework and human-organization-technology fit (HOT-fit) model to enable them to propose a four-dimensional model (human, technology, organization, and environment). The authors support our assumptions of including the cost, security, complexity, and compatibility of the cloud health system. The major limitation of this study is the different requirements regarding the adoption of cloud computing technology, where the authors have focused only on medical centers and metropolitan hospitals. Regional hospitals are excluded from the sample. This limits the ability to generalize the proposed factors to other types of hospital in other countries.

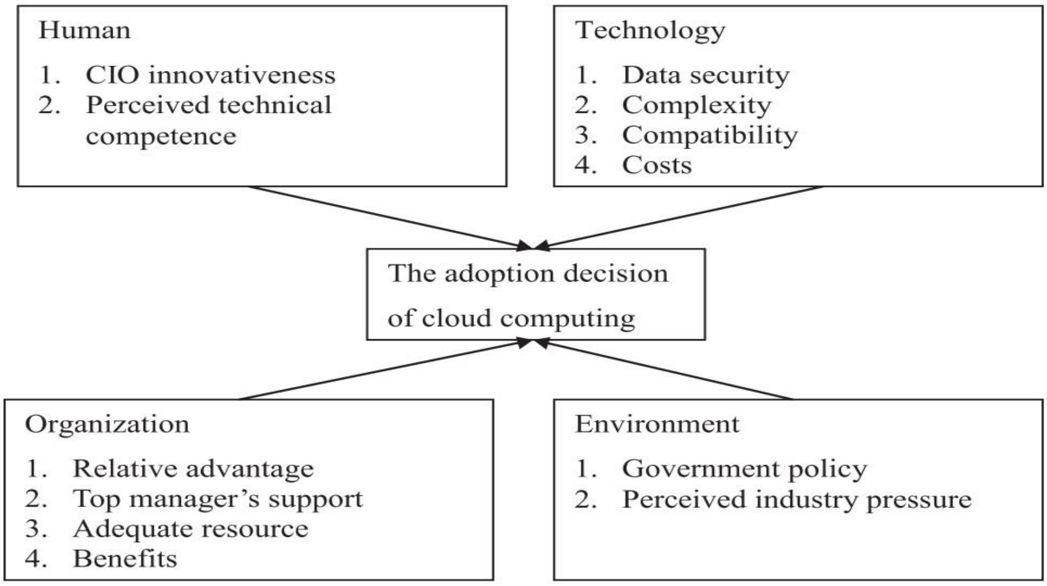

Figure 2.7 The critical factors affecting the decision to adopt cloud computing in a hospital in Taiwan by Lian et al. (2014)

Figure 2.8 shows the main factors proposed by Ratnam et al. (2014). The authors investigated the factors of cloud computing adoption to enhance services in the Malaysian healthcare sector through the use of structural equation modeling. They found that adopting the cloud in the Malaysian healthcare sector influenced the efficiency and collaboration among healthcare service providers. Meanwhile, they asserted that the security factor is an important antecedent of IT resources that affect cloud adoption. However, their study was limited to certain factors identified from the literature in relation to the Malaysian context.

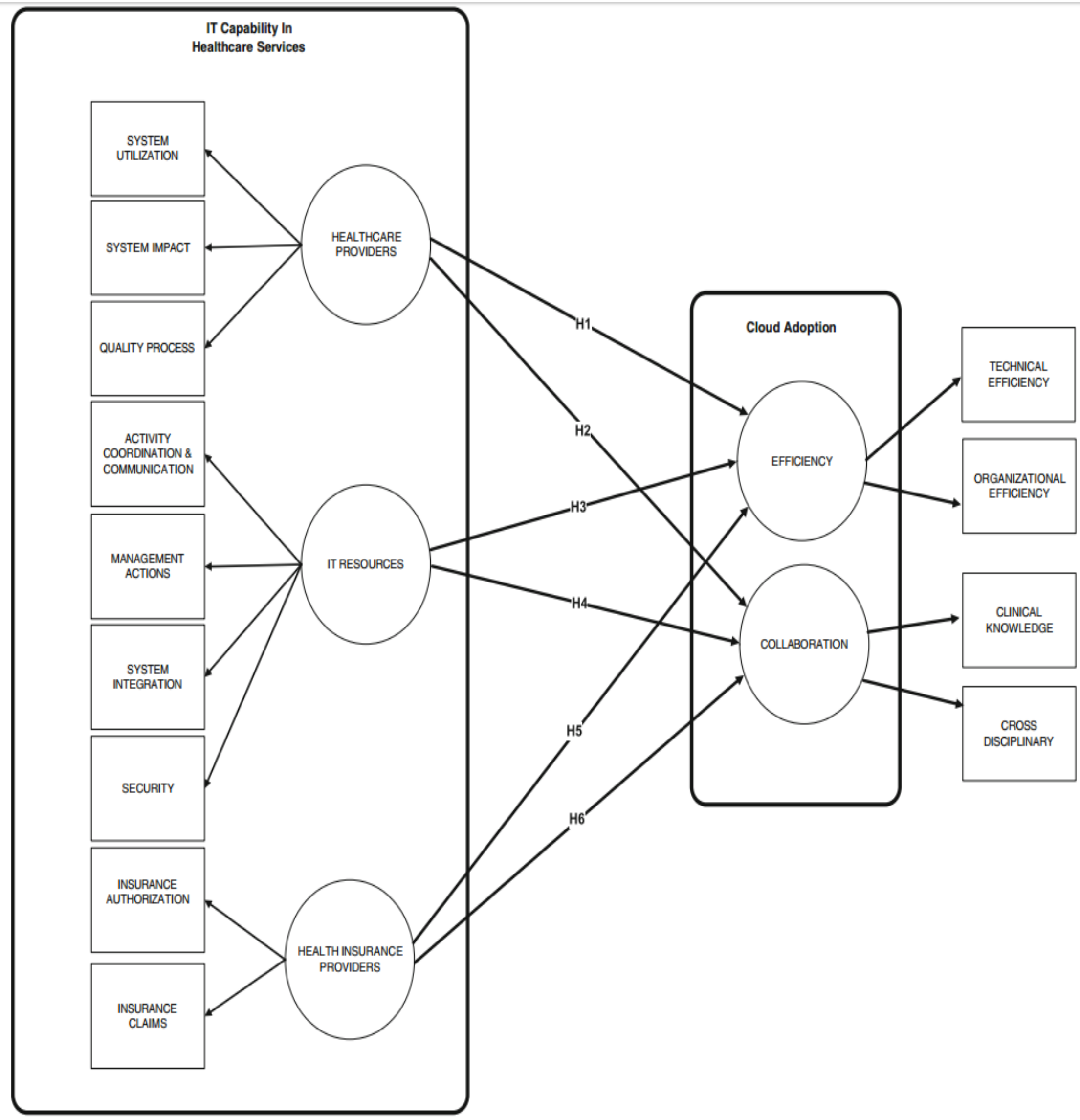

Figure 2.8 Adoption of cloud computing to enhance the Malaysian healthcare sector by Ratnam et al. (2014)

Lai and Wang (2015) used a push-pull-mooring-habit framework to explore the intentions of middle-aged and elderly patients to use cloud healthcare services. The authors assumed that cloud healthcare services can help ameliorate the medical manpower shortage and improve patients' quality of life. They proposed the key factors shown in Figure 2.9, with some limitations, including the focus on hospitals in urban areas only. Also, they highlighted the importance of security and privacy factors in changing patients' intention to use cloud health systems.

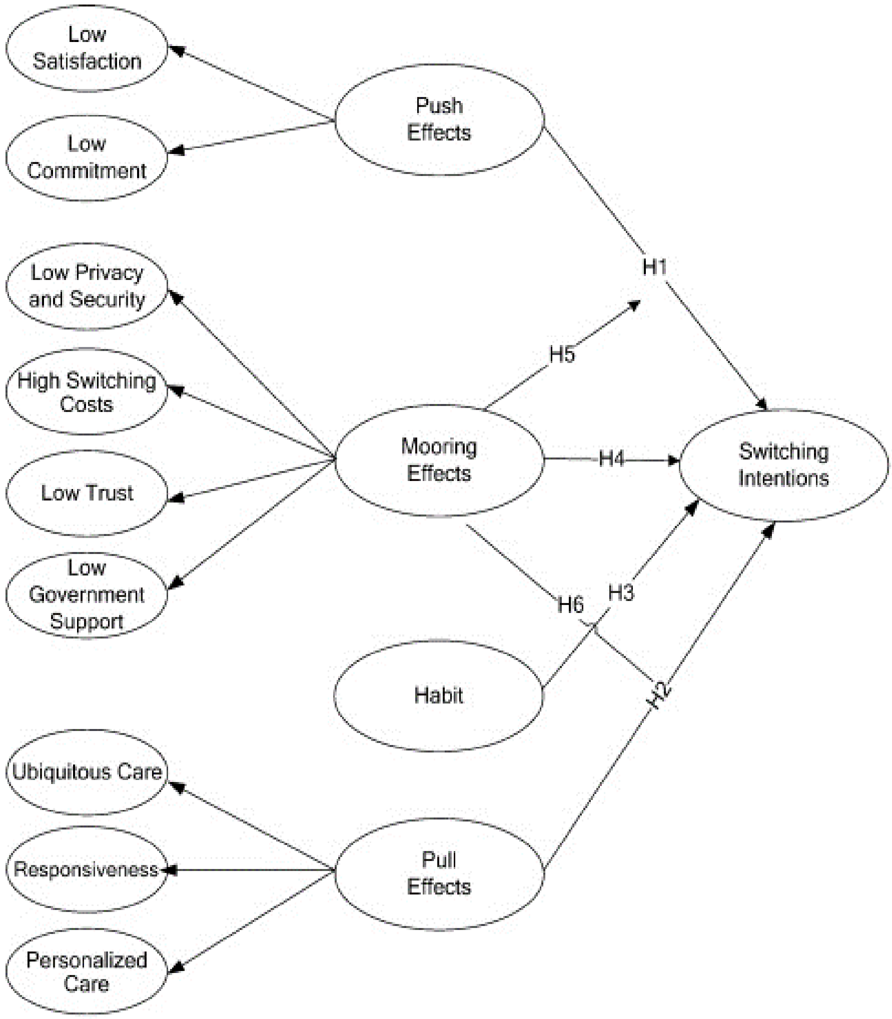

Figure 2.9 Factors affecting switching intentions to use cloud healthcare services by Lai and Wang (2015)

Lian (2017) developed a model to help understand the potential quality-related factors that affect the cloud computing success of hospitals in Taiwan. The study was conducted on chief information officers to indicate their perception of private cloud computing using a questionnaire survey. Figure 2.10 shows the proposed model, which consists of information quality, system quality, and service quality, along with their effects on trust and cloud computing satisfaction.

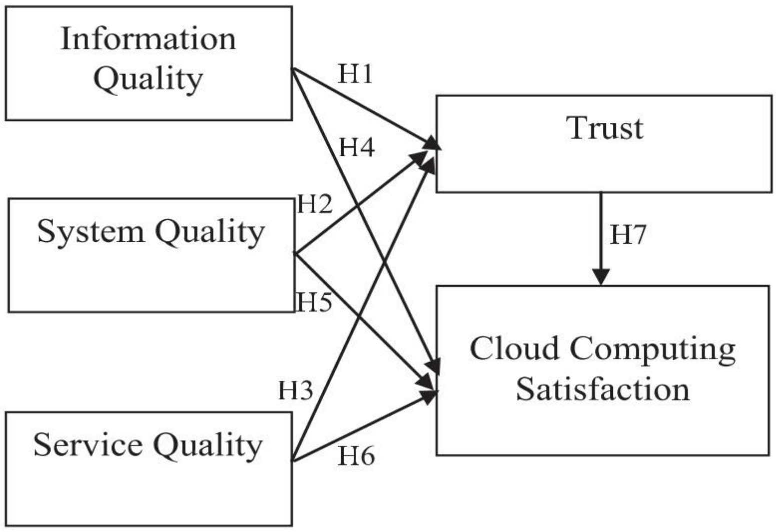

Figure 2.10 Cloud computing success model for hospitals in Taiwan (Lian, 2017)

Additionally, AlBar and Hoque (2017) studied the factors that influence the adoption of cloud enterprise resource planning (ERP) in Saudi Arabia by combining the diffusion of innovation theory (DOI) and the TOE framework. Their framework proposed four main domains (technology, organization, environment, and innovation characteristics), as shown in Figure 2.11. Their study found that a competitive environment, complexity, ICT infrastructure, observability, relative advantage, regulatory environment, ICT skill, and top management support had a significant influence on the adoption of cloud ERP, while compatibility, organizational culture, and trialability had no significant impact. Their findings offered practical guidelines for the successful adoption of cloud ERP in Saudi Arabia. The main limitations of their study were the limitation of factors and the context being limited to the Saudi environment only: they suggested that future studies include more samples that can represent the population more accurately.

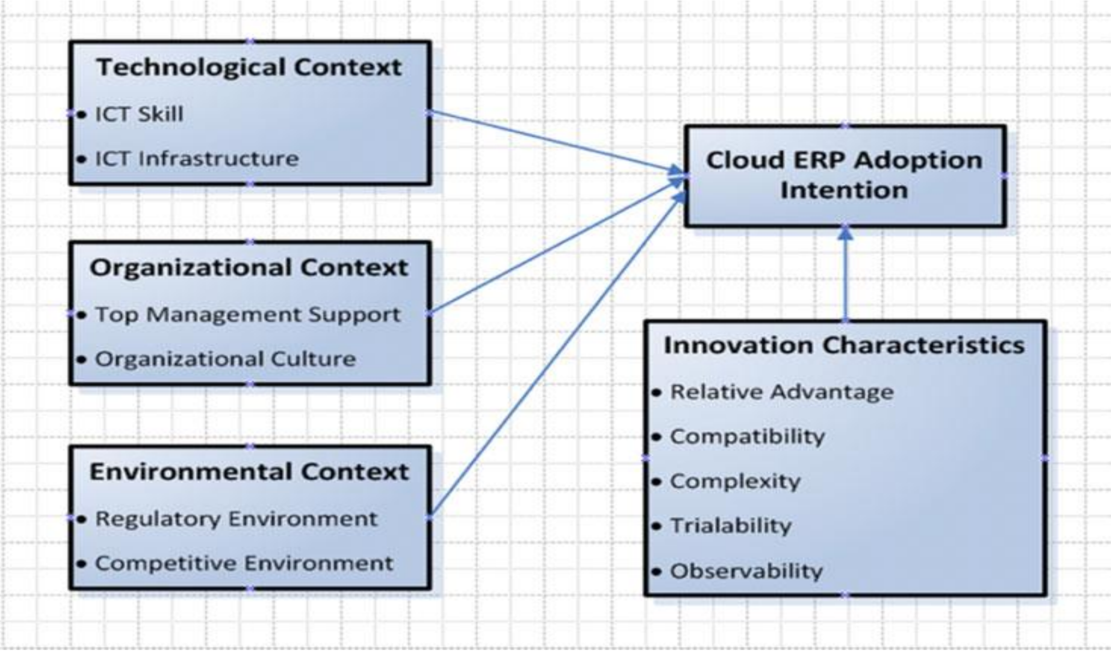

Figure 2.11 Cloud ERP adoption in Saudi Arabia by AlBar & Hoque (2017)

From Table 2.2, it can be concluded that most studies on cloud utilization in healthcare imposed some limitations related to the factors, context of use, and purpose of use. They are limited to certain developed and developing countries, with no study being conducted in the Iraqi context.

Table 2.2 A comparison of different cloud computing models in the healthcare sector

Studies	Description	Context	Country
Zhang and Liu (2010)	Developed an EHR security model based on a use case scenario. They illustrated the corresponding security countermeasures and state-of-the-art security techniques that can be applied as basic security guards.	Electronic health records	US
Lian et al. (2014)	Investigated the critical factors for driving decision makers to adopt cloud computing technology in the hospital industry. They found the five most critical factors are data security, perceived technical competence, cost, top manager support, and complexity.	Hospital industry	Taiwan

to be continued…

…continuation

Ratnam et al. (2014)	Used structural equation modeling to model cloud adoption to enhance the Malaysian healthcare sector. They considered factors related to investments and costs of infrastructure, communication, medical-related equipment, and software.	Healthcare sector	Malaysia
Lai and Wang (2015)	Developed an extended push-pull-mooring-habit model to understand middle-aged and elderly patients' intentions to use cloud healthcare services. They found that push effects such as low satisfaction/commitment, mooring effects such as low privacy/security, low trust, high switching costs, and habit effects, along with pull effects, such as personalized care, ubiquitous care, and responsiveness, all have significant effects on individual intention to switch to cloud healthcare services.	Cloud healthcare service	Taiwan
Hsieh (2015)	Integrated the technology acceptance and SQB perspectives to determine how healthcare professionals' intention to use the health cloud service is associated with their intention to resist it. He found that healthcare professionals' resistance to use of the health cloud is the result of regret avoidance, inertia, perceived value, switching costs, and perceived threat. In addition, he found that attitude, subjective norm, and perceived behavior affect professionals' intention to use the health cloud.	Health cloud service	Taiwan
Hsieh (2016)	Integrated UTAUT and SQB theory to develop a model of intention to use and resist cloud health services among patients. He found that the main cause of resistance is sunk costs, inertia, perceived value, transition costs, and uncertainty. Performance expectancy, effort expectancy, social influence, and facilitating conditions are shown to have positive and direct effects on patients' intention to use the health cloud. The study showed the importance of incorporating user resistance in technology acceptance studies in general and health technology usage studies.	Cloud health intention to use and resistance	Taiwan

to be continued…

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Lian (2017)	Proposed a model for private cloud computing based on certain factors. The result showed the role of trust in information systems' success in understanding cloud computing success in Taiwanese hospitals. The proposed model is believed to help hospitals evaluate or achieve success after adopting private cloud computing healthcare services.	Cloud computing success	Taiwan
AlBar and Hoque (2017)	Proposed a model for adopting cloud ERP by combining the TOE model with the DOI to produce a four-dimensional model consisting of technology, organization, environment, and innovation characteristics domains. The proposed model is believed to offer practical guidelines to the successful adoption of cloud ERP in Saudi Arabia and assist other developing countries.	Cloud computing ERP	Saudi Arabia
Present work	This study aims at investigating the key factors affecting healthcare professionals in Iraqi hospitals to utilize cloud computing services.	Health information system	Iraq

2.9 SUMMARY

This chapter has introduced the main application of cloud computing in the healthcare sector. It has explained the main components of cloud computing by illustrating the role of SaaS, IaaS, and PaaS in providing the required services to end users. A comparison of previous models related to cloud computing utilization in healthcare sectors was introduced to help us construct the research gap and rationale to conduct this study. Drawing from the previous cloud computing models in healthcare sectors, it can be noted that most studies have examined certain organizational and behavioral aspects according to the current state of technology applied to satisfy certain purposes. This led the researcher to identify the main antecedents affecting healthcare physicians' and technicians' intention to utilize cloud health information systems and to model the relationships between these identified factors, leading to an exploration of how this can drive healthcare professionals' utilization of cloud technology in Iraqi hospitals. The researcher relied on the physicians and technicians as the main evidence to test the hypothesized relationships between the proposed variables. The technicians considered as the backbone of the healthcare industry and their perceptions should be investigated in research. Moreover, the physicians' perceptions need to be investigated in technology adoption studies because they are the main users of such systems. In addition, the direct effect of organizational and system-related factors on individuals' usage behavior has not been adequately examined or investigated in previous studies, which offers a promising angle to consider in this study. From this, the researcher was able to conclude that modeling a cloud health information system in developing and developed countries is yet to be examined, or has been examined with limited inputs. The next chapter presents the method used in this thesis to achieve the proposed research objectives.

CHAPTER III

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The current use of technology in various developed countries has impacted the way that healthcare members process and share information, the way multiple parties use that information, and the way to monitor a medical case. This implementation of advanced technology such as cloud services in the Iraqi healthcare committee is still at the infancy stages where utilizing it effectively may provide new and interactive platforms needed for healthcare members to manage medical data. In regard to the utilization of cloud services in healthcare information systems, it is still unclear how such technology is currently integrated: both physicians and technicians utilize a myriad of different technological platforms to enhance the healthcare service quality.

This study aims at identifying and modeling the relationship between the key factors for driving successful utilization of health information systems based on cloud computing services in the Iraqi public healthcare sector.

Since this study is the first of its kind in the context of the Iraqi healthcare sector, different views have been studied. Previous studies in healthcare sectors mostly emphasized the potential of addressing physicians’ and technicians’ perception when it comes to clarifying technology utilization and adoption. This is because both technicians and physicians are familiar with cloud services and are thought to use it in various ways. On the other hand, it is believed that gaining inputs from both groups helps provide an in-depth understanding of common factors that are shared among healthcare members.

Although the integration of cloud services within health information systems has recently increased substantially, their implementation is still seen in its elementary stage. The current policies in the healthcare sector in Iraq have addressed the needs of such technologies in order to reduce socioeconomic disparities within the healthcare sector; therefore, determining the key factors contributing to the utilization of cloud services in Iraq is essential.

3.2 RESEARCH METHODOLOGY

The research method is the process employed to collect information and data in order to solve a problem and make decisions (Welman et al. 2005). It is a procedure where concerns and issues in scientific research tend to be systematically solved (Kumar 2008). The method requires identifying the phases in conducting a study, as well as the process by which these phases are applied. Research methods are often generalized and recognize ways of approaching the research questions. It can never be assumed that all methods can be applied to all research questions: therefore the method selection is restricted by the area of research the researcher seeks to explore (Hall & Hall 2008).

There are two major research approaches, namely, quantitative and qualitative research (Yin 2013). Qualitative research can obtain information about people's attitudes, behavior, and experience, whilst a quantitative study can provide statistical evidence by making use of methods like quantitative questionnaires or a survey (Dawson 2002). Commonly, information systems studies apply either quantitative or qualitative methods as a single approach, but the importance of combining these two research methods is receiving increasing attention. According to Creswell (2009), a combination of research methods could be effective for research that tries to investigate complex phenomena that requires considering information from various perspectives. Therefore, the researcher in the present study considered applying a mixed-methods approach. Creswell (2009) describes three criteria that need to be taken into consideration when designing a mixed-methods research: these are the priority, followed by implementation, and then integration of the qualitative and quantitative approaches.

The priority is the means of selecting the sequence of methods based on the research objectives. As such, this research involves two research approaches (qualitative and quantitative) and gives priority to the qualitative approach, reflecting our first research objective. Implementation refers to the data collection methods, whether in parallel or in sequence: in this research, the researcher used the sequence mixed-methods design to achieve the research objectives. Finally, integration refers to combining the interpretation of the results obtained from the qualitative and quantitative parts in the same study (Creswell 2009).

Thus, this study has main three parts (qualitative – quantitative – qualitative). The first part of this study (representing the first research objective) collects and analyzes the qualitative data obtained from the preliminary interviews as a means of exploring and understanding the meaning which individuals attribute to social or human problems. As such, the researcher explores the current antecedents and deduces the factors that may influence healthcare professionals in Iraqi hospitals in their use of a cloud health information system. The analyzed qualitative data are then used to build a quantitative research instrument (questionnaire). The second part (representing the second and third research objectives) includes the quantitative data collection and analysis, with the aim of testing the hypotheses (examining the relationships between variables) and developing the statistically validated models. The quantitative part proposed two research models for both physicians and technicians, these models have been tested statistically before proposing to merge them in one model. Finally, the third part of this research (representing the fourth research objective) involves a qualitative approach via the use of an interview technique in order to explore the experts' views to be able to confirm the applicability and suitability of the proposed merged tested model of this study, and to confirm that the study is up to scientific standards that allow the researcher to achieve the study's objectives. According to Harris and Brown (2010), structured questionnaires and semi-structured interviews are often employed to provide confirmatory results in mixed-methods studies. Furthermore, Creswell (2009) advises having two separate sections for the quantitative study and qualitative data collection and data analysis. The mixed-methods design is illustrated in Figure 3.1.

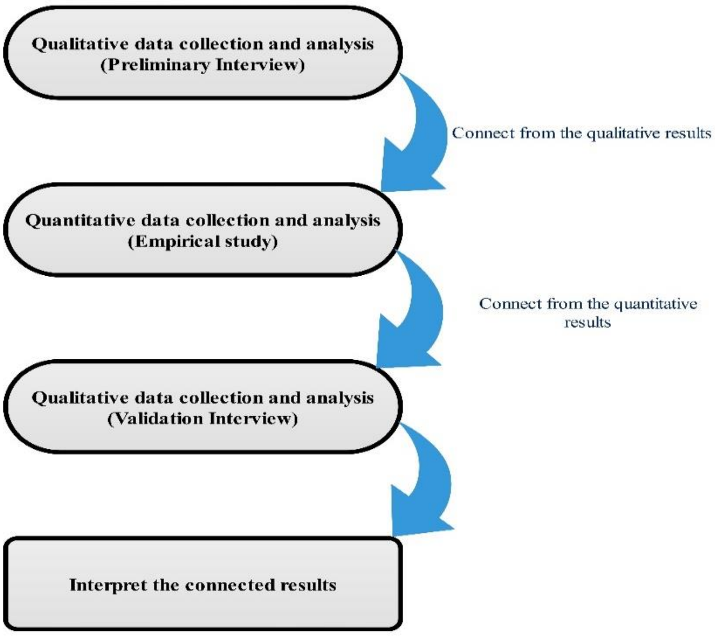

Figure 3.1 Mixed-method process

On the other hand, researchers need to choose the most appropriate design approach depending on the kinds and sources of data being gathered, based on the research questions, the data gathering, and analysis strategy to be used, as well as the time and budget limitations to complete the study. According to Sekaran and Bougie (2016), there are several types of research that can be categorized based on the study purpose (which is generally classified into exploratory, descriptive, hypothesis testing, and case study analysis research); the type of investigation (classified into causal and correlational); the unit of analysis (categorized into individuals, dyads, groups, organizations, and cultures); and the time horizon for collecting data (cross-sectional versus longitudinal). This mixed-methods research is a descriptive, correlational, individual unit of analysis, cross-sectional, predictive, and deductive research. This research method allowed the researcher to deduce logically from the results of the study through several phases, including preliminary data gathering, theory formulation, proposing the conceptual model and hypothesizing, research design, data collection, data analysis, deduction and interpretation, and validating the tested model. The methodology flow of this thesis is illustrated in Figure 3.2 and explained in sections 3.3 to 3.8.

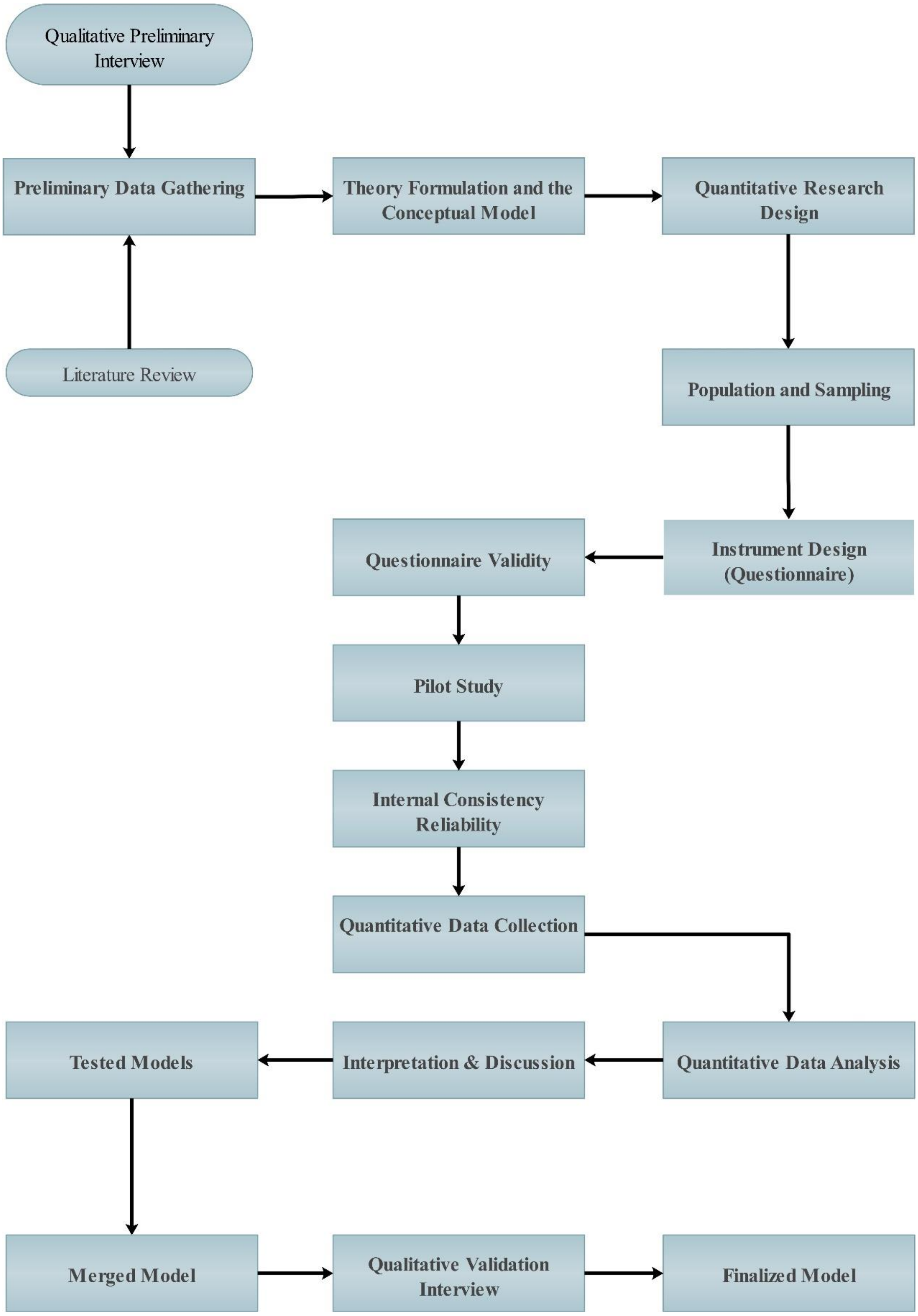

Figure 3.2 Methodological phases

3.3 PRELIMINARY DATA GATHERING

Both phases of the preliminary interviews, as well as the literature review, provided more understanding of the factors that may influence this field. A literature survey and interview procedure guarantee a comprehensive review of factors, along with the concepts which are essential to the situation being studied. The research also seeks to understand the importance of these factors and the methods by which these factors ought to be investigated so the research problem can be solved. At this point, the researcher recognizes ambiguous issues and gaps, as well as describing the relevance of the present study. For that reason, the interview and the literature survey are generally important to propose a new conceptual model that theoretically embodies the research problem (Sekaran & Bougie 2016).

3.3.1 Literature Survey

The literature survey documents a comprehensive review of the published and unpublished work from secondary data sources in the areas of specific interest to the researcher. The researcher can start the literature survey even as the information from the interviews is being gathered. Reviewing the literature on the topic area at this time helps the researcher to focus further interviews more meaningfully on certain aspects found to be important in the previous studies, even if these had not surfaced during the earlier questioning (Sekaran & Bougie 2016). The literature has been reviewed comprehensively in Chapter II based on the method stated in the following subsections.

a. Search criteria

The researcher carried out the initial literature search between February 2016 and July 201) through the Universiti Kebangsaan Malaysia Database, ISI Web of Science (before discontinuation by the university), ScienceDirect, Scopus, IEEE Xplore, Emerald, and Google Scholar databases. The search for relevant previous studies was done using the standard screening method in which the researcher selected the studies containing keywords related to the query (‘health information systems’ AND ‘cloud services in managing healthcare data’ OR ‘cloud healthcare systems’ OR ‘e-health based cloud’).

The researcher used a systematic review as the methodological framework in this chapter. The PRISMA protocol was applied in this study by approaching an expert in the field to evaluate the suitability of the identified articles.

b. Study selection

The process of study selection mainly involved scanning the sources gathered from the literature based on two iterations of screening and filtering. The first iteration excluded duplicates and irrelevant articles by scanning the titles and abstracts, while the second iteration filtered the articles after a thorough full-text reading of the articles screened from the first step. The two iterations used the same inclusion criteria followed by screening and reviewing.

c. Inclusion criteria

In this study, the researcher relied on the articles gathered by searching the mentioned databases depending on the following criteria:

1. Using the options in each search engine to include only journal and conference articles and published theses. Other patents and unofficial reports were not included.

2. Articles written in the English language.

3. Within ten years (2007–2017), except for root and fundamental articles. Since the utilization of cloud computing in the healthcare sector is relatively new, 2007 was found to be the starting year for such utilization.

4. The articles examined the direct impact of health information systems and services on healthcare professionals. Healthcare professionals in the context of this study represent physicians and technicians.

After the initial removal of duplicates, the number of studies for each term was screened and documented in both screening and filtering iterations in accordance with the current study’s variables. A total of 2,849 articles and theses were identified from the literature, as demonstrated in Figure 3.3. A total of 184 articles were considered promising after applying the inclusion criteria: 110 articles used a quantitative method, 17 articles used a qualitative method, 26 articles used mixed methods, and only 31 articles used content and systematic review methods. From this, it can be seen that the majority of previous studies used a quantitative method to examine and validate research models related to the varied usage of cloud computing in the healthcare context.

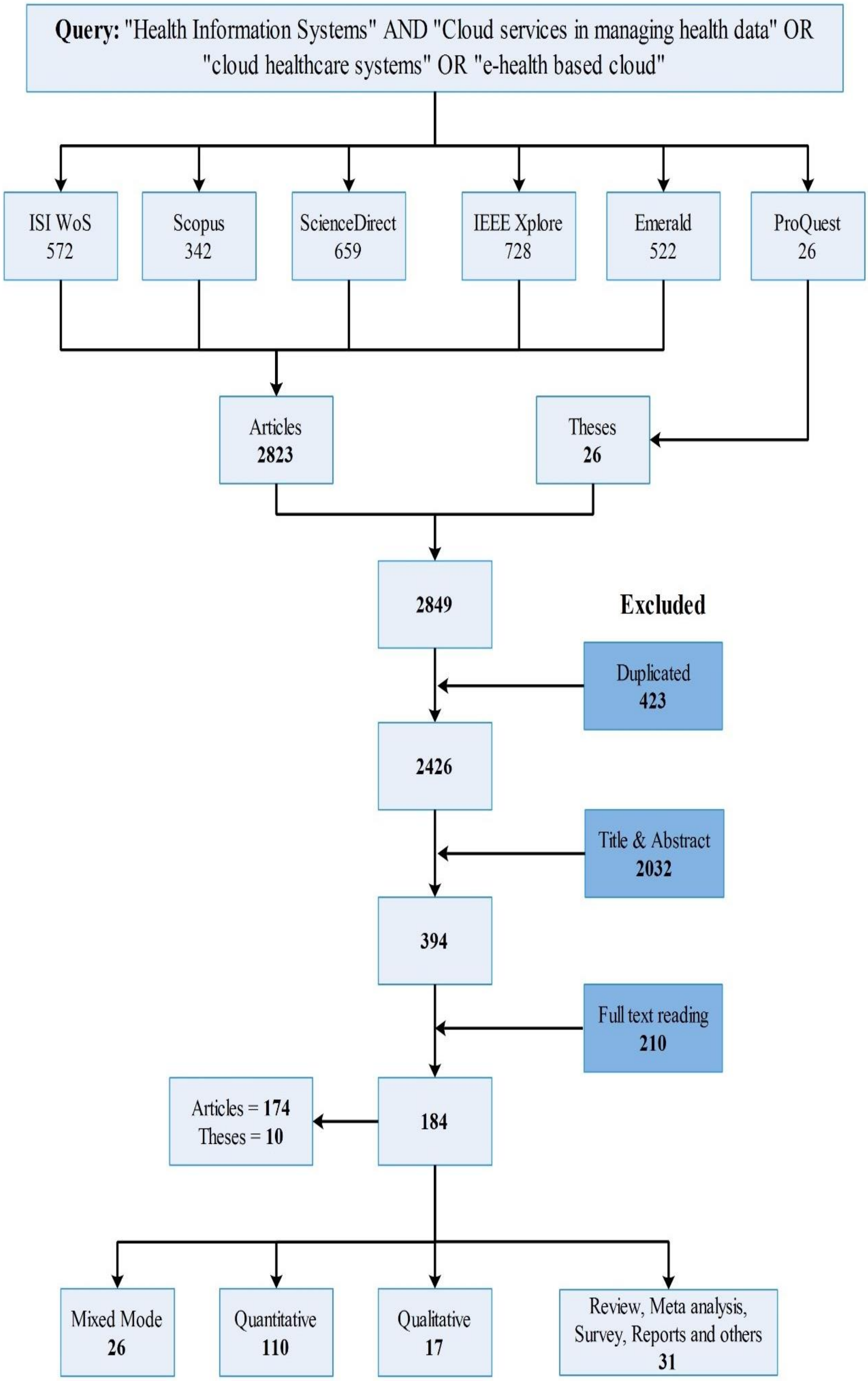

Figure 3.3 Flowchart of the search for articles

3.3.2 Qualitative Preliminary Interviews

In this phase of the research, the researcher investigated the factors affecting the utilization of cloud services in the Iraqi public healthcare sector. Thus, a number of interviews were conducted to collect the qualitative information. Before proceeding to describe the interview process, it is important to mention that there are various types of interview, including semi-structured, structured, and unstructured interviews. The structured interview uses limited questions and obtains certain answers relevant to the pre-prepared questions. In semi-structured interviews, the researcher is able to add/remove/modify the pre-prepared questions based on the situation, so the researcher can explore in depth the phenomena that need to be investigated. An informal interview (unstructured) is more flexible, as the researcher prepares a list of topics to be discussed during the interviews and the questions emerge during the session.

In the present study, the researcher made use of semi-structured interviews to be able to ask questions beyond those prepared. This interview structure was considered more suitable than other techniques, as data are obtained directly from the users experiencing the problems. Moreover, this is an effective mechanism relevant to data analysis right after performing every interview, as well as for deciding when to stop collecting data. A semi-structured interview was selected because: 1) it guaranteed a higher response rate to the questions when asked directly to the participants; and 2) it requires less time and energy to administer. Many researchers like to use semi-structured interviews as that questions can be prepared in advance but can be adapted during the interview. The semi-structured interview pallows participants the flexibility and the freedom to express their perspectives in their terms. It can also provide comparable and reliable qualitative data (Pudjianto et al. 2011).

Grounded theory was applied as a qualitative research approach (Glaser & Strauss 2009; Glaser 1998). This approach is often applied to develop an explanation, proposition and/or model that best fits the collected data to provide an understanding of a phenomenon, situation, or process. This method is the opposite of classic social science and information systems research. The methodology of this approach usually starts with data collection, preferably using semi-structured/unstructured interviews, after which it is possible to develop the desired model from the collected data following a systematic analysis (Glaser & Strauss 2009). After reviewing the literature comprehensively, the researcher was aware that the area of interest has limited coverage in Iraq; Ponomarov and Holcomb (2009) recommend this approach for areas that have limited coverage in the literature. It is proved to be helpful in generating in-depth understanding where little has been recognized regarding the phenomenon of interest; it is also suggested where complex social procedures like managerial decision making under uncertainty are concerned. The interviews were conducted at separate times. The interviewees comprised of physicians and technicians from four selected Iraqi hospitals. Individual interviews, although costly, may produce a bigger number of responses (Goldman & McDonald 1987). After data collection, important points that were extracted from the interviews were marked using a series of codes.

a. Preliminary interview objectives

The interviews were conducted in the preliminary phase of this study to be able to collect in-depth information from the targeted population relating to the dimensions of the research problem. The interviews also sought to discover the factors that can impact the utilization of cloud services in Iraqi hospitals. Additionally, the aim was to know the thoughts and opinions of the technicians and physicians—considered as the actual users of the HIS in hospitals—on services, IT environments, and restrictions of IT departments. Furthermore, interviews can easily identify the positives and negatives of the existing IT systems in organizations that are utilizing other architectures. In addition, the factors inhibiting or perhaps supporting the utilization of cloud services re deduced for use in this study. Thus, conducting interviews with the technicians and physicians was essential to be able to achieve the research objectives.

b. Preliminary interview preparation and execution

Before conducting the interviews, a set of questions was prepared consisting of fourteen questions (see Appendix A), which addressed the interview objectives and covered the research dimensions. The researcher considered using open-ended questions as this kind of question allows the respondents to give more details about the phenomenon. The way the researcher conducted the interviews was by telephone. According to Sekaran and Bougie (2016), this kind of interview helps to contact subjects dispersed over various geographic regions and to obtain immediate responses from them. This is an efficient way of collecting data when one has specific questions to ask and the responses are needed quickly. On the negative side, the interviewer cannot observe the non-verbal responses of the respondents, and the interviewee can block a call. Telephone interviews are best suited for asking pre-prepared questions where responses need to be obtained quickly.

In the preliminary study, the criterion sampling technique was used to select the relevant participants for the preliminary interview. Criterion sampling refers to selecting cases that should meet some pre-specified criterion (Creswell 2013; Yilmaz 2013). Creswell (2009) states that the selection of participants and sites relies on people and places that give the best understanding of our central phenomenon. In line with that, Creswell (2009) highlights that the choice of participants depends whether or not they are information rich. Therefore, the interview was conducted with 15 technicians and 15 physicians from four main hospitals situated in Baghdad, Iraq. The selection of those participants was based on the following criteria: they have experience in using cloud-based HIS, and they had an academic background. The number of participants was considered adequate for preliminary study purposes, as Griffin and Hauser (1993) contend that 20–30 participants is sufficient for a qualitative interview when the participants are a homogeneous target audience. This is supported by Warren (2002), who recommends 20–40 participants. The participants’ demographic information is tabulated in Table 3.1. Prior to the interview, the topics were sent to the interviewees well in advance to allow them to prepare. During the interview, as it was a telephone interview, the data were collected by taking notes on paper; calls were recorded for some of them, but some interviewees did not give permission to record their interviews. The timeframe for the preliminary interviews was from December 2015 to February 2016; the time taken for conducting each interview was about 20–30 minutes. The most important points were taken from the study and discussed.

Table 3.1 Demographic information for preliminary interview participants

Demographic information	Category	Total	Technicians	Physicians
Gender	Male	26	15	11
	Female	4	0	4
Age	Less than 30 years old	14	9	5
	Between 31 and 40 years old	11	5	6
	Over 40 years old	5	1	4
Level of education	Diploma	4	4	0
	Bachelor’s degree	10	8	2
	High Diploma	8	2	6
	Master’s degree	4	1	3
	PhD	4	0	4
Years of experience	Less than 1 year	1	1	0
	Between 1 to 3 years	29	14	15
	Over 3 years	0	0	0
Position	Administrator	0	0	0
	Top manager	1	0	1
	Manager	3	1	2
	Responsible	5	1	4
	Employee	21	13	8

c. Preliminary interview data analysis

After transcribing the interviews, the researcher used thematic analysis to analyze the qualitative data collected from all of the interviews. As outlined by Braun and Clarke (2006), thematic analysis is a flexible and simple method applied to generate new ideas by means of identifying and analyzing the patterns or themes produced in the data simply by organizing and describing it to make sense of it. According to Braun and Clarke (2006), the main steps in thematic analysis are to read the data many times to become more familiar with it, to create primary codes by noticing the occurrence of patterns, to merge the codes into themes which show the data accurately, then to review the themes to make sure that they support the study, before, finally, naming and defining the themes along with the constructs (Braun & Clarke 2006). The researcher followed the above-mentioned steps in the present study: the researcher read and checked the interview texts several times to become familiar with the responses before creating the codes, combining the codes into themes, and finally defining the constructs. The results and findings are discussed in section 5.2 of Chapter V.

3.4 THEORY FORMULATION AND THE CONCEPTUAL MODELS

Theory formulation, the next step, is an attempt to integrate all the information in a logical manner so that the factors responsible for the problem can be conceptualized and tested. In this phase, all available information is integrated with the purpose of conceptualizing, hypothesizing, and testing the critical constructs, therefore figuring out the causes of the problem and the methods to solve it. The relationships among constructs should be integrated and confirmed to figure out how they contribute to the problem. Two main factors motivate the formulation of a theory: firstly, various studies have investigated other constructs that may be unrelated to the condition presented in this study; secondly, in previous studies, some of the hypotheses might have been substantiated and others not, presenting a perplexing situation. Thus, formulating a theory for any problem in any study is essential to achieve a solution (Sekaran & Bougie 2016).

Based on the literature survey and interviews, this study proposes two new models for technicians and physicians respectively. The first measures the effect of organizational structure factors (in terms of cost-effectiveness, hardware modularity, software modularity, internet network, and training availability) on technicians' confirmation and behavioral control to enhance their utilization of cloud health information systems. The second model measures the effect of system integrity factors (in terms of compatibility, complexity, data security, and privacy) on physicians' perception (confirmation and behavioral control) to enhance their utilization of cloud health information systems. The construction of the proposed models is supported by a set of theories (organization theory, the theory of reasoned action, and the diffusion of innovation theory) that verify the combination of such factors. Subsection 4.2.1 in Chapter IV discusses the theories that are used in this study. Furthermore, all the potential relationships between the proposed variables are hypothesized to be further investigated empirically.

3.5 QUANTITATIVE RESEARCH DESIGN

Research design involves determining how the chosen method will be applied to answer the particular research question (Hall & Hall 2008). Bryman and Bell (2015) define the research design as the framework that provides the process for data collection together with data analysis. It is designed to make the research problem researchable by planning the research process in the best way to achieve specific answers to particular questions. Research design involves planning what is required to collect and utilize the data to obtain the desired information (Creswell 2009; Goodenough & Waite 2012). Neuman and Kreuger (2003) contend that a survey method is suitable for research objectives or research questions that deal with behaviors or beliefs. Contrastingly, Zikmund (2003) states that surveys are significantly better methods for measuring opinions, awareness, and behavior.

To be able to answer research questions 2 and 3, a quantitative research method has been used in this study to gain insights into the utilization of cloud computing in HIS. The main reason for choosing this method was its suitability for weighing individuals' perceptions of the factors to be examined and verified. In addition, it provides a reliable measure for exploring the relationships between organizational structure/system and individual factors on the one hand and the utilization of cloud services on the other. This, as a result, allowed the researcher to state clearly the positive relationships so that the Iraqi healthcare sector can take the actions necessary to boost cloud service utilization.

A questionnaire technique has been used to determine healthcare members' views on the validity of the research variables. The main reason for choosing the questionnaire is its practicality in simplifying the analysis of the data more scientifically and objectively than other forms of research. In addition, it can help the researcher to compare and contrast with other research and may be used to measure change positivists believe for examining existing hypotheses (Wright 2005). A quantitative research design involves identifying the appropriate sample that represents the population, the research instrument design (including testing the validity and reliability), data collection procedure, and data analysis methods.

3.5.1 Population and Sample Size

Population refers to the entire group of people, events, or things of interest that the researcher wishes to investigate. The target population for this study was the public healthcare sector in Iraq, situated in Baghdad Governorate. The reason for this selection is the functionality and reliability of the adopted technology compared to other states in Iraq. There are approximately 39 public hospitals in Baghdad. However, only four general hospitals have been chosen, as shown in Table 3.2, which also shows the number of beds for each hospital and the identified physicians and technicians. These hospitals are situated in Baghdad.

The reason for choosing these hospitals is due to their capacity and their ability to offer different healthcare aids. The sample hospitals were chosen based on the recommendation of the state healthcare director in Baghdad through a filtering process in terms of the number of beds, physicians, patients, medical cases, and available technicians. The selection process resulted in four public hospitals: other hospitals were eliminated because they were beyond the scope of this study from the perspective of time and resources. However, the selected hospitals were within the scope of this research study, which pertains to physicians and technicians who are familiar with the use of cloud technology. A total of 304 physicians and 146 technicians were identified as the target population in these hospitals and they are aware of cloud services.

Table 3.2 Hospitals with number of beds, physicians, and technicians

Hospital	Number of beds	Number of physicians	Number of technicians
Baghdad Teaching Hospital	998	119	59
Al-Yarmouk General Teaching Hospital	770	97	44
Al Kindi General Teaching Hospital	333	47	25
Al-Karkh general hospital	198	41	18
Total	2,299	304	146

A sample is a population subset that consists of several members selected from a population where not all elements of the population are chosen. The sample should represent the population, and the size of the sample should adequately reflect the population that the researcher is interested to investigate (Sekaran & Bougie 2016).

To be able to represent the population, the healthcare professionals that use cloud services over health information systems are seen to belong to two sets (based on the observation and preliminary interviews). The first set is the physicians, including general practitioners, specialists, and the managers of healthcare departments: this set we define as the physicians sample in our study. Technicians and their department managers represent the second sample. The researcher did not consider collecting data from other healthcare staff for many reasons associated with each sample: dentists and pharmacists use clinical information systems and dental centers are often located outside the hospitals. As for other sub-staff (including nurses, radiologists, laboratory technicians, assistants, etc.) and managerial staff, they use clinical information systems in their departments, such as the Nursing Information System (NIS), Radiologist Information System (RIS), Laboratory Information System (LIS), Admission/Discharge/Transfer system (ADT), etc. Also, the sub-staff have limited access to the features of the cloud HIS. It has been found that some hospital departments assign a technician responsible for their cloud HIS to reduce the technical errors that may occur. This leaves us to conclude that the representative samples that meet our study focus and scope are the samples of physicians and technicians who are the actual users of the HIS.

According to Hair et al. (2016), a sample is a selection of individuals or elements from a bigger body or population. The individuals selected in the sampling process should represent the population as a whole. A good sample needs to reflect the differences and similarities identified in the population to ensure that it is possible to make inferences from the small sample about the large population. In terms of the current study, the PLS-SEM multivariate analysis approach ascribes less importance to sample size, as small sample size of 100+ is considered adequate for such studies to obtain results representing the effects that exist in a population of several million elements or individuals (Goodhue et al. 2012; Hair et al. 2016; Marcoulides & Saunders 2006).

In the present study, the researcher looked at three ways to calculate the required sample size for the physician and technician populations. The first method, according to Barclay et al. (1995), requires that the sample size is equal to ten times the number of structural paths directed at a particular construct in the structural model. Specifically, the required sample size should be determined by means of power analysis based on the part of the model with the largest number of predictors (Hair et al. 2011; Marcoulides & Chin 2013). Reflecting that concept on our models revealed that, for the physician's model, we have eight paths directed from the independent variables to the dependent variables: as such, the required sample size based on this method is (80) subjects. As for the technician's model, the structural paths pointing to the dependent variables number ten, and so 100 respondents was the sample size requirement.

With the second method, since sample size recommendations in PLS-SEM essentially build on the properties of ordinary least squares (OLS) regression, we can rely on the recommendations of Cohen (1992) in his statistical power analyses for multiple regression models, provided that the measurement models have an acceptable quality in terms of outer loadings (loadings should be above the common threshold of 0.70). Table 3.3 shows the minimum sample size requirements necessary to detect minimum R^2 values of 0.10, 0.25, 0.50, and 0.75 in any of the endogenous constructs in the structural model for significance levels of 1%, 5%, and 10%, assuming the commonly used level of statistical power of 80% and a specific level of complexity of the PLS path model.

Table 3.3 Minimum sample size required (Source: Cohen, 1992)

	Significance level											
Number	10%				5%				1%			
of IVs	Minimum R^2				Minimum R^2				Minimum R^2			
	0.1	0.25	0.50	0.75	0.1	0.25	0.50	0.75	0.1	0.25	0.50	0.75
2	72	26	11	7	90	33	14	8	130	47	19	10
3	83	30	13	8	103	37	16	9	145	53	22	12
4	92	34	15	9	113	**41**	18	11	158	58	24	14
5	99	37	17	10	122	**45**	20	12	169	62	26	15
6	106	40	18	12	130	48	21	13	179	66	28	16
7	112	42	20	13	137	51	23	14	188	69	30	18
8	118	45	21	14	144	54	24	15	196	73	32	19
9	124	47	22	15	150	56	26	16	204	76	34	20
10	129	49	24	16	156	59	27	18	212	79	35	21

Based on Cohen's table, for a statistical power of 80% to achieve a minimum R^2 of 0.25 with a significant level of 5%, we need 41 physician participants (four independent variables) and 45 technicians (5 independent variables).

The third method uses G*Power software to carry out power analyses specific to model set-ups. This is the method most commonly used by researchers, since the software provides multiple settings and features for most kinds of analysis. Many researchers from various disciplines have depended on this software to achieve their recommended sample size for their research (Hair et al. 2016). The researcher therefore depended on this calculation as the main evidence for collecting data from the recommended sample size. Many parameters/settings have to be adjusted before calculating the sample size in G*Power software. Firstly, the statistical test type: as this research uses the PLS-SEM approach, we can rely on multiple linear regression statistical power analysis (Cohen 1992). Also, the test family used was t-test. Furthermore, the parameters are defined below:

- One-tail: this research considered the use of directional hypotheses.
- $f^2 = 0.15$: medium effect size value.
- Alpha error probability (p-value) = 0.05 (5% significant level).
- Power (1-β err prob) = 95% (confidence level).

For both structural models, the sample size has been calculated based on Figure 3.5 and Figure 3.4. We can see that a minimum sample size of 74 was required for the physician and technician models with four and five independent variables. Some researchers recommended adding 20 percent to the sample size derived from the G*Power software. As a result, 89 observations was the recommended sample size to be used in this study for both samples.

Despite these sample size calculation methods, the research sample considered adequate for structural equation modeling (SEM) should be above 100 (Bagozzi & Youjae 2012; Hair et al. 2016). Therefore, the researcher sent the link to online questionnaires to all the targeted population in these hospitals to ensure gathering the required number of respondents.

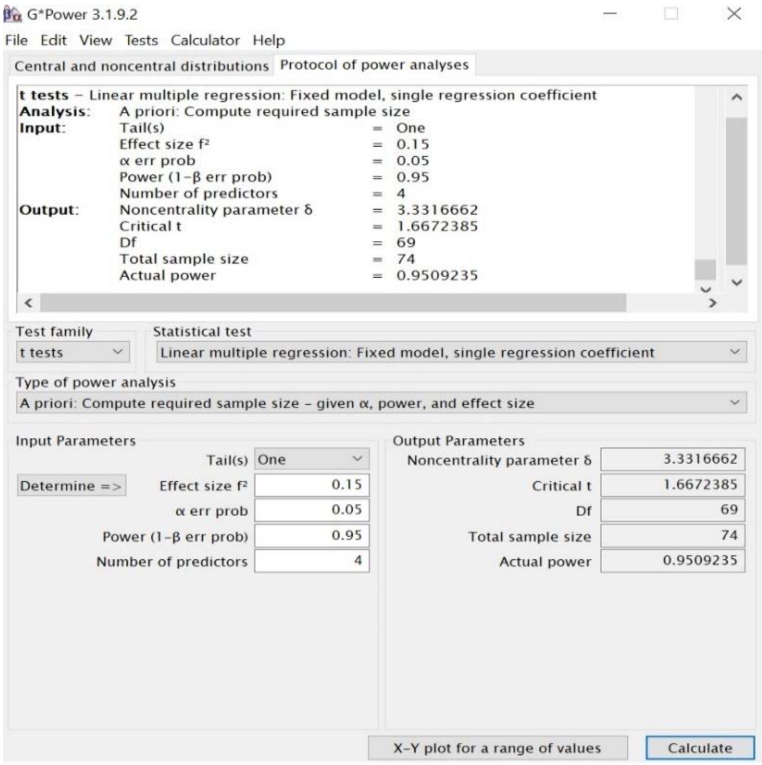

Figure 3.5 G*Power sample size calculation for physicians

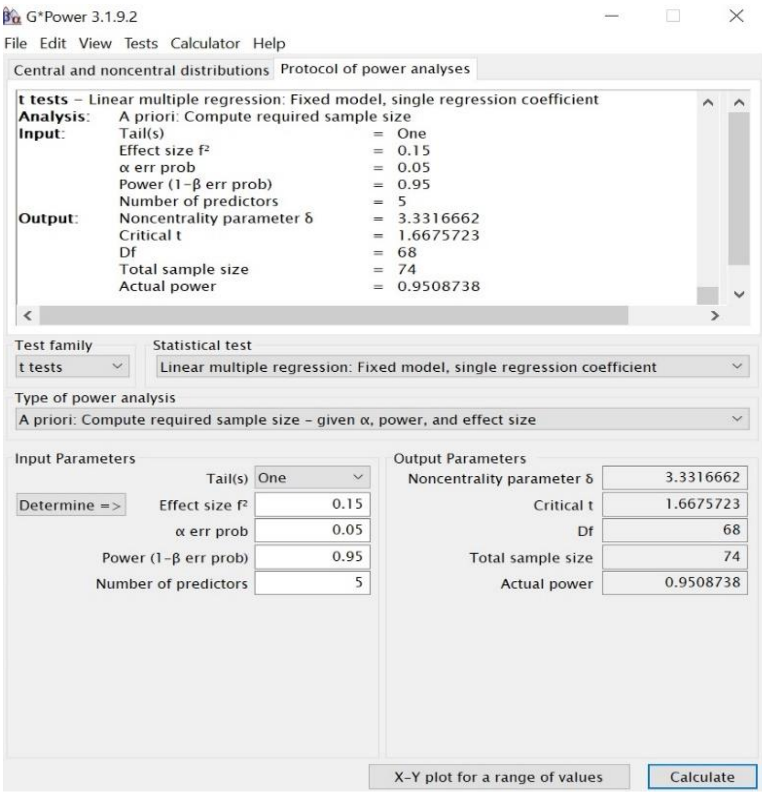

Figure 3.4 G*Power sample size calculation for technicians

3.5.2 Sampling Technique

There are two main types of sampling design: probability and non-probability. For probability sampling, all the population elements have the same chance of being selected as a sample subject. With non-probability sampling, there is no predetermined or known chance of being chosen as a subject. Where the sample should represent the population or generalize it, probability sampling designs are usually used. Non-probability sampling designs are used if time or other factors become important rather than generalizability. Both designs have various sampling strategies. Figure 3.6 shows the main sampling techniques according to Sekaran and Bougie (2016).

Generally, there are two main probability sampling plans: simple random sampling (unrestricted) and complex probability sampling (restricted). For the unrestricted plan, each population element has a chance of being chosen as a sample subject. On the other hand, the complex plan includes five designs. Cluster sampling is considered the least expensive sampling technique, but it is usually used when no population elements list is available. Another restricted sampling design is stratified sampling, which is usually used when we have more than one element in the same sample—for example, classifying the population of organizational members based on their job level. Systematic sampling selects every n^{th} element of the population in a systematic way. In cluster sampling, groups or perhaps chunks of elements that would have heterogeneity amongst the members within each group are generally selected for study. Area sampling is used when the target population is in different geographical areas. Finally, the double sampling technique is used when we need to investigate the same sample again.

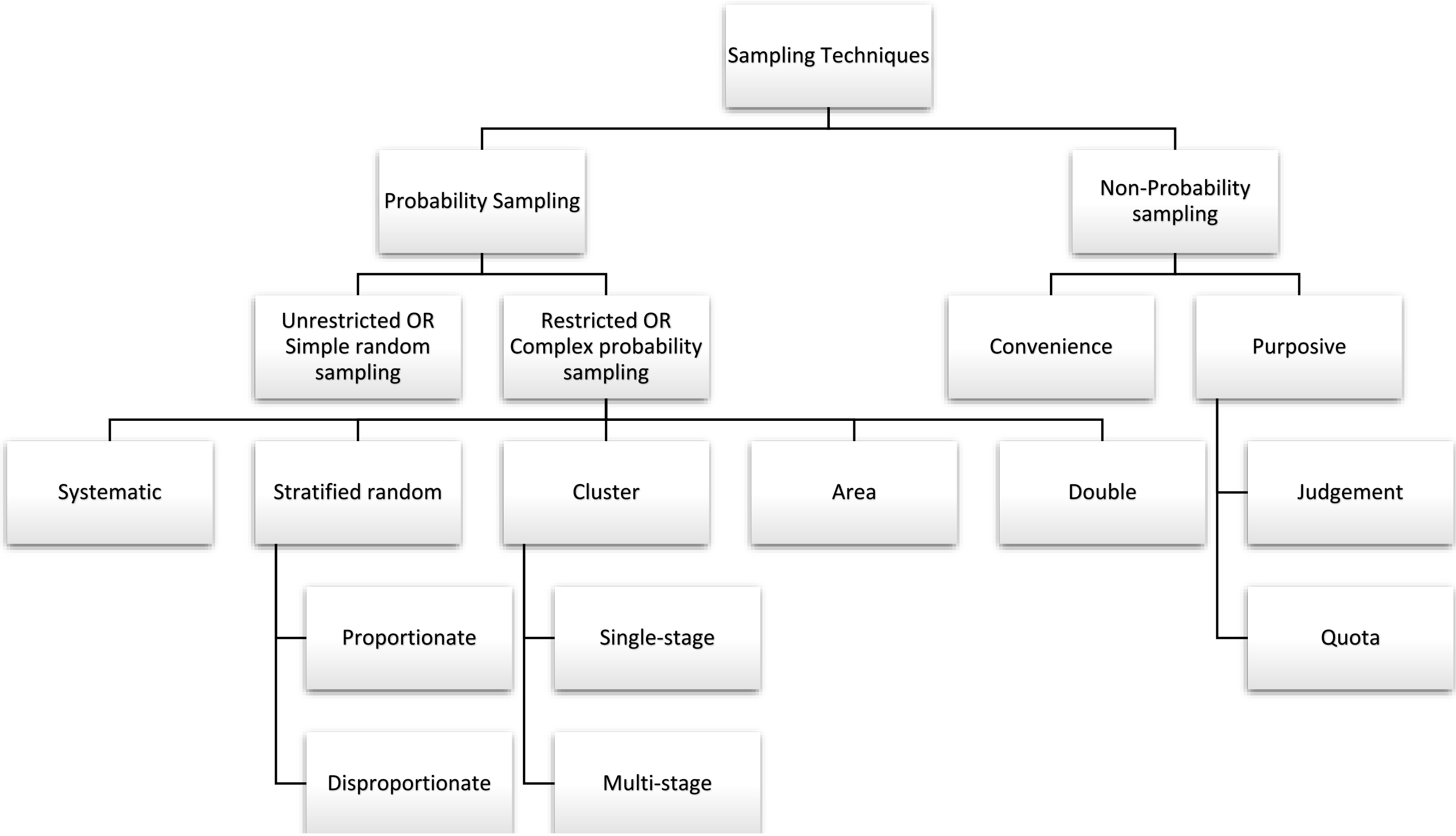

Figure 3.6 Sampling techniques

On the other hand, there are two main types of non-probability sampling design: convenience and purposive sampling. Convenience is the least reliable sampling design with regard to generalizability; however, it is sometimes used as an alternative when the researcher is looking for quick, less time-consuming data collection. The purposive sampling technique consists of two types: judgment purposive sampling, which can be used when there is a minimal population that can provide the needed information, and quota purposive sampling, usually used when the researcher considers the factors of time and cost, and to adequately highlight minority elements in the population. Despite the fact that the generalizability of all non-probability sampling techniques is very restricted, it has various advantages and is in some cases the only possible choice for the researcher.

As a result, the sampling method used in this study was simple random sampling, in which the researcher randomly selected the respondents from the target population. This was due to the flexibility and generalizability offered by this method. In an unrestricted probability sampling design, all the population elements have an equal and known possibility of being chosen as a sample subject. This sampling technique has the least bias and offers the most generalizability. On the other hand, this sampling method can become cumbersome and expensive (Sekaran & Bougie 2016).

3.5.3 Research Instrument

The quantitative instrument was designed based on the identified samples. Two questionnaires were adapted from previous studies to reflect the study's proposed models variables. The first considers exploring technicians' perceptions of the organizational structure variables and their potential effects on technicians' confirmation and behavioral control to utilize cloud services. For the second sample, the questionnaire was designed to explore their perceptions of the system integrity factors in relation to their confirmation and behavioral control to utilize the cloud HIS. The main reason behind this separation is to collect data accurately from relevant users. The proposed organizational structure variables can take into account the technicians' background, while considering physicians' perceptions may not accurately obtain the specifically technological aspects in this dimension. The system integrity variables are well defined by the physicians, as they are the main actual users of the systems.

This assumption is supported by many researchers. For example, Predmore (2005) emphasizes the role of healthcare technicians in forming a successful healthcare system along with the physicians, stating that the technicians are the backbone of the healthcare industry and their perceptions should be investigated in research. Abd Ghani and Jaber (2015), in their study of telemedicine systems, highlighted the need to investigate physicians' perceptions in technology adoption studies because they are the main users of such systems. Horan et al. (2004), in their work regarding clinical medical assessments systems, assert that physicians' perceptions should be investigated in studies concerning system factors such as compatibility and complexity of the investigated healthcare system. Ratnam et al. (2014), Harfoushi et al. (2016), and Alharbi et al. (2016) investigate healthcare technicians' perception of the adoption of cloud computing services in the healthcare sector through organizational technology factors. Meanwhile, Hsieh et al. (2015) and Amin et al. (2017) investigate physicians' perception of cloud system adoption in the healthcare industry.

As a result, the researcher designed two questionnaires, the first to collect technicians' feedback regarding organizational structure factors and to assess its effects on technicians' confirmation and behavioral control to utilize the cloud HIS, the second designed to collect physicians' feedback on system factors and to assess the effects on physicians' confirmation and behavioral control to utilize the cloud HIS.

As shown in Appendix B and Appendix C, before starting both questionnaires, respondents were given a brief description of the research study aims and focus so that they could adequately answer the questionnaire items. This was followed by some demographic questions to gain more insight into the respondents' background. The researcher asked respondents to provide information about their gender, age group, education level, and experience in using a cloud HIS.

The instrument is closed-ended questionnaire where respondents need to provide a specific answer for each item. The two questionnaires were adapted from previous studies with minor modifications to reflect the study context. The cover letter, demographic background section, individual-related factors section, and cloud HIS utilization section were the same for both the physician and technician questionnaire. For physicians, the researcher asked about factors related to the system integrity , while technicians were asked about organizational structure factors along with the above-mentioned sections.

For cost-effectiveness, items were adapted from Tehrani and Shirazi (2014), who developed their questionnaire based on Chau and Hui (2001). Individuals' opinions on the cost of cloud computing are measured from different perspectives. The researcher asked respondents about the feasibility of cloud computing services to reduce their capital expenditure, the initial investment, cost of licensing, deployment time, cost of upgrading the system, cost of maintenance, etc.

For hardware modularity, items were adapted from Tallon (2008), whose questionnaire was designed to address the main aspects related to systems interoperability and integration, and seamless access via the common user interface.

For software modularity, items were also adapted from Tallon (2008), the emphasis being mostly on rapid software development, reusable code, software portability across systems, and the ability to handle different data formats.

Items for measuring internet network aspects were adapted from Tallon (2008), with an emphasis on the ability to expand or contract network reach, remote access to shared data, and redirecting requests to internal and external parties.

Items measuring complexity and compatibility were adapted from a very well-known instrument developed by Moore and Benbasat (1991). Some of these items, specifically technological characteristics, were modified for the context of cloud computing. Moreover, items measuring training availability were adapted from Igbaria et al. (1995) and Lin and Lee (2005). They consist of organized learning activities capable of improving individual performance through changes in knowledge, skills, or attitudes. The training process includes such activities as identifying employee training needs, designing annual training plans, devising training objectives, choosing delivery methods, implementing training programs, evaluating training results, and documenting training records.

The measurement items for information privacy concerns were adopted directly from Dinev and Hart (2006), whose conceptualization of the construct closely matches ours. Three further items were adapted from Tehrani and Shirazi (2014). Items measuring cloud computing services security were adapted from Tehrani and Shirazi (2014).

For individual related variables, the researcher considers the items of Taylor and Todd (1995) for measuring respondents' control over cloud computing services in HIS. Meanwhile, items for respondents' confirmation of the services were adapted from Bhattacherjee (2001).

Finally, respondents' views about cloud computing service utilization in HIS were adapted from Davis (1989). Table 3.4 shows the adapted items. A five-point Likert scale (strongly disagree, disagree, not sure, agree, strongly agree) was used in this study to determine the level of agreement among the respondents. The five-point Likert scale is one of the most widely used scales for providing a clear view about a certain proposition. It also eliminates the potential confusion a user may face when using a seven- or nine-point scale (Likert 1932). Furthermore, a five-point Likert scale is used to increase response rate and response quality, along with reducing respondents' frustration level (Babakus & Mangold 1992).

Table 3.4 Questionnaire item adaption

Construct	Number of adapted items	Source
Cost-effectiveness	7	(Tehrani & Shirazi 2014)
Hardware modularity	4	(Tallon 2008)
Software modularity	4	(Tallon 2008)

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Internet network	4	(Tallon 2008)
Training availability	6	Two items from (H. F. Lin & Lee 2005); four items from (Igbaria et al. 1995)
Compatibility	7	
Complexity	4	Adapted from (Oliveira et al. 2014), who constructed them from (Ifinedo 2011; Moore & Benbasat 1991; Thiesse et al. 2011)
Privacy	7	Four adapted from (Dinev & Hart 2006); three adapted from (Tehrani & Shirazi 2014)
Security	4	(Tehrani & Shirazi 2014)
Behavioral control	5	(Taylor & Todd 1995)
Confirmation	3	(Bhattacherjee 2001)
Cloud health information system utilization	3	(Davis 1989)

3.5.4 Validity of the Instrument

Singh et al. (2006) define validity as "an evaluation of the adequacy and appropriateness of the uses of assessment results". Validity is proof that the measure is defined properly and measures what it is intended to measure (Castel et al. 2008). Ensuring a well-validated data collection instrument is an essential step in any research (Sekaran & Bougie 2016). To ensure good instrument content validity, all the items chosen for each construct in both questionnaires were validated by a panel of experts. Since all the measurement items in this research had been adapted from previous studies, the validity of the constructs had been tested previously. However, because of possible differences in the scope and environment of the study, a face validity assessment was carried out by experts to check and verify the ability of the instrument to measure exactly what it was supposed to measure. Field studies usually perform face and content validity for the instrument used. The reliability and accuracy of the instrument can be verified by the experts in the field to permit results to be generalized. Face validity can be either a formal or informal face validity evaluation, which is very important before proceeding to use an instrument in the actual study (Tojib & Sugianto 2006).

Therefore, the validity of the instrument was assessed by taking steps before the final distribution of the questionnaires, mainly to help evaluate and provide experts' comments on the items for each construct to make sure that all questions/items were correct and free from errors. The researcher validated both the physician and the technician questionnaires through a panel of five experts. Their expertise covered this research aspect, being in the fields of information systems, cloud computing, social sciences, e-health, health information systems adoption, and one physician from an Iraqi hospital alongside her academic work as a lecturer in the Faculty of Medicine at the University of Mustansariah, Baghdad, Iraq. The first four experts met with the researcher in face-to-face sessions, while the fifth validation (with the physician) was conducted by email. Table 3.5 presented the experts' profiles.

Table 3.5 Questionnaire validation experts' profiles

#	Academic position	Years of experience	Institution/Position	Field of experience	Time/Date of meeting
1	Professor	28	UNITEN - CSIT	Cloud computing adoption, information systems	10 March 2017 3:30 pm
2	Associate Professor Doctor	34	UKM - FTSM	Information science, service science, supply chain management	13 March 2017 10:00 am
3	Associate Professor Doctor	20	UNITEN - CSIT	Cloud computing, parallel and distributed systems, grid computing	6 March 2017 11:00 am
4	Doctor	16	UNITEN - COGS	Information systems adoption, adoption for HISs	6 March 2017 9:00 am

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5	Doctor Physician	14	Faculty of Medicine, University of Mustansariah	M.B.Ch.B., F.I.B.M.S., Hematopathology	18 March 2017 e-mail: maysemalwash@yahoo.com

After receiving the responses from the experts, very minor changes were made to the questionnaires. This is mainly because most items used in this study were originally adapted from well-known studies in the field. The comments included aspects related to the format in terms of the layout and presentation of the Likert scale. Another comment was about providing a brief summary of the work at the beginning, followed by the research questions. Some amendments were made to the questionnaire to exclude incorrect grammar and vocabulary, duplicate meanings, typographical errors, long sentences, and words that participants could have difficulty comprehending. Finally, the two questionnaires were ready to collect data from the sample. As the official language in Iraq is the Arabic language, the researcher translated both questionnaires before proceeding to collect data.

3.5.5 Translation of the Research Instrument

Both questionnaires were developed in English (Appendix B and Appendix C) and then translated into Arabic (Appendix D and Appendix E) since this study is carried out in Iraq (where the official language is Arabic). This was done to provide maximum understanding among the participants. The need for accurate translation had to be met to ensure clarity and understanding. In accordance with Adler (1983), two main translation procedures were implemented: firstly, back translation, where the initial questionnaire was translated into Arabic language and back-translated to English language; and secondly, expert translation, where the questionnaire was translated by an expert proficient in both Arabic and English as well as the subject matter. Therefore, the Arabic versions of the questionnaires were prepared by a translation expert in a legal office for translation that is recognized by the scientific academy for translation languages and legal certified translation in Iraq to make sure it preserved the meaning of the original English version (see translation proof letter in Appendix J).

3.5.6 Pilot Study

This section describes the pilot study for the present research. A number of researchers recommend conducting pilot studies (Goodman et al. 1998; Smith & Studd 1992). According to Cohen et al. (2013), all data gathering should be piloted to check that all questions and instructions are clear. This process enables the researcher to remove any items that do not yield usable data. Hence, the purpose of the pilot study is to validate the selected format for the study before proceeding to implement the main tool.

The pilot study was carried out with a small sample of respondents who were randomly chosen from the four selected hospitals. Thus, the validated online questionnaires' links were distributed among physicians and technicians in four public hospitals located in Baghdad, Iraq. A total of 35 physicians' and 32 technicians' responses were received. This was considered appropriate for a pilot study, as suggested by Johanson and Brooks (2010), who state that 30 participants is actually an acceptable minimum recommendation for a pilot study to represent the main population of interest where the purpose is a preliminary survey. Table 3.6 shows the demographic characteristics of the physicians and technicians who responded to the questionnaires distributed in the pilot study phase. It is important to mention that the sample used for the pilot study was not included in the main study. Therefore, the data obtained were entered into the SPSS to execute the internal consistency reliability for each construct.

Table 3.6 Demographic information for pilot study participants

Variable	Physicians	Technicians
Gender		
Male	21	27
Female	14	5
Age in years		
25–30	10	19
31–35	9	11
36–40	9	1
> 40	7	1
Level of education		
Bachelor's degree	10	21

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High diploma	11	6
Master’s degree	9	5
PhD	5	0
Internet usage in hours		
Less than 1 hour	3	0
1–3	23	18
4–6	9	9
> 6	0	5
More than one year’s experience using HIS		
Yes	24	21
No	11	11

3.5.7 Reliability of the Instrument

Reliability relates to the extent that some items in the provided scales are internally consistent (Hair et al. 2006; Singh et al. 2006). The reliability of scales to be utilized in the questionnaire may be verified by determining the coefficient of the Cronbach’s alpha of a set of items, as suggested by Pallant (2013) and Sekaran and Bougie (2016), who also declared that a high Cronbach’s alpha coefficient (usually above 0.7) indicates a reliable measurement. This is also supported by Santos (1999), who reports that a Cronbach’s alpha coefficient should be more than 0.70 in order to be deemed acceptable, and by Wyrwich et al. (1999), who reported that a coefficient of 0.80 reflects internal consistency.

Reliability testing was accomplished for all items in both questionnaires, except the demographic parts. The reliability test was constructed separately for each measurement. The results (see Table 3.7) revealed that items explaining each construct are within the acceptable range of (0.696–0.848) for technicians’ constructs and a range of (0.709–0839) for physicians’ constructs.

Table 3.7 Questionnaire reliability results

Sample	Construct	Number of adapted items	Cronbach's alpha
Technicians	Cost-effectiveness	7	0.704
	Hardware modularity	4	0.712
	Software modularity	4	0.700
	Internet network	4	0.715
	Training availability	6	0.848
	Confirmation	3	0.727
	Behavioral control	5	0.696
	Utilization of cloud HIS	3	0.808
Physicians	Compatibility	7	0.718
	Complexity	4	0.779
	Privacy	7	0.777
	Security	4	0.709
	Confirmation	3	0.709
	Behavioral control	5	0.744
	Utilization of cloud HIS	3	0.839

3.6 QUANTITATIVE DATA COLLECTION

In December 2015, the researcher obtained approval to conduct the study in the selected hospitals from the Department of Scientific Research in the Iraqi Ministry of Health. The researcher contacted the Director of Healthcare Affairs of each of the four selected hospitals after obtaining their contact details from the Ministry of Health. After several attempts, all four hospitals agreed to participate in the study. Based on the requirements, nature, and design of this study, the data collection was done in three different phases/timeframes: qualitative preliminary interview data collection (discussed in section 3.3.2), quantitative data collection (discussed below in this section), and qualitative final validation interview data collection (discussed in section 3.8).

In the present study, the quantitative data were collected using an online survey (web-based questionnaires). The online web-based survey is considered a reliable method to collect data, since nowadays internet access is available to almost everyone, and the popularity of the internet increases daily. There are many advantages to online surveys, such as the ability to reach the required sample through virtual online communities and social media, the time saved by the researcher in conducting the surveys, and the reduced financial cost by moving to an electronic medium from a paper format (Bachmann et al. 1996; Couper 2000; Wright 2005; Yun & Trumbo 2000). Furthermore, the online survey provides multiple features such as tracking of survey respondents' email, email response notification, real-time tracking of item responses, description of responses, and the ability to export survey responses to statistical software packages. Other basic features include the ability to share data with other researchers, enabling research teams with members in different locations to share survey results (Ilieva et al. 2002; Wright 2005). Thus, online surveys are gaining more intention from researchers for their advantages: the proportion of survey data collected in the United States using online data collection methods exceeds 60 percent and is above 50 percent in many developed countries (Hair et al. 2016).

The two web-based questionnaires were designed using Google Forms, the online links then distributed to the relevant participants. Before the distribution process, an approval letter was obtained from the relevant bodies of the selected hospitals. The researcher obtained a full list of physicians' and technicians' contact details from the hospital coordinator in each hospital. The distribution process was through multiple routes: some respondents were contacted through email, some through social media. Furthermore, some respondents in the selected hospitals helped the researcher by sharing the online survey link with colleagues in their departments. A notification message was sent to the whole sample to explain the purpose of the study and to request participation with a link to the online survey. After one week, a reminder email/message was sent to the sample to encourage non-respondents to participate. Finally, 259 physicians and 109 technicians responded to the questionnaires. The collected data were then analyzed to answer the research questions.

3.7 QUANTITATIVE DATA ANALYSIS

Based on the recommendations of Creswell (2009), data collection and analysis are discussed in separated sections. The data collection method for the three parts of this mixed-methods research are discussed comprehensively in this chapter, while the data analysis results and discussion are presented in Chapter V.

The proposed models contain 12 latent variables in total, which need to be analyzed using an appropriate method. Multivariate analysis includes the application of statistical methods which simultaneously analyze multiple variables. Typically, the variables represent measurements in respect of individuals, companies, activities, events, situations, etc. The measurements are often gathered from surveys or even observations that are generally used to gather primary data. There are four main types of data that can be collected in a Likert scale survey: these are nominal, ordinal, interval, and ratio data. Jamieson (2004) highlights the need to analyze nominal and ordinal data using non-parametric tests, while interval and ratio data have to be analyzed using parametric tests. In the present study, the collected data were all ordinal data.

Many researchers have discussed using parametric tests for ordinal data collected using a Likert scale questionnaire. Kuzon et al. (1996), in their article 'The seven deadly sins of statistical analysis', assert that the use of parametric analysis for ordinal data is the first sin that researchers should avoid. The legality of assuming an interval scale for Likert-type categories is not appropriate; thus using parametric tests is not applicable, so scholars recommend the use of non-parametric tests for ordinal data, such as mode, median, frequencies, chi-square, Spearman's correlation, ordinal logistic regression, Mann-Whitney U-test, and Kruskal-Wallis (Boone & Boone 2012; Cohen et al. 2013; Sullivan & Artino 2013). Therefore, the researcher applied non-parametric tests to analyze the ordinal data obtained from the distributed questionnaires.

The statistical methods usually used by social scientists are called first generation strategies (Fornell 1982; Fornell & Larcker 1987). These involve regression approaches which include multiple and logistic regressions, as well as analysis of variance, and techniques such as confirmatory and exploratory factor analysis, cluster analysis, and multidimensional scaling. Nevertheless, over the past twenty years, several researchers have increasingly been switching to second generation techniques to overcome the weaknesses of first generation techniques. These methods, known as SEM, allow researchers to integrate unobservable variables measured indirectly through indicator variables. They also facilitate accounting to get measurement errors within observed variables (Chin 1998). SEM has been considered an effective multivariate method to analyze constructs' results, specifically latent constructs, which have multiple dimensions, enabling the evaluation of both measurement properties and the theoretical (structural) relationship (Haenlein & Kaplan 2004; Hoyle 1995; Kline 2015; Maruyama 1997; StatSoft 2013). The SEM approach has therefore been adopted to model the relationships among the variables.

The researcher in the present study started by preparing and cleaning the collected data; then descriptive statistics of the sample were reported to provide sufficient knowledge of sample characteristics before proceeding to apply the SEM data analysis. The following subsections 3.7.1–3.7.3 show the method of each step. More details on each activity are provided in Chapter V.

3.7.1 Data Cleaning and Screening

Before proceeding to analyze the collected data, some SPSS statistical software (version 24) tests were conducted. Hair et al. (2016) acknowledge that the data collected from a questionnaire should be checked before proceeding to analyze it as a way of addressing potential issues and trying to fix them. Data cleaning, in general, puts the emphasis on finding potential problems in the data before any analysis takes place. It involves using various error prevention strategies to find and fix potential issues in a dataset (Pallant 2013). Typically, errors can be found in data when the views provided by the respondents are not complete across constructs. Here, the process of screening and cleaning the collected data was conducted before the data analysis phase using some SPSS statistical software tests. Depending on the recommendations of Hair et al. (2016) and Broeck and Fadnes (2013), the researcher addressed four main aspects in depth in this phase: 1) checking for missing data (using the multiple imputation feature to analyze the patterns and impute the missing data values); 2) checking for suspicious response patterns (identifying unusual cases); 3) checking for outliers (using boxplots); and 4) checking for normality (using skewness and kurtosis tests).

3.7.2 Sample Descriptive Statistics

The final phase before proceeding to the SEM data analysis is descriptive statistics. This is a statistical means of demonstrating the likelihood of agreement and disagreement in a construct (Argyrous 2000). It usually comes in a closed-ended format, where respondents' response to a certain aspect is narrowed in a manner that is easy to comprehend (Coakes & Steed 2009). Descriptive statistics involve describing the demographic and construct variables based on the data received. The description of the demographic information is carried out by calculating frequencies, while descriptive statistics for the constructs are usually calculated by measuring the central tendency. Unlike using the mean to calculate the central tendency, the use of mode and median is much preferred by researchers for ordinal data. Jamieson (2004) states that "The mean (and standard deviation) are inappropriate for ordinal data", since the intervals between the ranks in a Likert scale cannot be considered equal. This assumption is supported by Sekaran and Bougie (2016), who highlight the need to use modes and medians to measure the central tendency instead of using the mean value. The researcher therefore used descriptive statistics to demonstrate the demographic characteristics of the present study sample. SPSS statistical software (version 24) was used to calculate the mode and median for the descriptive statistics of constructs to measure the central tendency, being the preferred non-parametric test for ordinal data (Blaikie 2003).

3.7.3 Partial Least Squares Structural Equation Modeling (PLS-SEM)

SEM goes beyond the ordinary regression models to be able to integrate multiple independent variables and dependent variables, as well as hypothetical latent variables that consist of observed variables (Savalei & Bentler, 2009). Latent constructs are unobservable and may only be measured simply by multiple dimensions which represent, or perhaps are reflected by them. There are two kinds of SEM: covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM, also called PLS path modeling). CB-SEM is mainly used to confirm or reject theories; it can be defined as a set of relationships among multiple variables that are usually tested empirically. This is done by identifying how effectively a proposed theoretical model can estimate the covariance matrix of a sample dataset. In contrast, PLS-SEM is mainly used in exploratory research to develop theories. This is done by focusing on describing the variance in the dependent variables when examining the model. PLS-SEM applies OLS regression with the aim of reducing the error term of the endogenous constructs. In brief, PLS-SEM estimates coefficients (path model relationships) which maximize the coefficient of determination values (R^2) of the targeted endogenous constructs. This particular feature defines the prediction purpose of PLS-SEM. Therefore, PLS-SEM is the desired method when the objective of the research is the development of theory and variance explanation (prediction of the constructs). PLS-SEM is considered to be an SEM variance-based approach.

In cases where there is scant knowledge about the structural model relationships or perhaps about the constructs' measurement characteristics, or even when the focus is considerably more on exploration than confirmation, PLS-SEM is better than CB-SEM (Henseler et al., 2016). Hair et al. (2011) and Henseler et al. (2009) highlight the main reasons for choosing SEM as the most suitable approach to the study in a few main points, as shown in Table 3.8 below.

Table 3.8 PLS-SEM vs. CB-SEM (Sources: Hair et al., 2011; Henseler et al., 2009)

	Criteria	PLS-SEM	CB-SEM
Research objective	1. Predicting key target construct	**X**	
	2. Theory testing, theory confirmation, or comparison of alternative theories		**X**
	3. Exploratory research or extension of existing theory	**X**	
Measurement model	1. Formative constructs		**X**
	2. Formative and reflective constructs in one model	**X**	
Structural model	1. Complex structural model	**X**	
	2. Non-recursive structural model		**X**
Data characteristics and algorithm	1. Data meet distribution assumptions		**X**
	2. Data do not meet distribution assumptions	**X**	
	3. Small sample size	**X**	
	4. Large sample size	**X**	**X**
	5. Normal distribution	**X**	**X**
	6. Non-normal distribution	**X**	
Model evaluation	1. Use latent variable scores in subsequent analysis	**X**	
	2. Need to test for measurement model invariance		**X**

In the present study, a PLS-SEM multivariate analysis approach was applied to the cleaned data. The PLS path modeling approach was selected because it is considered more suitable for predictive and exploratory research, while CB-SEM is more suitable for theory testing (Fornell & Bookstein 1982). Since this study was generally formulated to predict the relationships among the proposed variables and to examine the effects between them, PLS-SEM was considered the most appropriate approach. Furthermore, PLS-SEM does not require major restricted data assumptions, such as sufficient sample size or multivariate normality distribution; therefore, PLS is referred to as a soft-modeling technique. Additionally, Goodhue et al. (2006) assert that PLS is not really inferior to CB-SEM, especially when a problem of small sample size and the non-normal distribution of data is expected in a study.

The present study obtained 259 and 109 responses from the physicians and technicians, respectively, thus leading the researcher to prefer PLS path modeling, further to the sample size calculation presented earlier in this chapter. The main objective of PLS-SEM is to maximize the explained variance of the endogenous latent variables in the PLS path model. That is why the measurement and structural model assessments focus on metrics to indicate the predictive capabilities of the model. The evaluation of PLS-SEM involves two steps: assessing the quality of the measurement model followed by structural path model evaluation.

As for the tool used to apply PLS-SEM, the researcher involved the use of Smart-PLS statistical software package version 3.0 (Ringle et al. 2015). Among a range of available statistical software, Smart-PLS is considered the most reliable with a friendly graphical user interface environment that includes all the required tests for the path model (Hair et al. 2016; Hair et al. 2017; Monecke & Leisch 2012). Furthermore, its official website offers an active online discussion forum (forum.smartpls.com 2018) which makes it easier for researchers to share their knowledge and to resolve their issues faster. It also involves using factor analysis to verify the structure of the dimensions in the questionnaires to be able to determine whether or not the factor analysis results support the intended dimensions, and to calculate the regressions among the variables. Figure 3.7 illustrates the tests used.

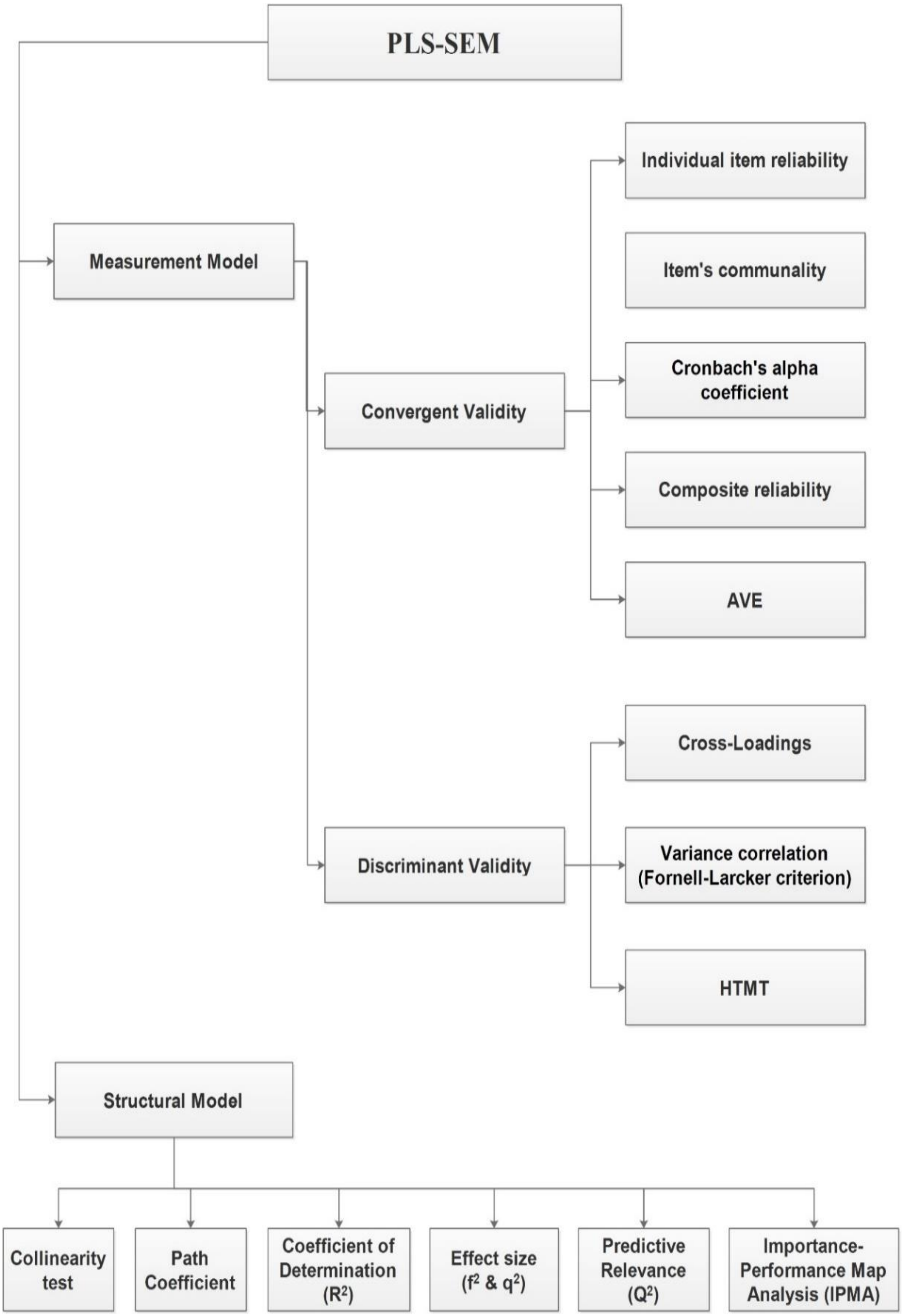

Figure 3.7 PLS-SEM tests

a. Measurement model assessment

The measurement model is a part of the path model that consists of the constructs and their relationships with their indicators; it also known as the outer model in the PLS-SEM. Researchers should select the assessment method for the measurement model depending on the type of constructs used to formulate the model, either reflective or formative measures. In the present study, all the measures used are reflective measures, so the measurement model should be assessed as a reflective measurement model. The goal of assessing the model is to make sure that the construct measures are reliable and valid, therefore supporting their inclusion in the structural path model. Assessment of the reflective measurement model consists of two major steps: convergent and discriminant validity. In the subsequent sections, the researcher addresses each criterion to evaluate the reflective measurement model.

i. Convergent validity

Convergent validity can be defined as the degree to which multiple items measuring the same concepts are in agreement. The assessment of convergent validity involves evaluating the internal consistency reliability, individual indicator reliability (item loading), item communality, composite reliability, and average variance extracted (AVE).

The first evaluation is the internal consistency reliability. The most commonly used test for internal consistency is Cronbach’s alpha, which can provide an estimation of the reliability according to the inter-correlations of the observed indicator variables. It assumes an equal reliability for all indicators (assuming that the outer loadings on the construct are equal for all indicators). However, PLS-SEM prioritizes all indicators based on their individual reliability. Furthermore, Cronbach’s alpha is very sensitive to the item number in the scale and tends to underestimate the reliability of internal consistency. Therefore, it might be employed as a more traditional measure of internal consistency reliability (Sarstedt et al. 2017).

Because of the limitations of Cronbach's alpha, there is a need to apply a different measure for internal consistency reliability, which is known as composite reliability (CR). This reliability measure takes into consideration the different indicator variables' outer loadings. According to Hair et al. (2016), Cronbach's alpha is a traditional reliability measure that usually results in pretty low reliability values. On the flip side, CR seems to overestimate the reliability of internal consistency, and thus results in relatively high reliability estimates. As a result, it is good to report both criteria, the correct reliability value usually being between the Cronbach's alpha (the lower bound) and the CR (the upper bound).

The reflective measurement model assessment also involves indicators' outer loadings and the constructs' AVE. Higher outer loadings on a construct show that the related indicators have much in common, captured by its construct. The outer loading size is also commonly known as indicator reliability. Indicators' outer loadings ought to be statistically significant. A popular measure to determine convergent validity within the construct level is the AVE, which can be defined as the mean value of the indicators' squared loadings connected with the construct (the summation of the squared loadings divided by the indicators' number). Similarly, some researchers have reported the communality of the items, which is the square value of the indicator outer loading, like the AVE, but the communality value is for one indicator (Hair et al. 2016). Therefore, the researcher reports the convergent validity results of the indicators' reliability and communality, as well as the constructs' Cronbach's alpha, CR, and AVE in Chapter V.

ii. Discriminant validity

Discriminant validity is the degree to which a construct is absolutely distinct from other constructs by means of empirical standards. Therefore, establishment of discriminant validity means that the construct is unique and captures phenomena not shown by other constructs within the model. According to Hair et al. (2016), the Fornell-Larcker criterion, cross-loadings, and especially the HTMT ratio of correlations can be used to examine discriminant validity.

In the cross-loadings discriminant test, an indicator’s outer loading with its construct should be higher than any other correlations (cross-loadings) with other constructs to indicate discriminant validity. Logically, the indicator needs to be correlated with its construct rather than with any other construct in the model to meet discriminant validity. The second method to assess discriminant validity is the Fornell-Larcker criterion, which compares the square root of AVE values with the latent variable correlations. The logic of this method is that the construct shares much more variance with its connected indicators rather than with any other construct.

Recent research that has seriously examined the performance and efficiency of cross-loadings and the Fornell-Larcker criterion to assess discriminant validity has found that neither approach reliably detects discriminant validity issues (Henseler et al. 2015). In particular, when two constructs are perfectly correlated, the cross-loadings test fails to point out the lack of discriminant validity, which makes this criterion inefficient for empirical research. In the same manner, the Fornell-Larcker criterion test becomes inefficient when the same construct item loadings differ only slightly. The Fornell-Larcker criterion is therefore considered efficient in detecting discriminant validity issues when the items loadings vary more strongly (Voorhees et al. 2016).

As a solution, Henseler et al. (2015) suggested assessment of the HTMT ratio of correlations. HTMT is defined as the ratio of between-trait correlations to within-trait correlations. It is the mean of all correlations of items across constructs measuring different constructs (HTMT correlations) relative to the geometric mean of the average correlations of items measuring the same construct (the monotrait-heteromethod correlations). Theoretically, this approach is an estimation of what the real correlation between two constructs could be if they were properly measured (if they were perfectly reliable). That true correlation is also known as disattenuated correlation.

b. Structural model assessment

After confirming the reliability and validity of the constructs and indicators, assessment of the structural model is needed. The structural model represents the conceptual or theoretical component of the path model. It also known as the inner model in PLS-SEM, consisting of the latent variables and their path relationships. The latent variable (also called a construct) is the unobserved theoretical or conceptual component in the structural model. The latent variable that explains other latent variables (outgoing paths in the path model) is known as exogenous, while the latent variable that has at least one incoming path in the path model is known as endogenous.

To assess the structural model, several steps should be followed. Prior to testing the path model, a collinearity test should be carried out on the data (Hair et al. 2016). As the structural model assessment involves checking the path coefficient, and as the path coefficients are determined by the OLS regression of each endogenous latent variable on its related predecessor constructs, a critical level of collinearity could bias the path coefficients. Collinearity can be defined as a data problem that occurs if two independent variables are highly correlated. Multicollinearity occurs when more than two independent variables are highly correlated. Very high multicollinearity arises if exactly the same information has been entered into two or more independent variables (they are perfectly correlated). Therefore, checking for collinearity issues is essential. This step involves inspecting the collinearity for every set of predictors through checking the construct's tolerance (VIF).

After ensuring that there are no collinearity issues with the datasets, the researcher followed a systematic assessment of the structural model based on the recommendations of Hair et al. (2016), which consists of several steps: 1) path coefficients; 2) coefficient of determination (R^2); 3) effect size (f^2); 4) predictive relevance (Q^2); 5) effect size (q^2); and 6) importance-performance map analysis (IPMA). Chapter V presents each test separately with the results of testing the study's models.

3.8 QUALITATIVE FINAL VALIDATION INTERVIEW

A qualitative research method has been chosen to gather information in a social context that focuses on the way people interpret and make sense of their experience (Ritchie et al. 2013). The case study qualitative research approach has been adopted. The main source of evidence for the case study strategy is the interview, as interviews address the problem in depth and in specific detail (Creswell 2013; Yilmaz 2013; Yin 2013). Semi-structured interviews were conducted to make the interviews flexible and to allow the respondents to raise aspects that the researcher may not have thought about prior to the interviews. The researcher used criterion sampling to collect the qualitative data using the interview strategy, as this sampling technique allows the researcher to select the study sample based on a pre-defined criterion (Creswell 2013; Yilmaz 2013). The selected participants met the criterion. To validate the study outcome, the researcher conducted face-to-face semi-structured interviews individually with seven experts. The first expert had experience in analytical statistics as an expert at the University of Malaya, while three others were experts in the field of cloud computing and distributed systems, e-health, and information systems, besides their background as technicians. There were also three physicians from two different hospitals in Iraq, two of them with academic expertise as professors in the Faculty of Medicine (see Table 3.9). The number of interviewees was limited to seven due to information access and contact constraints, in addition to issues with settings appointments, time constraints, and confidentiality.

The researcher constructed four questions as a guide for the interviews (see Appendix F). The researcher focused on open-ended questions because this type of question allows the interviewees to give more information about the situation (Jacob & Furgerson 2012). The main objective of the interviews in this phase was to confirm the propose merged model that consists of the validated physician and technician models; the researcher also sought to confirm the applicability and suitability of the proposed merged model of this study and to confirm that the study met the scientific standards that would allow the researcher to achieve the study objectives. The most important parts of the study were prepared in a document and sent to the interviewees before the interview sessions, along with a validation form to write their answers for the four questions freely before signing/stamping the form. The provided documents included the proposed models, ROs, RQs, RHs, tables showing the literature survey of previous models and related factors showing the importance of addressing the proposed issues and domains, the research methodology used, the quantitative instrument design, validation and pilot study results, data analysis procedure and results, and, finally, the tested models and the proposed merged model.

Overall, the interviews lasted approximately 35–60 minutes each and were all conducted within a two-month period (August–September 2018). Content analysis was applied to analyze the qualitative data obtained from the interviews: this is a qualitative technique that has been widely used to analyze written, oral, or visual communication messages and can be defined as a systematic and replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding (Stemler 2003; Zammani & Razali 2016). Analyzing data using computer-based qualitative analysis software or by hand takes into account the amount of data to be analyzed. According to Creswell (2015), qualitative data of a few pages can be analyzed by hand rather than using computer software. Thus, the researcher analyzed the qualitative data derived from the seven interviewees manually to deduce their perceptions toward the study models' suitability. The results of this phase analysis are discussed in Chapter V, section 5.6.

Table 3.9 Validation interviewees' profiles

#	Academic position	Current institute/faculty	University	Field of experience	Years of experience	Time/Date of meeting
1	Doctor	Deputy Dean of Research Affairs	Al-Hikma University College, Iraq	Cloud computing adoption; information systems; e-health systems	9	19 September 2018
2	Doctor	Deputy Dean for Scientific Affairs	Imam Sadiq University College, Iraq	Information science; service science	7	12 September 2018

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3	Associate Professor Doctor	Department of System & Networking, College of Computer Science and Information Technology	Universiti Tenaga Nasional Head of Energy and Environment at Institute of Energy Policy and Research	Cloud computing; parallel and distributed systems; grid computing	20	10 August 2018
4	Professor Doctor (Physician)	Al-Hussain Medical City & College of Medicine	University of Karbala, Iraq	Professor of internal medicine and physician (CABM, FRCP, MBChB)	41	29 August 2018
5	Doctor (Physician)	Al-Hussain Medical City & Al-Razi Specialized Aesthetic Medical Center, Iraq		Specialist dermatologist physician	37	2 September 2018
6	Professor Doctor (Physician)	Karbala Pediatric Teaching Hospital for Children & College of Medicine	University of Karbala, Iraq	Professor of pediatrics and consultant physician (CABP, IBCLC, FRCP, MBChB)	41	23 September 2018
7	Doctor	Senior Visiting Research Fellow, Academic Enhancement and Leadership Development Center (ADeC)	University of Malaya	Applied statistics, biotechnology, statistical modeling, research methodology	22	14 August 2018

3.9 SUMMARY

This chapter has discussed the research method and the stages involved in this study. A full description of the research approach, justification of selection, and the research design have been discussed. The study adopts a mixed-methods approach, in which qualitative and quantitative approaches are integrated: in other words, this research consists of three research approaches—qualitative preliminary interviews, quantitative empirical study, and qualitative validation interviews. The sampling method and technique, data collection, and data analysis have been discussed for the qualitative and quantitative parts. Table 3.10 shows the data analysis methods used to answer each research question. In the following chapters, the qualitative/quantitative data analysis results and discussion are reported, followed by a full discussion to answer each research question and its related hypotheses.

Table 3.10 Data analysis for each research question

#	Research question	Measurement	Analysis method
1	What are the key determinants of cloud computing services utilization in healthcare information systems?	Semi-structured interviews	Thematical analysis
2	How can the relationships between the identified factors and the cloud HIS utilization be presented?	The proposed research model presents the identified factors, supporting its construction by a set of theories, and hypothesizes the relationships.	
3	What is the relationship between the organizational structure and system factors, individual factors, and cloud HIS utilization in the Iraqi public healthcare sector?	Questionnaire-based five-point Likert scale	Descriptive statistics Measurement model assessment (item reliability, communality, AVE, Cronbach's alpha, composite reliability) Structural model assessment (VIF, path coefficient β, R^2, f^2, Q^2, q^2, IPMA)
4	To what extent is the final model applicable and valid for healthcare professionals' utilization of cloud HIS in the Iraqi healthcare sector?	Semi-structured interviews	Thematic analysis

CHAPTER IV

RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

4.1 INTRODUCTION

In this chapter, the research proposed models are presented as well as the research hypotheses were developed and explained with each proposed variable. This study models aims to enhance the utilization of the cloud health information system within the Iraqi public healthcare sector.

4.2 THE PROPOSED RESEARCH MODELS

Many studies have been conducted in developed countries to increase their healthcare workers' utilization of emerging technologies. However, Venkatesh and Zhang (2010) state that the applications may differ from one specific cultural context to another, and some variables may fluctuate in their importance based on culture. Previous studies support this opinion, showing contrasting results in different cultural contexts, where the culture of Middle Eastern countries, including Iraq, are seen to differ from that of developed countries. Therefore, previous models and theories need to be validated in Iraq to obtain distinct and accurate results. Moreover, some researchers argue that theories and/or previous models do not contain all the variables relevant in each context (Low et al. 2011). Hence, for new complex technology adoption such as cloud computing, more than one theoretical framework is required to achieve a better understanding of the adoption decision (Low et al. 2011).

The researcher therefore conducted preliminary interviews to identify the current antecedents that may facilitate the utilization of cloud HIS in Iraqi environments. The preliminary interview results showed that a number of factors were related to organizational structure in terms of cost-effectiveness, hardware modularity, software modularity, internet network, and training availability. Other factors were related to the system in terms of compatibility, complexity, security, and privacy. These two aspects were found to influence personnel factors in terms of confirmation and behavioral control to utilize cloud HIS. Based on the identified factors and domains, the researcher constructed the research models based on the previous theories, as discussed briefly in the following subsection.

4.2.1 Theoretical Phase

The construction of the study models was supported by three main theories: organization theory, the diffusion of innovation theory, and the theory of reasoned action. The researcher’s review of the literature revealed that these theories can be used to explain the association between the structural, system, and individual factors in utilizing cloud computing services in the Iraqi healthcare sector.

Organization theory consists of four main components that are assumed to influence the environment. These are culture, physical structure, technology, and social structure. Hatch and Cunliffe (2013) state that knowledge distributed throughout the organization has the potential to influence individuals’ ability to work and the consequent outcomes. The outcome of a person is identified by environmental settings such as technology, physical structure, culture, and social structure, as shown in Figure 4.1. Hatch and Cunliffe (2013) highlight the need to study any of the four aspects of organization theory that are contributing to the problem in an organization. Hence, understanding the effect of these aspects within organization theory can explain the current shortage of structure and technology in Iraqi hospitals to utilize cloud computing services. The cultural aspect of organization theory is therefore considered not to be essential in this study, since we assume that the homogenous culture of the healthcare members in different Iraqi cities has no effect on their usage behaviors of cloud HIS.