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A model for cloud-based hospital management systems for South African public health sector.

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**A model for cloud-based hospital management systems for South
African public health sector**

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In the

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At the

TSHWANE UNIVERSITY OF TECHNOLOGY

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DECLARATION

I Thembokuhle Magudulela, hereby declare that this dissertation entitled “***A model for cloud-based Hospital Management System for South African public health sector***” submitted to the Department of Informatics, Tshwane University of Technology for the award of the degree Master of Computing: Informatics, is my own original work and has never been submitted for assessment to any other university or for another qualification. I further declare that all sources used or consulted have been acknowledged by citation and inclusion in the reference list.

16/02/2023

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DEDICATIONS

This dissertation is dedicated to my mother (Masha), who has encouraged me to achieve this qualification; you always reminded me that I still have time and ability to achieve my goals. Your prayers worked wonders girl. More dedication to my late grandmother who loved education, my husband thank you so much Chauke the role you played while focusing on my studies is amazing, I'm grateful. Lastly, to Jesus, thank you for keeping your words without you this was not going to be a success.

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ABBREVIATIONS

CE	Consumer Electronics
CHC	Community Health Centres
CPS	Cloud Service Provider
D-S	Dempster-Shafer
DSR	Design Science Research
EHR	Electronic Health Record
EHRS	Electronic Health Record System
EMR	Electronic Medical Records
GMEI	Generic Medical Equipment Interface
HIS	Health Information System
HIT	Health Information Technology
HMS	Hospital Management System
HPRS	Health Patient Registration System
ICT	Information and Communication Technology
IT	Information Technology
NHI	National Health Insurance
PE	Performance Expectation
PHC	Primary Health Care
PMS	Patient Management System
RFID	Radio Frequency Identification
TOE	Technology Organizational Environmental
UML	Unified Modelling Language
CM	Cloud Machine
WHO	Worlds Health Organization

ABSTRACT

Real-time access of information in the Healthcare environment is essential as it not only helps medical personnel to have adequate and timely information, but it also assists patients to be served more easily. This can only be achieved if hospital management systems and their sub functionalities are easily accessible just-on-time. This necessitates the Hospital Management System (HMS) to be deployed in the cloud environment so as to reduce the limitations of poor and intermittent networks, low bandwidth, as well as insufficient information technology (IT) human resources. When successfully implemented, the cloud-based HMS increases efficiency, scalability, and overall performance of the health system by sharing resources with many devices used by different personnel within the healthcare sector - especially in developing countries such as South Africa that are widely challenged by poor technological infrastructure. Much as this is so, literature indicates that there is still lack of appropriate models customised to the South Africa context to inform the deployment of HMS into the cloud. Hospitals, especially those in rural areas, are operating at a low bandwidth, and have poor IT infrastructure that causes intermittent networks leading to disruptions and slow service delivery. The goal of this study was to develop a model for cloud-based HMS for the South African public health sector. Data for this study was collected using a close-ended questionnaire from district municipality hospitals in Gauteng Province, South Africa, and analysed quantitatively. Results indicated that social aspects, followed by risk analysis and control as well as organizational aspects are highly significant antecedents in developing a cloud-based HMS model. However, the results also indicated that environment aspects' contribution too is valid, but not significant. This study contributes to the ongoing call to have seamless healthcare provision systems, especially after the challenges of Covid-19 that saw many countries struggling to provide healthcare services due to lockdowns. The model developed in this study is expected to extend the research of modernizing healthcare provision by leveraging technological innovations. This study recommends that future research should involve the analysis of interacting effects of individual users' demographics in order to have a better forecast for future consistent usage of cloud-based services.

CHAPTER ONE: INTRODUCTION

This chapter introduces the concept of cloud-based health systems, including the Hospital Health Management Systems, and how they have been applied in the South African public health sector. The chapter highlights the problem that this study intended to address and, thereafter, gives the objectives that the study sought to achieve in order to address the research problem. The research questions are outlined, and the justification of the study discussed. Finally, the chapter gives the contribution this study makes as well as the outline of this dissertation.

1.1 Introduction to the field of study

Information and Communication Technology (ICT) is universally regarded as a vital tool for improving business competitiveness and economic growth of a country as it has the potential to improve the quality, safety, and efficiency of service delivery. Generally, there is a consensus that ICT has significant effects on the productivity of firms, but these effects can only be realized if, and when, ICTs are widely spread and used efficiently.

ICT has the ability to help people collect, store, manage, and distribute knowledge. For instance, in the healthcare domain the use of Information Technology (IT) has improved communication between medical personnel and patients (Djock, 2021). Previously, patients would queue for hours to get help in hospitals as everything was done manually. This trend has, however, changed with the increasing use of automated healthcare systems such as Hospital Management Systems (HMS) that have increased the speed at which patients' information is accessed and retrieved (Khan et al., 2014). The use of IT and its application has propelled developments that have improved service delivery in all sectors, inclusive of public health. Recent developments in remote healthcare systems have witnessed significant interest from the IT industry, which provides universal and easily deployable healthcare systems (Prathiba & Jain, 2015; Djock, 2021).

Katuu (2018) asserts that well-formed hospital management workflows involve important decision-making that should be done efficiently and quickly. Katuu indicates that it is becoming difficult in many health sector facilities to improve efficiency without the use of HMS. The HMS assists in the handling of the different directions of hospital workflows, and it helps in managing smooth healthcare performance along with administrative, medical, legal, and financial control (Djock, 2021). Furthermore, HMS is essential in managing automated operations of the hospital, using radio frequency identification (RFID) tags to secure access (Prathiba & Jain, 2015).

According to the Lions Aravind Institute of Community Ophthalmology report (LAICO, 2019), HMS is an information system that covers many aspects of patient care and administration in hospital management. It is designed with certain flexibilities in each module, which can be customised to suit the needs of the individual hospital and provides a comprehensive software solution. The HMS goes beyond advanced medical equipment, paper-free strategies, or information centralization/sharing, allowing a patient's medical history to be available whenever and wherever it is needed for the patient's treatment (Indra, 2019).

HMS helps to maintain valuable patient data by providing better information systems, as well as standardising the workflow, patient flow, and various activities which enhance the overall performance of the hospital (Katuu, 2018). With the use of HMS, duplication of entries could be avoided since data entered from many departments is stored in a single computer that can be shared with other users connected to the network without re-entering it. The HMS allows more than one user to access data simultaneously without affecting each other. According to Adler-Milstein et al. (2015), HMS has great potential in reducing medical errors, increasing legibility, cutting unnecessary healthcare costs, and boosting healthcare quality and provision.

More advancement in IT and the new development trends in computing have seen organisations improve their day-to-day business operations. New developments like

cloud computing, mobile technology, and machine learning have seen massive developments that, when leveraged, can improve service delivery in all sectors of healthcare (Khan et al., 2014; Djock, 2021). Cloud computing trends reveal the next generation application architecture. Tracking and upgrading underlying server software is time consuming, yet is a crucial process that requires periodic and sometimes immediate upgrades. Most of the time a cloud provider takes care of this automatically. Cloud computing models handle administrative tasks such as database backup, software upgrades, and periodic maintenance (Cook, 2018). Leveraging these benefits will boost healthcare provision and improve citizens' quality of life. From this background, HMS has been migrated and integrated into the cloud environment in order to leverage the benefits such as increased accessibility, flexibility, and reliability of the cloud environment (Rupareliya, 2017). These systems are referred to as the cloud-based hospital management systems (Attune, 2019).

When successfully implemented, the cloud-based HMS increases efficiency, scalability, and overall performance of the health system by sharing resources with a large number of devices within the cloud (Attune, 2019). Physicians and medical staff can connect to the cloud and access information and resources with proper privileges to ensure security and privacy. All resources and information are made available in the hospital community cloud for all registered users. Cloud-based HMS changes the way doctors, medical staff, and clinicians share patients' information and as such enhances the overall hospital productivity and reduces costs (Khan et al., 2014). Additionally, Rupareliya (2017) notes that the rapid adoption of cloud platforms facilitates the making of accurate business decisions by companies through accessing their data in real time. This real-time access of information is essential in the healthcare environment as it not only helps medical personnel to have adequate and timely information, but it also assists patients to be served more easily.

1.2 Background of the study

South Africa has an estimated population of 54, 956, 900 - the majority of whom access health services through government-run public clinics and hospitals (Stats SA, 2018). The South Africa health system comprises the public (run by the government) and the private, which is owned by individuals and/or groups of individuals and companies. The healthcare system in South Africa is structured in five layers, namely primary healthcare (clinics), district hospitals, regional hospitals, tertiary (academic) hospitals, and central (academic) hospitals (WHO, 2018). The general household survey (2016) conducted by Statistics South Africa (Stats SA) found that about seven out of every ten households use public health facilities as their first point of access when household members need health care services for an illness or injury (Stats SA, 2018).

According to the WHO's statistics report, South Africa's public sector has 14 regional hospitals, 63 provincial hospitals, 279 district hospitals, 289 health centres, and 3,105 health posts (WHO, 2019). The South Africa public health sector follows a hierarchical referral system. District hospitals play a central role between the Primary Healthcare (PHC) clinics, Community Health Centres (CHCs), regional, and tertiary hospitals. They offer level one (generalist) services to in- and out-patients referred from PHC clinics and CHCs. District hospitals should ensure that patients are treated at the appropriate level of care and receive continuity of care.

South Africa's public health system is a countrywide network of care facilities ranging from mobile and rural clinics to huge academic hospitals in the urban centres (Stats SA, 2018). Healthcare in South Africa differs from the most basic primary healthcare, offered free by the state, to highly specialized, hi-tech health services available in both public and private sectors (Li & Walters, 2015). However, the public sector is stretched and under-resourced in many places, especially in rural community settings. While the state contributes about 40% of all expenditure on health, the public health sector is under pressure to deliver services to about 80% of the population (Treasury, 2019).

Currently, there is little use of ICT in many South Africa government hospitals, and where ICT is used, each system is used as a stand-alone and lacks integration (Hillestad et al., 2005). This increases the overheads and administrative costs to the public health sector and leads to poor facilitation. The health patient registration system (HPRS) provides a patient registry and master patient index using the South Africa identification number and other forms of legal identification. At the end of March 2018, a total of 2 968 primary health care (PHC) facilities were using the system and more than 20 million people had been registered on the system, compared with 1 849 PHC facilities and 6.3 million registered at the end of March 2017. As a result, patients have to queue for long hours to access their files, see medical personnel, and receive medication. The South Africa government spends a lot of money on health, including health IT systems which are either underutilised or used in silos. Due to this lack of integration, healthcare personnel prefer to use the traditional manual file system that makes retrieval slow and takes longer for a patient file to be retrieved since there are numerous files stacked on shelves (Mojaki, 2018).

The term "e-Health" refers to the use of information and communication technologies, such as mobile phones, patient monitoring equipment, Personal Digital Assistants (PDAs), desktop computers, and other devices, to support the delivery of healthcare. In Low- and Middle-Income Countries (LMIC), where the demand is highest, e-Health has been suggested as a strategy to assist healthcare practices and enhance quality and access to healthcare. E-Health interventions in the healthcare system can help with service delivery scheduling and medicine supply management. A number of them have been demonstrated to be effective in African settings, indicating that e-Health may be able to help underfunded healthcare systems. Scalability, cost-effectiveness, sustainability, and a lack of information technology infrastructure, expertise, and support in LMIC contexts remain issues, though (Horwood et. al 2023).

According to Gray and Vawda (2018), South Africa healthcare providers are still facing challenges of management, exchange of data, and integration due to lack of functionality among the currently used systems. They state that although South Africa is relatively better equipped in terms of ICT infrastructure than other emerging economies in the world, connectivity is expensive and there are still areas without strong network coverage. As a result, depending on the currently available network infrastructure, there are intermittent networks that slow down the effectiveness, use, and delivery of healthcare services. It might be difficult to automatically, effectively, and ideally divide the execution of a program among several mobile or stationary devices with varied connections. Nowadays, a mobile application is either written in a monolithic manner, allowing for as much functionality to be accommodated on the mobile device, or in the conventional client-server paradigm, transferring the majority of computation to a remote server, or it is customized to match an anticipated combination of client, environment, and service (Shi et al., 2020).

This implies that it is essential for South Africa healthcare services to be migrated to the cloud for better connection. Furthermore, the South Africa health sector is still challenged with a lack of alignment and integration of the interventions into health plans, strategies, and systems (mHealth strategy, 2019; Kalema & Busobozi, 2019). In addition, there is also a lack of technology policy frameworks and regulations to support ICT procurement and management processes, as well as lack of adequate infrastructure and internet connectivity, which are considered as important factors in delivering on the electronic health (eHealth) strategy (Geldenhuys, 2015).

HMS is developed to help healthcare providers to have a real-time collection of medical information from one source of configurations to enable faster provision of services (Katuu, 2018; Indra, 2019). Such HMS improves patient-to-doctor allocation and appointments, and access to information that includes patients' inventory, pharmacy, administration, scheduling, as well as treatment. As Maphumulo and Bhengu (2019) observe, HMS would play a major role in counteracting many challenges in the South

African healthcare sector, such as patients' prolonged waiting time in health centres due to the shortage of human resources, adverse events, poor hygiene and poor infection control measures, poor record-keeping, as well as increasing litigation due to avoidable medical errors. However, the integration alone has little or no help in solving the challenges of poor infrastructure, poor internet connectivity causing intermittent networks, and low bandwidth hence the call for deployment in the cloud environment (Geldenhuys, 2015).

The South African mobile health strategy of 2019 calls for drastic health provision reforms and the leveraging of technology to improve healthcare service delivery (mHealth strategy, 2019). Additionally, Rispel et al. (2018) alludes that having a national Human Resources for Health (HRH) is critical to the achievement of universal health coverage reforms; however, there are limited human resources in the South African public health sector. Rispel et al. observe that when effectively implemented HMS are essential in ensuring standardization of medical data collection and analysis as well as provision of medical information and services. However, many South African health sector centres operate with limited IT budgets and at low bandwidth, which causes intermittent network and leads to ineffective utilization of HMS (Sandy & Mavhandu-Mudzusi, 2016; Kalema & Busobozi, 2019). Furthermore, Siegfried et al. (2018) observes that many current HMSs lack contextualization that makes the utilization and effective usage a challenge.

As LAICO (2019) indicates, HMS could work well in areas with sufficient ICT infrastructure, reliable network connectivity, and good bandwidth. This implies that to ensure equality in the provision of healthcare services, the HMS should be deployed within the cloud environment so that health institutions in areas challenged with ICT infrastructure are also catered for. Additionally, Aijing and Jin (2015) allude that many HMS are becoming outdated and cannot meet the needs of hospital management due to increasing changing trends in technology and data generation. They note that some HMS have common design challenges of interoperability, unfriendly interface, low security and efficiency, lack of interactivity, poor portability and maintainability, as well as information

sharing. These challenges, coupled with poor and intermittent network, cause ineffective utilization of HMS hence the calls for deployment of these systems into the cloud.

Siegfried et al. (2018) emphasize the need for contextualization when developing a model for HMS. They state that a contextualized model for health promotion guidelines development is essential in reducing overhead and development costs, time, and results in effective usage as it will be designed based on evidence gathered from stakeholders using empirical methods. They further indicate that contextualization leads to the development of a system rooted in the culture of stakeholders. Therefore, this study sought to develop a model that informs the deployment of HMS within the cloud.

1.3 Research problem

Maphumulo and Bhengu (2019) note that there is enough evidence to prove that the quality of healthcare in South Africa is still being compromised by various challenges that impact negatively on the healthcare sector. They observe that for South Africa to improve its healthcare quality, there must be reduced delays in healthcare delivery, improved efficiency and effectiveness in healthcare provision, increased market share and lower cost, as well as reduced errors in healthcare provision. The decline in quality healthcare has caused the public to lose trust in the South African healthcare system (Gray & Vawda, 2018).

According to Rispel et al. (2018), much as the South Africa government has tried its best to support the health sector and is spending a big part of its budget on health, little has been done to fully utilize the electronic systems that have been implemented in many public health institutions. In many instances where usage of such systems has been noted in hospitals, system components or legacy stems have been used as a stand-alone, and lack integration which increases operational overheads. It is common to find patients' information being duplicated in each business unit of the hospital, which makes information retrieval a challenge and delays the process - making patients to spend more

hours in queues (Callender, 2007; Gray & Vawda, 2018). This has been worsened by the constant interruption in power supply, intermittent networks, and low bandwidth especially in the rural settings (Kalema & Busobozi, 2019). This implies that migrating the implemented HMS into the cloud environment becomes inevitably necessary for improved healthcare delivery.

Many HMSs deployed in the South African hospitals would have been of great importance if all their components or systems were used in a cloud-based environment that would have made information retrieval and sharing much easier (Prathiba & Jain, 2015). However, literature indicates that there is still lack of an appropriate model contextualized in the South Africa perspective to inform the migration of these components and health systems used in hospitals into the cloud environment (Rispel et al., 2018; Siegfried et al., 2018). This is essential for solving the challenge of intermittent networks and disruptions that impede the accessibility and reliability of HMS (Geldenhuys, 2015).

1.4 Research goal and objectives

To solve the identified problem, this study set to achieve the following goal and objectives:

1.4.1 Goal

The goal of this study was to develop a model for cloud-based hospital management systems for the South African public health sector.

1.4.2 Objectives

To realize the research goal the following objectives were set to be achieved:

1. To establish factors that influence cloud-based HMS implementation in South Africa.
2. To determine the extent of cloud-based HMS integration in South African health institutions.
3. What are the rankings of the established factors and how do they apply in the development of a cloud-based HMS model for the South African health sector.

1.5 Research questions

The following were the research questions that needed to be answered to achieve the research goal.

1.5.1 Primary research question

The primary research question of this study was: What model can be developed for a cloud-based hospital management system in the South Africa public health sector?

1.5.2 Secondary questions

To answer the primary research question, the following secondary questions were to be answered:

1. What factors influence the migration of cloud-based HMS for the South African public health sector?
2. To what extent has cloud-based HMS been utilised in South African health institutions?
3. How can the identified factors be ranked and used to model a cloud-based HMS for the South African public health sector?

1.6 Justification of the study

With the current infrastructure challenges and limited IT personnel as well budgets in the public health sector, migration of hospital management systems can make medical personnel's lives very simple, though this could require more training of some personnel to familiarize themselves with the new system. This means relevant frameworks must be put in place so that management is mindful of how to handle such situations in the new IT environments.

Cloud computing in the healthcare system is a potential trend for the development of medical information systems that improves flexibility and agility. It facilitates the covering of health services and provides access to data anywhere, anytime at a low cost. Furthermore, it maintains collaboration and team work for healthcare delivery, allowing users to share information more easily, having large storage of big data, and reduces costs (Hanan et al., 2016). Moreover, the cloud offers pay-as-you-go access to services such as hardware infrastructure, platforms, and software for solving common biomedical computational problems. Cloud is differentiated from traditional high-performance computing by its rapid availability and scalability of services. As such, cloud services are engineered to address big data issues and to enhance the likelihood of data and analytics sharing, reproduction, and reuse (Navale & Bourne, 2018). This implies that a cloud-based HMS will not only facilitate with fast and quick access and retrieval of data but also with the storage of the huge amounts of patients' data used in public health facilities.

According to Prajakta (2015), an HMS system helps one to have one's health check-ups done quickly at the best price via the nearest path labs and to access the reports anywhere and anytime on a mobile device. Migrating HMS to the cloud will help to achieve this objective. Providing healthcare services through mobile technology and high tech devices would enhance doctors' consultation services as well as patient monitoring services without doctors having physical contact with their patients. However, for more comprehensive service delivery migrating these services to the cloud becomes

mandatory as it improves analytics that hospitals may use for medical research, referrals, as well as patients' personalized care (Hanen et al., 2016). According to Rouse (2014), the cloud-based environment would enhance healthcare provision within health facilities at limited costs as all data, software, and application will be managed at one single central location; and accessibility can be done from any device anywhere and at any time.

1.7 Expected Contribution

This study's contribution is twofold, namely theoretical and practical.

1.7.1 Theoretical Contribution

This study's goal was to develop a model for cloud-based HMS contextualized in the South African setting. The study followed a logical process to come up with this empirically tested model. Therefore, theoretically, this study bridges the gap of lack of a South African contextualized model to inform the development of cloud-based HMS. Based on the model developed by this study as the reference point, future researchers will be in a position to extend research of the migration of applications and services into the cloud-based environment. By using this study's model as a reference point to extend research, this study will be making a significant theoretical contribution to the computing body of knowledge.

1.7.2 Practical contribution

The developed model has gone through systematic empirical evidence and testing. Hence, policy makers and health institutions will use it to make informed decisions regarding the development of the cloud based HMS to run their day-to-day operations. Using this model in the day-to-day operations of health institutions will enable medical personnel and social workers to share data with trusted parties, not worrying about the access speed and backups. Better still, with this model, management will be comfortable to buy-in the migration of services and applications to the cloud so as to have simple, on-

demand network access to a shared pool of programmable resources that can be supplied and released quickly with minimal administration effort and service provider engagement. Therefore, using the developed model for this study will be a significant contribution to practice and management.

1.8 Research Outline

Chapter One provides the introduction:

The first chapter gives an overview of the study as well as an introduction. It also includes a description of the study problems, objectives, and questions. It also explains the reasons for the study as well as the projected contributions.

Chapter Two is dedicated to the literature review:

This covers literature review on HMS in different areas which include benefit of HMS, barriers of HMS use, factors influencing HMS implementation, and integrated HMS. It further discusses the South African health sector, cloud computing and its benefits, and cloud-based IHMS. Finally, the chapter goes through the theoretical foundations of TOE and DOI which were employed as a lens for this research.

Chapter Three outlines the research Methodology:

The chapter describes the researcher's strategy for solving the challenge. This includes the researcher's overall strategy, the viewpoints that guided their thinking, beliefs, and/or assumptions that were used as a guide on how to solve the problems identified, the approach taken, data collection methods, sampling techniques, and a description of the pilot study. Last but not least, the ethical issues that were considered in the study are presented, along with their associated dangers and how the risks were mitigated.

Chapter Four outlines data analysis and presentation of results: In this chapter, the results of the data analysis for each component under consideration are analysed. A thorough study of the participant demographics is provided in Chapter 4. This chapter

includes the link between attributes and their association score. Regression is described in Chapter 4's final section, along with a brief explanation of hypothesis testing.

Chapter Five provides the discussions, interpretation, conclusion, and recommendation: This chapter goes into further detail about the findings and the tested hypotheses. The findings in relation to the research questions, as well as the purpose and objectives of the study, are further examined in Chapter 5. The chapter concludes with proposals for creating a cloud-based model for the South African public health sector. It also gives the study's conclusions.

CHAPTER TWO: LITERATURE REVIEW

This chapter discusses related literature of Hospital Management Systems (HMS). Different aspects of HMS are discussed that include the benefits, barriers impeding successful implementation and usage, as well as the factors influencing the implementation of HMS. The chapter further discusses the South African public health sector, cloud computing and its benefits, and cloud-based HMS. Furthermore, the chapter discusses the theoretical foundations that were used as a lens for this research and that informed the design of the conceptual model. Finally, the chapter discusses the constructs of the conceptual model and their operationalization that led to the development of the study's hypotheses.

2.1 Hospital Management Systems

HMS is an enabling technology that helps medical personnel to pursue more powerful quality improvement programs that are not possible with normal paper-based records (Miller, 2004). It helps to achieve a high operational efficiency in the healthcare sector, which is an essential goal for health institutions. HMS is an information system that covers the patient care and administration in hospital management LAICO (2019). HMS is built with certain flexibilities in each module, which can be customized to suit the needs of the individual hospital. More still, HMS helps to maintain the valuable patient data for providing better information systems. In addition, it ensures that there is a standardization of workflow, patient flow, and various activities which enhance the overall performance of the organization. Through intranet services, management will have access to online information about key factors.

HMS, unlike other common systems, requires more resources in terms of hardware, software, training, implementation, and post-implementation support for it to be implemented in a hospital (Hanan et al., 2013). There are certain essential hardware requirements and certain need-based requirements. Depending upon the size and

volume of work, a hospital can decide whether to provide one or more computers for each area, or one computer to manage more than one application area. Apart from HMS software, the hospital should have certain basic software to run the HMS and also to perform other office automation functions.

According to Sandy and Mavhandu-Mudzusi (2016), HMS helps to avoid duplication as data is entered from various departments and stored in a single computer (file server). This means that other users on the network can share the data that is already entered instead of entering it again. HMS allows multi-users, whereby more than one user can access the data or program simultaneously without affecting each other's work, as illustrated in Figure 2.1. It is also essential in expanding computer applications in new areas with minimum effort.



Figure 2.1: Hospital management system (Source: Existec, 2019)

2.1.1 Benefits of Hospital Management Systems

As patients' data increased over time, financial savings accumulated due to the fact that staff started spending less time locating information. More advanced ordering capabilities including decision support, electronic transmission of orders to pharmacies and laboratories, and better tracking of test-order status and test results became faster (Prathiba & Jain, 2015). This implies that a properly designed and effectively used HMS improves the availability, timeliness, and accuracy of health information sharing and dissemination.

The HMS enables healthcare organizations to maintain patient data (name, health concerns, address, phone number, disease history, and test results) as digital records in

a single database. It accelerates the manual paperwork management procedure and the traditional method of keeping patient medical records. Using an online patient management system helps hospital employees to quickly and conveniently retrieve patient information using the application's features (Space, 2022). Increasing the consistency, scalability, and dependability of hospital administration software improves patient care and experience while also making a healthcare practice's operations more efficient. Healthcare difficulties such as delayed care for individuals who require rapid medical attention can be avoided with proper data management. As a result, hospital management software would boost the efficiency and appeal of healthcare services to their target audiences, such as doctors and patients (Voznaya, 2021).

Managing a hospital is a difficult task with no room for error. A manual approach cannot guarantee error-free and 100% accurate processing. Errors and blunders are always a possibility. Installing an automated management system entirely eliminates the possibility of errors, as well as compliance concerns and lawsuits, which are the two largest headaches for medical centres and hospitals (Anblicks, 2021). In the last few years, there have been significant advances in information technology, and there has been a revolutionary shift, particularly in hospital administration and automation systems. Apart from handling the mundane operational staff that hospital information systems produce, they give intelligent and accurate management information systems (Sanjana, 2019).

Petlovana (2020) stated that because the HMS eliminates the need for additional staff, hospitals are able to keep labour expenses low. Medical history, test results, and treatment procedures are all stored in the system. There are no particular demands that must be made. The HMS assists the hospital in improving communication and patient care coordination. Hospital Management Systems provide a simple way to manage patient billing via their mobile app or web portal, where they can view real-time data on payments received from various insurances, allowing them to better manage their cash flow and keep track of how much money they owe each individual customer at any given time (Insta, 2021).

According to Deorwine (2020), all of the patient's critical information is stored in the hospital database. Doctors can receive disease history, test issues, and suggested medication without delay in order to make a precise diagnosis. HMS lowers the chances of making a mistake. Experts have stated that hospitals that use a manual system are more vulnerable to data theft and leaks than those that use an automated method. Each item of data in a full-fledged hospital management system is kept safe from unwanted access. However, rather than a stand-alone indigenous system, hospitals must adopt a state-of-art system with centralized authorities. A hospital's efficiency can be considerably improved by using a system that can manage all forms of medical data, inventory, outcomes, and reporting. Furthermore, the software automatically filters data, resulting in faster operating operations and the elimination of time-consuming, repetitive tasks that humans perform (Voznaya, 2021). More advanced use of HMS leads to greater opportunities for improving quality healthcare and enables patients to reschedule visits, send emails to providers, receive email reminders, order medication, access their chats, and obtain more individualized educational patient healthcare information (Ojo and Poopola, 2015). Other benefits of HMS as highlighted by Doukas et al. (2010) and Prathiba and Jain (2015) include:

- a) **Ease of implementation:** By streamlining all of its documentation and patient information, HMS is simple to implement and manage.
- b) **Boosted productivity:** HMS assists minimizing the amount of time it takes to access and search patient records. Productivity improves as time consumption is reduced.
- c) **Human error elimination:** Mistakes are inherent while working with the manual system. Human errors can be effectively eliminated with the correct software.
- d) **Cost reduction:** The expense of physical storage, paperwork, and additional staff is reduced when using a cloud-based HMS.
- e) **Patient care:** Because the administration is monitoring efficiency, the physician will be able to devote more time to patients.

- f) **Increased security:** Right user ID and password can only access the system. Therefore, it increases the security of data.
- g) **Maintenance:** Right HMS is completely safe and secure. It allows for more efficient data and document handling while maintaining higher levels of secrecy.
- h) **Collaboration:** It minimizes duplicate entries and improved coordination among hospital managements' various functions.
- i) **Risk management:** Paperwork management and system storage are both extremely dangerous. In the event of a calamity, data can be lost.
- j) **Easy integration:** With all of its administrative and managerial functions, HMS is simple to implement.

2.1.2 Factors influencing HMS implementation

According to Hanen et al. (2013), the high up-front financial cost of implementing HMS is a primary barrier to HMS adoption. This barrier is compounded by uncertainty over the size of any financial benefit that may increase over time. Additionally, Cook (2018) notes that HMS is seen as challenging to use due to its multiplicity of screens, options, and navigational aids. This implies that implementation post-process should involve training of users to reduce the time spent on learning effective ways to use the system. Failure to train users may lead to difficulties in usage.

According to Lewis and Seibold's (1997), change theory, people are naturally resistant to change unless they first perceive that there is a problem with the way things are currently being done and that an improved process exists. Second, the person or group faced with change must be willing to learn the new process and feel safe in the learning environment, through mentorship. Lastly, for the new process to be sustainable, it must be congruent with the persons' other tasks and responsibilities.

Huryk (2010) states that, implementation and expansion are at the core of global efforts to improve healthcare quality and patient safety. As a large portion of the healthcare workforce, medical practitioners' attitudes towards HMS are likely to have a major impact on the Electronic Health Record (EHR) implementation process. In accordance with two change theories, if Health Information Technology (HIT) implementation projects are to be successful, medical personnel must recognize that incorporating EHRs into their daily practice is beneficial to patient outcomes.

Healthcare IT, in general, has been viewed as a critical component in lowering costs and improving the efficiency and safety of the health-care industry. HMS serves a wide range of clinical and administrative activities or tasks in hospitals, including radiology, anaesthesia, pathology, emergency medicine, billing, appointment scheduling, refunds, and so on. The HMS can be used to support a wide range of tasks in each of these domains (Guimaraes et al., 2020). Information on population health is managed via HMS. Also, HMS has the ability to assist in the provision of health care, and it can be improved by adjusting it for barriers specific to each area.

According to Mcnair et al. (2006), the healthcare sector would be unfathomable without HMS based on IT and related applications for acquiring and distributing clinical data. Furthermore, a hospital' administrative, financial, and clinical aspects can be effectively managed with a comprehensive and unified HMS. The primary goal of HMS is to provide the best possible support for patient care and administration through electronic data processing. It is one of the most important features of HMS that management can access the necessary information at the right time for efficiency.

Many new factors, such as active participation of frontline workforce, system training, organizational time commitment, goal specificity, professional values, and communication, have emerged as important to this process in decision-making and implementation, the importance of leadership, time commitment, organizational silos, executive level and frontline staff participation (Patri & Suresh 2018). Over the previous

few decades, hospital administration has evolved significantly. The execution of a HMS project requires business skills, current technologies, connected equipment, mobile apps, and clinical understanding. The number of healthcare providers has grown, and people now have a wider range of medical professionals from which to choose. For the benefit of both parties, interactions between the hospital and the patient can be streamlined. Each institution has the ability to develop a healthcare delivery strategy that is efficient, clear, and quick (Voznaya, 2021).

According to Wijayati and Achadi (2019), the human components have the greatest influence on hospital information system adoption. The organization comes in second, followed by the environment in third, and technology in fourth. Human variables that influence the success of hospital information systems include general computer knowledge and skills, as well as the simplicity of utilizing and learning to utilize the system. The ease with which users may learn how to use HMS will familiarize them with the system and, in addition to saving time and money, will lead to the system's successful acceptance and implementation. Furthermore, one of the most significant components in minimizing hospital information system failures is human training. In this instance, continuing training is critical for end users' successful deployment. Another factor that can influence the success of HMS implementation is user participation in the process. End-users must be actively involved in IT activities, and developers must consider employee feedback before, during, and after system design (Sheykhoteyefeh et al., 2016).

Wijayati and Achadi (2019) state that top management's commitment to system success, support from various departments involved in system operations, management's rapid presence in system maintenance, well-defined system processes, consensus reached by various department heads regarding operating systems, top management leadership styles, user motivation by management, planning and coordination for system success, and minimal disruption to normal workflows are all organizational factors to consider. These findings suggest that elements like leadership styles and organizational

commitment to the electronic health information system's performance will surely play a role in its success. The degree to which all stakeholders collaborate and are involved, as well as the management structure's ability, are critical to the successful implementation of innovation (Ojo and Popoola, 2015). In addition, competent project management and precise planning will ensure that the initiative is implemented, institutionalized, and accepted by users (Sheykhotayefeh et al., 2016).

Government policy, industrial, social, and political pressure are all considered environmental factors in this study. Changes in government, the government's desire to invest, government policies, quality assurance tools and a flexible government bureaucracy will all have an impact on the effectiveness of HMS implementation. The government's role in technology adoption is critical and must not be overlooked. Government policies on tax and tariff subsidies, rules and regulations, incentives, and technology support all play a role in whether or not they are accepted (Wijayati & Achadi, 2019).

The technological components denote the technical issues that arise when computing technology is adopted. Security, privacy, software, and hardware compatibility are all included in the technological dimension. In the context of the distribution environment, particularly the cloud computing environment, security is the most significant concern. This is especially true in hospitals, where health-care data must be stored and retrieved in a secure setting. It is critical to ensure that data security and confidentiality of hospital information systems. The system contains a great deal of useful information. Unsafe data can be abused and exploited, resulting in negative consequences for patients (Wijayati and Achadi, 2019). Compatibility of hardware and software is also a technical aspect in HMS implementation. Software that is well-designed, infrastructure that supports system implementation, software that is simple to use, adequate hardware components, adequate technical support from the system provider, supporting communication network infrastructure, software evaluation prior to implementation, and sufficient expertise in

HMS operation are all necessary (Ojo & Popoola, 2015). These factors are summarized in Table 2.1.

Table 2.1: Summary of factors influencing HMS implementation

Fact	Explanation	Source
Resistant to change	People are naturally resistant to change unless they first perceive that there is a problem with the way things are currently being done.	Lewis and Seibold, 1997
Sustainability	For the new process to be sustainable, it must be congruent with the person's other tasks and responsibilities.	Lewis and Seibold, 1997
Quality and safety	Implementation and expansion are at the core of global efforts to improve Healthcare quality and patient safety.	Hurkey, 2010
Recognition	For HIT implementation projects to be successful, medical personnel must recognize that incorporating EHRs into their daily practice is beneficial to patient outcomes.	Hurkey, 2010
Lower costs	It has been viewed as a critical component in lowering costs and improving the efficiency and safety of the health-care industry.	Guimaraes et al, 2020
Wide range	The HMS can be used to support a wide range of tasks in each of these domains.	Guimaraes et al, 2020
Efficiency	A hospital' administrative, financial, and clinical aspects can be effectively managed with a comprehensive and unified HMS.	Mcnair et al., 2006

Accessibility	It is one of the most important features of HMS that management can access the necessary information at the right time for efficiency.	Berg, 2001
Human	The ease with which users may learn how to use HMS will familiarize them with the system.	Sheykhotayefeh et al., 2016
Environmental	Changes in government, the government's desire to invest, government policies, quality assurance tools and a flexible government bureaucracy will all have an impact on the effectiveness of HMS implementation.	Wijayati and Achadi, 2019
Organization	The degree to which all stakeholders collaborate and are involved, as well as the management structure's ability, are critical to the successful implementation of innovation.	Ojo and Popoola, 2015
Technology	The technological components denote the technical issues that arise when computing technology is adopted.	Wijayati and Achadi, 2019

2.2 The South Africa health sector

According to Just (2019), healthcare in South Africa reflects the country's position as a blend of the first and third worlds. This implies that some public healthcare facilities in rural areas are very basic indeed, while some private facilities (and medical research) are cutting-edge, placing South Africa firmly at the forefront of medical advances.

Compared to before 1994, South Africa is a much improved country, with notable advancements in the health field. Set against the backdrop of the 1997 White Paper for the Transformation of the Health System, the first wave of transformation saw the creation of an enabling policy and legal framework for the complete overhaul of the health care system, the creation of an integrated national public health system from disjointed, racialized, or Bantustan 'health' departments, and the removal of racial barriers in access to health care. Within the first 100 days of the late President Mandela's inauguration, free healthcare for pregnant women and kids was put into place to show the new administration's dedication to providing services. The overall performance of the South African health system has not been improved by reforms. Although we spend 8.5% of our GDP, or over R332 billion, on healthcare, the majority of this money is spent in the private sector to serve the socioeconomic elite. The under-resourced public sector is required to care for the remaining 84% of the population, who suffer from a much heavier burden of sickness (Rispel, 2016).

Li and Walters (2015) assert that healthcare services in South Africa are set to undergo drastic reforms with the recent announcement of the long-awaited National Health Insurance (NHI) Bill and Medical Schemes Amendment Bill. These reforms are meant to address what has become a national outcry over inefficient public healthcare services and inaccessible private healthcare.

Researchers such as (McIntyre et al., 2013; Mukwena & Manyisa, 2022) allude that accessing quality health services is nearly impossible for many South Africans, as they have to contend with generally poor services in the public sector or unaffordable medical bills from private Health facilities. He notes that public health facilities remain the only option for the more than 42-million citizens who do not have private health insurance, who are evidently growing more ill by the day. SA has the highest level of HIV prevalence in the world, TB remains the leading cause of death, and lifestyle diseases are on the rise (Just, 2019; Kalema & Busobozi, 2019). Public hospitals and clinics in South Africa are usually reasonably well equipped and staffed but are often very overcrowded with

patients, and patients have to wait for long hours to consult with the medical personnel who are also usually overworked (Just, 2019; Mukwena & Manyisa, 2022).

In order to improve healthcare systems and make it easier for the public to receive health information, the healthcare sector has been using digital health technology. More and more outpatient healthcare institutions worldwide are making the switch from a mostly paper-based practice environment to an electronic or paper-light environment as a result of the development of digital health technology and the digitization of health data.

2.3 Cloud computing

Hassan et al. (2017) describe cloud computing as a paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on demand by the International Organization for Standardization (ISO) and the International Electro-technical Commission (IEC). Rupareliya (2016) defines cloud computing as a model that enables everywhere, convenient, on-demand network access to a shared pool of configuration resources that can be rapidly provisioned and released with minimal management effort or service provider interaction. Foster et al. (2000) and Rupaleriya (2017) allude that cloud computing is a large-scale distributed computing paradigm driven by economies of scale, in which a pool of abstracted, virtualized, dynamically scalable, managed computer power, storage, platforms, and services are delivered on-demand to external customers over the internet. Health (2017) notes that cloud computing could be looked at as a large pool of computing and/or storage resources, which can be accessed via standard protocols via an abstract interface.

Rosenberg and Mateos (2011) highlight five principles that define cloud computing, and these are:

a. Off premises hardware assets

Cloud computing (and managed hosting) represent the transition from internally hosted IT to outside hosted IT resources, and they have significant economic

ramifications. The two main effects are a change from capital expenses (CAPEX) to operational expenses (OPEX) and a potential decrease in OPEX related to infrastructure operation. The financial barrier for starting a new project is reduced as a result of the switch from CAPEX to OPEX. Budget must be set aside and then spent for the acquisition of hardware and software licensing in the self-hosted approach. Whether or not the project is a success, this fixed cost must be committed to and paid for through depreciation of the assets over a number of years. Starting a new project has substantially lower barriers in an outsourced approach. In the case of managed hosting, the initial charges are often equal to one month's operational expenses, and only one year's worth of costs must typically be paid in advance.

b. Elasticity as resource demands grow and shrink

This substantial resource base makes it possible for a phenomenon called 'elasticity'. Elasticity is the capacity to adapt dynamically the amount of resources consumed in response to the amount required. Normal, steady-state conditions for typical applications call for a basic amount of resources, whereas peak load conditions call for more. In a world without clouds, one would need to develop enough capacity to handle peak load scenarios with reasonable performance, in addition to performing well under baseline load conditions. This entails over-provisioning the quantity of hardware for a particular allocation in the case of a self-hosted model. When using managed hosting, one can start with a limited number of resources and add more as the needs of the application increase, but it typically takes weeks to provision a fresh batch of dedicated hardware resources.

c. Metered billing for pay-as-you-go

Metered billing is the fifth distinguishing feature of cloud computing. As we just discussed, there is often an upfront beginning charge and a necessity to engage in a commitment to pay services for a full year in the case of managed hosting. Pay-as-you-go models, like the cloud model, overcome this financial hurdle. There

is no obligation to sign a yearly contract or to consume a certain amount. Typically, resources can be assigned as needed and paid for solely on an hourly basis. The elimination of the financial barrier extends beyond projects managed by an IT group and this method is currently being utilized by many entrepreneurs beginning new businesses. These entrepreneurs can now use massive amounts of compute resources for pennies an hour, eliminating the need for them to acquire funds as they might have in the past. The playing field has been dramatically altered as a result, putting the little guy on par with the biggest enterprises.

d. Virtualization of computing resources

Cloud infrastructures, which are based on thousands of servers, can have a very large scale. Getting the most out of each server is essential to keeping costs low because each one takes up physical space and consumes a lot of electricity and cooling. Virtualization is the most important aspect in the new IT phenomena known as the cloud, which is the high usage of commodity hardware made possible by recent technology advancements. Each server is divided into a number of virtual servers, each of which functions as a separate server capable of supporting a full set of operating systems and applications. The main pieces that can be consumed as needed are virtualized servers. These virtualized machines make up a sizeable resource pool that can be exploited as needed.

e. Automation of new resource deployment

New instances can be provisioned as needed for a cloud-deployed application, and these resources can be made available in a matter of minutes. These virtual instances can be taken down once the peak demand has subsided, and the extra resources are no longer required. The only additional expense is the time those instances were active and in use.

2.3.1 Characteristics of cloud

Cloud computing has a number of potentially advantageous properties. Numerous research studies have identified several distinguishing characteristics. As an example, the definition of cloud computing specifies five different types of cloud: on demand self-service, broad network access, resource pooling, rapid elasticity, and measured service are some of them. Kafhali et al. (2020) describes the characteristics of cloud computing as dynamic elasticity/scalability, simultaneous accessibility, virtualization, and pay-per-use. These characteristics are explained below:

a) Virtualization

Kafhali et al. (2020) describes virtualization as one of the most important aspects of cloud computing, as it ensures the cloud's continued operation. Due to the abstraction of real resources, it turns the cloud into VMs. These VMs can be created stored, transferred, and/or terminated in real time, making noisy computing a flexible and reliable resource. The summary of virtualization is represented Figure 2.1.

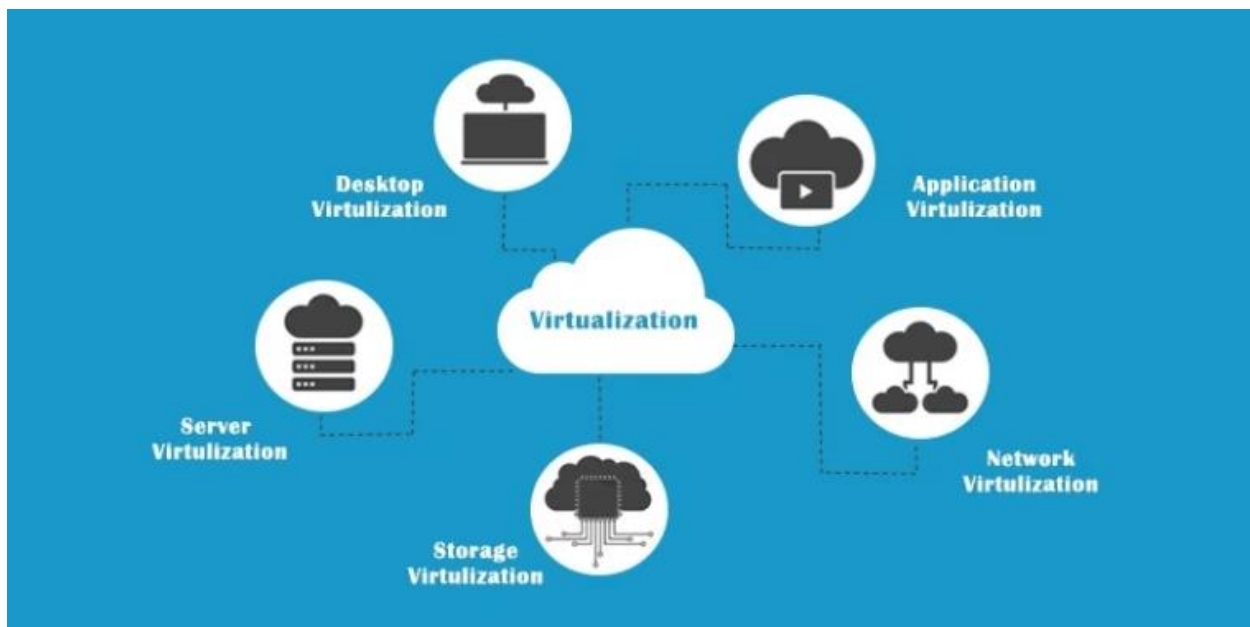


Figure 2.2: Virtualization. (Source: Redwitches, 2010)

Cloud providers use virtualization to develop environments that may meet each customer's demands in order to service their individual needs. Cloud providers can spin

up more virtual instances to satisfy demand when more customers sign up. These systems can be rapidly turned off as people exit the system. As a result, virtualization is an effective method of managing computing resources, maximizing utilization, and reducing downtime. The examples below show how virtualization is used in cloud computing.

b) Desktop virtualization

The user can construct a virtual desktop that is often hosted on a centralized data centre using desktop virtualization. The user can then use a thin client (such as web browser) to access this virtual desktop from anywhere, effectively turning it into a portable workstation (Liu et al., 2022).

c) Application virtualization

Running a program traditionally makes use of one's existing operating system and hardware resources. Essentially, the application is operating on top of one's PC. The application is encapsulated and separated from the underlying operating system using application virtualization. This allows one to use the app without having to install it on one's smartphone (Kumar & Charu, 2015)

An administrator can install an application on a server using application virtualization. Anyone who has access to this server can then access the program and run it as if it were already installed on their devices. This gives consumers advantages including portability, cross-platform operation, and the flexibility to run multiple instances of the application (Rashid & Chaturvedi, 2019).

d) Server virtualization

On a computer network, physical servers are powerful computers with several CPU's that host files and programs. Each physical server is usually dedicated to a single application or task for the sake of efficiency. However, because each server will only be employing a

fraction of its available processing capabilities, this can become wasteful (Shehzadi & Nazish, 2022).

Server virtualization addresses this issue by allowing a system administrator to divide a server into many virtual machines. These virtual machines will all use the servers' resources and will operate as separate physical devices, allowing one to locate the servers' processing power as one sees fit (Cervone, 2010).

e) Storage virtualization

Storage virtualization is the technique of abstracting many physical storage devices and combining them into a single storage cluster that can be handled from a single location. The user will see these storage devices as a single storage device (Cervone, 2010).

f) Network virtualization

A computer network is a collection of digitally connected computers that may share resources and communicate with one another. The process of merging network resources into a single software-based network is known as network virtualization. This generates a virtual network that allows one administrative authority over all of the original networks' hardware and software resources (Chiolo, 2022). One can use network visualization to merge many networks into a single unit (external visualization) or to join software containers into one's own network (internal visualization). Any network visualization allows one to split available bandwidth into different channels that one may assign and reassign as needed (Simalango, Kang & Oh, 2010).

g) Elasticity

Elasticity is a key feature of cloud infrastructure that allows it to adapt to changing non-functional requirements such as the amount and size of data provided by an application, the number of concurrent users, and so on. Cloud elasticity quickness provides potential benefits. It enables consumers to quickly scale out and scale in computing resources to

support their systems. It also tracks, monitors, manages, and reports on the use of resources (Jamil & Zaki, 2011).

h) Reliability

The capacity to host data-centre applications in the cloud requires a high level of reliability, which applies to both hardware and software-based solutions. The mounted high-performance infrastructure, which is designed for redundancy, is used to assess cloud reliability. Availability and reliability are inextricably linked. In reality, the availability of cloud services determines the system's reliability (LoBiondo-Wood and Haber, 2014).

2.3.2 Benefits of cloud computing

According to Pandey (2019), with the cloud, procurement of new inventory and storage space is reduced in a matter of days or even hours, giving businesses the ability to respond to a rapidly changing technological environment. The simplicity in cloud solutions makes teams more productive; in distributed teams the cloud removes region-specific dependencies, creating a collaborative team setting. Cloud solutions have strong built-in security programs, providing security analytics and visibility across the entire cloud environment. Cloud providers package several useful features such as disaster recovery, automatic logging, continuous deployment, and monitoring (Navale & Bourne, 2018).

The cloud environment comes with a no-downtime promise that increases the availability of resources to lead to better asset operation and customer satisfaction. Foster et al. (2009) emphasize that migrating applications to the cloud allows data to be accessed anytime and anywhere. Data stored on cloud services is instantly available to authorized users. Allowing customers to share their data with trusted parties, cloud providers can hire experts and implement infrastructure security measures that typically only large enterprises can obtain without worrying about backups as a customer; data is reliably backed up (Rouse, 2014).

According to Rouse (2014), cloud applications can be updated, tested, and deployed quickly, providing enterprises with fast time to market, and agility. This speed can lead to culture shifts in business operations. The unit price of servers comes down noticeably in comparison with native data centres. The pay-as-you-use model provides the flexibility that organizations seek to counter seasonal demand and scale up or down as required by the business. Cloud storage costs more in terms of operating than capital expenditures. The upfront expenditure of funds on physical infrastructure is known as a capital expenditure, or CapEx. The value of CapEx costs decreases over time. Operational expenditure, or Opex, on the other hand, refers to the spending and billing of services as necessary. Costs are written off during the same tax year. Because cloud storage companies use a consumption-based business model, customers only pay for the resources they actually use. They pay for anything they consume. Better cost prediction is provided. Prices are for specific resources and services, and invoicing is based on actual usage, which is crucial (Khan, 2022).

Pandey (2019) asserts that centralized managed data by IT operations personnel is more easily backed up on a regular schedule and restored should disaster recovery become necessary. Therefore, an organization does not have to worry about backups as data is reliably backed up.

Chhabra and Sing (2022) state that data owners and other parties demand high levels of security, which can be conducted by practical effective schemes based on security and privacy preserving algorithms. Although the trend towards data sharing offers us many opportunities and benefits, it can also occasionally turn into a way for intruders to alter, leak, or regenerate data. The authors give reasons why cloud computing should be adopted:

- a) It is quick to alter hardware, software, storage, network bandwidth, speed, and other factors to suit our demands.
- b) A flexible nature.
- c) High availability and utilization.

- d) With the use of software alone, one can simply govern the entire cloud and rapidly add, cancel, or rebuild resources.
- e) Depending on one's demands, one can adjust the scale, and make the resources smaller or larger.
- f) Because there are no upfront costs, it is extremely beneficial for small and medium-sized businesses.

2.3.3 Challenges of cloud computing implementation

Cabarcos et al. (2012) state that the cloud computing paradigm is poised to become the next internet revolution, but security concerns are preventing its widespread adoption. Better access control and identity management solutions are one of the most pressing challenges. Researchers and professionals have highlighted Federated Identity Management (FIM) as a critical security enabler because it provides the worldwide scalability required for the successful use of cloud technologies. However, the intricacy of the underlying trust models that must be in place before inter-domain cooperation limits existing FIM frameworks. Sánchez et al. (2012) also state that cloud computing is being proposed for a variety of consumer electronics (CE) applications, including consumer storage virtualization, and CloudTV systems that allow access to a variety of Web services such as social networking, user-generated video games, and so on. Given the dynamism availability of information, and heterogeneity of cloud, some private, community, public, and hybrid, security and identity management concerns have arisen.

As long as a trust relationship exists across cloud domains, which expose distinct versions of their identities, users in a private cloud should be able to access apps housed in a community cloud. This is because cloud situations are multi-provider and multi-service, and applications may mix data from various cloud-based sources, each with its own set of terms of service, privacy rules, and geographical location (Clemente et al., 2022). Because cloud environments are distributed and open, it is required to dynamically propagate trust in order to manage digital identity linked to access control, reputation,

anonymity, and privacy across domains in a secure and seamless manner (Sánchez et al., 2012)

Depending on the particular configuration options, user health data can be monitored, processed, and transferred up to 24 hours a day, 7 days a week, and 365 days a year. These massive health data sets must be saved and retained for extended periods of time in order to be analysed more efficiently in the future. Cost-cutting is a major barrier for health-care service companies who want to expand their customer base (Bradshaw et al., 2016). However, the cost of health-care web service should not be sacrificed at the expense of its performance. The performance characteristics of applications must be preserved, while the expenses of the underlying infrastructure are reduced. Lack of desired performance, on the other hand, gradually reduces the provider's profit as customers migrate to alternative suppliers. As a result, efficient methods are necessary to estimate user demand for services and scale the underlying resources in response to changing loads of user access requests.

Although many cloud computing platforms deliver services to the door of users, there are specific qualities that require special attention. The other one is that services are based on continuous connection availability, and affordability to everyone may not be possible due to high cost (Abbas et al., 2020). The security of information stored or communicated to/from the cloud is the primary concern of cloud computing implementation. Three parties are involved in cloud computing, these are: the cloud customer or user, the cloud service provider CSP, and the cloud network (usually the internet that can be considered as the transmission media of the cloud) as illustrated in Figure 2.3:

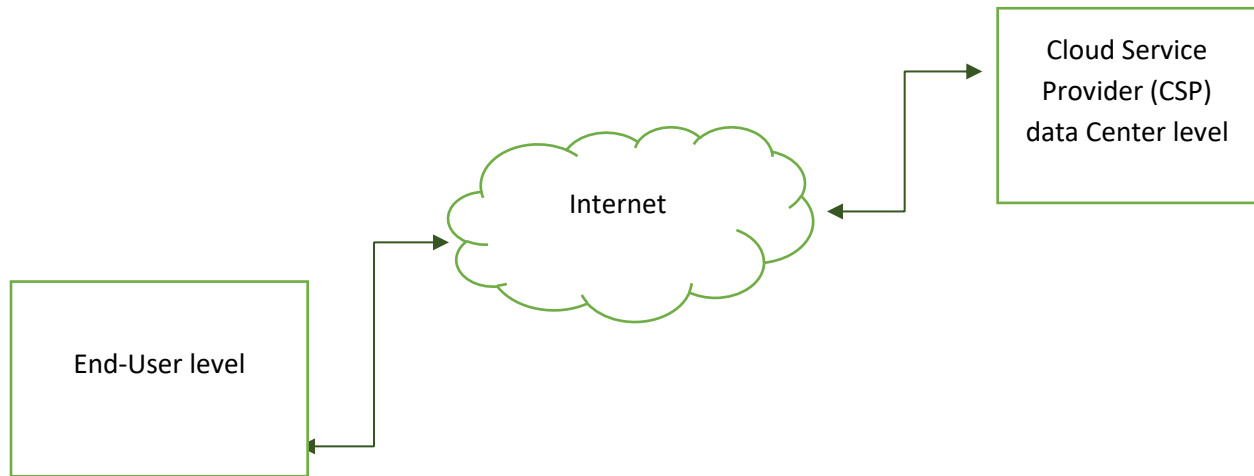


Figure 2.3: The three parties of cloud computing (Source: Turab et al., 2013)

The proceeding sections discuss the several forms of attacks at various levels, as well as methods for reducing their damage (Kafhali et al., 2020).

a) Cloud Service Provider level attacks

The cloud's shared nature and the rising demand for shared resources in cloud computing could make it an appealing target for attackers. End-users should take into consideration the vulnerabilities of cloud computing before migrating to it (Mageshwari et al., 2022).

b) Guest-hopping attack

Any breakdown of separation between shared infrastructures is defined as this. An attacker will attempt to get access to one virtual machine by breaking into another virtual machine on the same physical hardware. The use of forensics and VM debugging tools to detect any effort to breach a VM is one of the possible mitigations for a guest hopping attack (Albugmi et al., 2016).

c) SQL injection

It is frequently used to target websites. It is done by injecting SQL commands into a database of a web-based application to dump or crash the database. To protect against SQL injection attacks, any infrequently used stored procedures must be removed. Assign the fewest privileges possible to users who have database access permissions (Qian et al., 2015).

d) Side channel attacks

When an attacker installs a malicious virtual machine on the same physical machine as the victim, the attacker gains access to all of the victim's personal information. As a preventative, it may be better to verify that no valid user virtual machines share hardware with other users. In a virtualized cloud environment, this fully eliminates the potential of side-channel attacks (Wu et al., 2022).

e) Malicious insider

When an employee of a cloud computing service provider is given access to sensitive data of some or all customers' administrators, one of the cloud computing difficulties arises. This information may be vulnerable to security dangers if these privileges are granted. Strict rights planning, as well as security auditing, can help to mitigate this security risk (Singh et al., 2022).

f) Data storage security

Users' data is stored in the CSP set of servers, which are all running at the same time and in a dispersed fashion. It is critical to maintain data integrity and confidence (Deng et al., 2022). Every institution is endowed with rules and regulations. Security controls, such as access control and audit policies, are at the heart of cloud computing rules and regulations. Cloud computing is well-known for storing data in virtual data centres that can be accessed in a variety of ways. As a result, data located in different parts of the world is subject to the legal authority of the area in which the server is located. Although this aspect saves organizations money in the short term, it can backfire if problems arise,

such as non-payment of bills due to dissatisfaction, data security violations, and so on. Each country has its own set of norms and rules (Wang et al., 2010).

According to Vepuri and Rahman (2021), cloud computing is based on the presence of commodity hardware that dynamically allocates resources in response to changing demands. As a result, cloud computing enables the service to provide cost-effective solutions to a huge number of customers around the world, which would otherwise necessitate large expenditures in in-house servers and infrastructure. As a result, there's a good chance that data will be kept on the same physical system. When multiple consumers try to access data stored on the same computer, this poses a problem, because service providers' data segregation solutions will eventually fail. Furthermore, migrating existing applications to the cloud is a difficult undertaking; different cloud providers impose different application architectures, which are inevitably different from enterprise application architectures (Maes, 2022).

Data warehousing, data availability, anonymization, integrity, confidentiality, data loss and leakage, cryptography, and inaccurate data are concerns associated with cloud data storage. All problems relating to desktop, network, and smartphone operating systems are referred to as operating system-based problems. Multi-clustering, physical clustering, virtual clustering, or data-intensive applications are examples of clustering computing difficulties. The dynamic nature of cloud computing necessitates a high level of availability in order to ensure that corporate operations run smoothly. However, there are various danger spots in the cloud architecture that could affect data availability for end-users (Harauzek, 2022). The dependency of cloud computing on network connectivity can be defined as reliability in terms of hazards connected with cloud computing. Another major problem with the cloud is its reliability, which has been questioned repeatedly. As previously said, having an internet connection is one of the most important prerequisites for cloud computing systems. This reliance on the network can be fatal, as network failures can result in a loss to the company by causing extensive time delays (Vepuri & Rahman, 2021).

2.4 Cloud-based hospital management system

Idoga et al. (2019) state that cloud-based hospital management system is a database-driven client-server application with client-server architecture. It stores data in a MySQL database and employs PHP and other related technologies (jQuery, HTML, CSS, and Ajax) for server-side and front-end programming. All users get access to the application using a single login form. According to the functionality, the application automatically directs different types of users to their appropriate interface. Attune (2019) states that HMS comes with numerous advantages but obviously all of that comes at a cost, which is the cost of space, technology, and implementation. Opting for a cloud-based HMS rather than an in-house server is an option that has many advantages and is a smart choice while automating hospital processes.

Attune (2019) states that HMS comes with numerous advantages but obviously all of that comes at a cost, which is the cost of space, technology, and implementation. Opting for a cloud-based HMS rather than an in-house server is an option that has many advantages and is a smart choice while automating hospital processes. Cloud-based technology solutions mean healthcare organizations may no longer have to pull together disparate data from various systems into a separate data warehouse in order to reformat, normalize, reconcile and/or publish. Integration between financials, supply chain, HR, and customer service in a single system yields value from day one.

According to Health (2017), healthcare provider systems leveraging cloud-based computing and cloud services offer benefits when compared to in-house client-server systems including economic, operational, and functional advantages. The cost of staff resources required to deploy and maintain IT resources are included in the cost of cloud computing. Therefore, the need for additional healthcare provider skilled IT staff resources and related costs may be reduced when using cloud services. According to Oracle (2019), cloud-based HMS gets sophisticated security controls, including data encryption and fine-grained access controls, and access logging. HMS built using cloud

services can offer web access to data, avoiding the need to store information on client devices. The need for scarce IT security skills within the healthcare organization also is minimized.

2.4.1 Benefits of cloud-based HMS

Cloud-based technology solutions mean healthcare organizations may no longer have to pull together disparate data from various systems into a separate data warehouse in order to reformat, normalize, reconcile and/or publish. According to Health (2017), healthcare provider systems leveraging cloud-based computing and cloud services offer benefits when compared to in-house client-server systems including economic, operational, and functional advantages. The cost of staff resources required to deploy and maintain IT resources are included in the cost of cloud computing. Therefore, the need for additional healthcare provider skilled IT staff resources and related costs may be reduced when using cloud services. According to Oracle (2019), cloud-based HMS gets sophisticated security controls, including data encryption and fine-grained access controls, and access logging. HMS built using cloud services can offer web access to data, avoiding the need to store information on client devices. The need for scarce IT security skills within the healthcare organization also is minimized.

O'Dowd (2019) states that cloud-based application management makes troubleshooting and maintenance easier for IT groups. Upgrades are made directly to cloud apps, removing the need for users to update their software and protecting the network from malware brought by unsupported legacy updates. A cloud-based health information management system allows IT departments to see and monitor activity throughout the entire system, making it easier to spot unusual activity. Cloud-based security monitoring solutions can use cloud-based health information management systems to prevent compromised apps from exchanging information with other apps on the network, making it easier to pinpoint the source of a hack (Bradshaw et al., 2016; Mukwena & Manyisa, 2022).

Walker and Walker (2022) state that individual information systems can be integrated into a cloud-based system to save time on administrative duties such as synchronizing data between apps and updating records and files across various apps. Users can apply data obtained by other departments to their jobs by sharing information between apps. Users in other areas can benefit from demographic or billing data required by a department utilizing a separate application within the cloud-based health information management system. The consolidation of all healthcare department apps into one platform makes it easier for users who need less frequent access to applications. Users do not need to contact IT for special permissions, nor do they need to download rarely used software to their device. Sharing patient data with pharmaceutical vendors aids in the advancement of research and medication development. Because of the cost, all of this data is likely to be too large to be housed in an on-premises server. That cost is greatly reduced using cloud computing, effectively cutting the cost of new medication development as well as the price of the drug for customers (O'Dowd, 2019).

Rural practices and healthcare institutions with limited budget may benefit from cloud-based HMS solutions. Hospitals are facing challenges involving a shortage of funds and talent, inconsistent medical standards, inefficient information sharing, and difficulties in management during the adoption of health information technologies (Mukwena & Manyisa, 2022). Electronic health records are created and maintained digitally; implementing solutions that take use of the digital file format could be extremely beneficial to healthcare providers. More accurate records result from better administration of health information and records. HMSs are an important solution for health IT infrastructure because they reduce human error. Cloud-based HMS solutions are flexible and adaptable as businesses add more applications (Bradshaw et al., 2016). ICT infrastructure-related constraints may be able to be jumped over and overcome with the help of the cloud. To facilitate information flow, it is being integrated with cell phones, mapping software, and other technology (Kshetri, 2011).

Henze et al. (2016) indicate that patients who see specialists for medical issues have a better time speaking with their primary care physician when their medical records are openly shared. Patients in rural or remote areas, as well as disaster relief teams, benefit from remote video conferencing. Healthcare data takes up a lot of space and is expensive to store locally. With cloud storage, large files like x-rays and imaging data can be transported and shared considerably more quickly both inside and across hospitals. Analysing population data, demographics, and treatment data ensures that the most up-to-date data is available to support clinical decision-making and better patient outcomes. The ability to evaluate enormous amounts of data generated by healthcare institutions on a regular basis can help with both care delivery and medical search.

Cloud computing is not the same as local storage. The sole purpose of on-premises servers is to store data. Other technical improvements can be assimilated into a health IT system thanks to cloud computing. Cloud-computing allows for remote file sharing, Wi-Fi equipped devices, and custom apps, to name a few. All of the components (such as, wireless network, apps, and storage) operating together and providing a stable basis for all other healthcare technology is the most crucial portion of health IT infrastructure O’Dowd (2019). Cloud-computing has the potential to change the way healthcare is delivered by enabling professionals to provide better services in the management of chronic illnesses. A summary of the benefits of cloud-based HMS is presented in Table 2.2:

Table 2.2: Summary of cloud-based HMS benefits

Benefit	Summary
Web access	Avoiding the need to store information on client devices.
Security	The need for scarce IT security skills within the healthcare organization is minimized.
Maintenance	Upgrades are made directly to cloud apps, removing the need for users to update their software and protecting the network.

Monitoring	Allows IT departments to see and monitor activity throughout the entire system, making it easier to spot unusual activity.
Integration	Individual information systems can be integrated into a cloud-based system to save time.
Remote access	Users in other areas can benefit from demographic or billing data required by a department utilizing a separate application within the cloud-based health information management system.
Software	Users do not need to contact IT for special permissions, nor do they need to download rarely used software to their device.
Costs	Cost is greatly reduced using cloud computing, effectively cutting the cost of new medication development as well as the price of the drug for customers.
Flexibility	Cloud-based HMS solutions are flexible and adaptable as businesses add more applications.
Service	Cloud-computing has the potential to change the way healthcare is delivered by enabling professionals to provide better services in the management of chronic illnesses.

2.4.2 Factors influencing cloud-based HMS implementation

Cloud computing in healthcare has grown significantly in recent years, owing to its remote access capabilities, among other things. According to studies, it has gotten a lot of

attention in the medical area. However, research shows that a significant proportion of healthcare customers, particularly in developing countries, have yet to accept the technology for a variety of reasons, including data security and poor use of available ICTs in healthcare. The results of data security, IT infrastructure availability, the use of existing ICTs in healthcare, and potentially even understanding of the technology determine its adoption. Healthcare service providers' perceptions, attitude, and intentions about the usage of new technology, such as e-health technology applications, are significantly influenced by their IT literacy and experience. Expectations of achievement, effort, and social influence all have a favourable impact on behavioural intention. Conditions that made it easier to work, facilitate data security and information sharing all have a good influence. Health institutions are still underdeveloped, in part due to insufficient government funding but also because funds are not being used effectively to focus on urban and rural health information and communication technology (ICT) (Idoga et al., 2019).

The management of knowledge resources is becoming more and more important as hospitals are under pressure to improve their healthcare systems and improve patient care. The benefit is knowledge retention and sharing so that they may improve patient care delivery (Adeyelure et al., 2019). It should be highlighted as well that referral is found to be highly challenging after a patient is asked to go to another healthcare facility because the hospitals are not on the same platforms or employing information change. Therefore, using cloud computing in the healthcare industry could address all of these problems (Idoga et al., 2019).

Mgozi and Weeks (2015) state that there are various studies in literature in which the acceptance and intention to utilize a cloud-based healthcare technology solution have been explored. The intention of medical physicians to use a clinical decision support system was investigated, with performance expectancy (PE), social influence (SI), and self-efficacy (SE) being identified as important factors. Performance Expectancy is described as the degree to which the user expects that using the technology would assist

him or her in achieving job performance improvements. Social Influence is defined as the degree to which a person's abilities are necessary to utilize the new system, whereas Social Influence is defined as the degree to which an individual feels that important others believe he or she should use the new system. Technology is positively impacted by both perceived usefulness (PU) and perceived ease-of-use (PEOU). Perceived Usefulness is described as a person's conviction and view that using a particular technology will improve their performance and productivity. On the other hand, PEOU is defined as a person's perception that using a particular technology will result in a reduction in effort (Idoga, 2019).

The extent to which the adoption of a given technology has a favourable impact on consumers' performance of specific activities. Cloud-based health knowledge (CBHK) is thought to be important for the long-term viability of cloud-based healthcare systems. If healthcare practitioners have prior experience of the systems' working environment, it will be easier for them to employ cloud-based healthcare systems (Bawack & Kamdjoug, 2018). A robust healthcare system, according to WHO, is one that provides appropriate healthcare service to address the health needs of individuals in a specific geographical location whenever they are needed. With this in mind, cloud-based health system refers to any computing techniques utilized by healthcare service providers to supply healthcare services such as Software as a Service (SaaS), Infrastructure as a Service (IaaS), and platform as a Service (PaaS). A summary of factors influencing cloud-based HMS implementation is listed below in table 2.3:

Table 2.3 Summaries of factors influencing cloud based HMS implementation

Factors	Summary	Source
Data security	Safeguarding digital information against nefarious entities and uninvited human behaviour, such as cyber-attack or a data breach.	Idoga, 2019
IT Availability	Available IT infrastructure components that are required to operate and manage the organization.	Idoga, 2019
Technology understanding	Staff understanding how technology or systems available in the organization work.	Bawack & Kamdjoug, 2018
Social Influence	The degree to which an individual feels that their important others believe he or she should use the new system.	Mgozi and Weeks (2015)
Information sharing	The Management of knowledge resources is more and more important as hospitals are under pressure to improve their healthcare systems.	Adeyelure et al., 2019).
Performance expectancy	The degree to which the user expects that using the technology would assist him or her in achieving job performance improvements.	Bawack& Kamdjoug, 2018
Self-efficacy	The degree to which a person's abilities are necessary to utilize the new system.	Mgozi and Weeks (2015)
Funds	The government funds which are not properly used.	Idoga, 2019

Perceived usefulness	A person's conviction and view that using a particular technology will improve their performance and productivity.	Adeyelure et al., (2019).
Perceived ease-of-use	Defined as a person's perception that using a particular technology will result in a reduction in effort.	Mgozi and Weeks (2015)

2.4.3 Cloud based HMS security

Vandana et al. (2022) did research on Integrity based Authentication and Secure Information Transfer over Cloud for Hospital Management System They discovered that to have a secure system the database that stores 16-byte long hex code that was produced as the hash code. Additionally, the material is translated from binary to hexadecimal representation using the blowfish encryption technique. On the cloud server, all user-related information will be accessible. The database includes tables that include data on user registration and access details as well as information on the status of their requests for approval or denial. User 1 has full authority to revoke the keys after the files have been uploaded. The request is submitted, and the file can only be viewed with the private and public keys supplied upon the request's approval. All of the cloud users who have registered can see the files uploaded by a single user, but they cannot access them unless they have the uploader's private key. Any user can request access to a file's content, and if the request is granted by the actual file owner, the requestor will receive the keys. The keys are only valid for one download' or one single user access to the file before they are promptly revoked. The same user or a different user must submit a new request and obtain fresh revoked keys each time they need access to the same file. This guarantees that the objectives of secrecy, integrity, and authenticity are met.

An administrative framework for flexible e-healthcare services based on cloud computing was proposed by Singh et al (2019). Their article recommended a paradigm for developing flexible e-healthcare service management that relies on distributed

computing. The suggested structure has been improved and now includes additional divisions to provide a framework for healthcare services. A network that is easily accessible is created by a health data management system based on the client side, a straightforward healthcare cloud, and application side. Since it overcomes the limitations of nominal crime and forget passwords in the conventional nominal id secret key instrument applied for providing security, a biometric-based confirmation system is acceptable in this situation. Additionally, it has a high accuracy rate for safe data access and recovery. Finally, they suggested structure improves cost administration, time, cost, and storage patient profiles.

2.4.4 Cloud-based HMS implementation in South African health institutions

Patients suffering from different diseases have no choice but to seek treatment at any conventional medical facility across the country. Following extensive talks with accessible medical professionals in South Africa, it has been discovered that with the exception of a few teaching hospitals, the bulk of health institutions in the country continue to use the old method of storing medical data. Information on patients is also not included. Some hospitals use both paper and EHR, and those who have fully converted to EHR are confronting a number of issues (Azzez & Van der Vyver, 2018).

Theoretical frameworks exist to help structure cognitive processes and areas of consideration while migrating to the cloud or studying causes of cloud migrations. The people, process, and technology (Ghaffari et al., 2019) model; the technology organization and environment (Raut et al., 2017) framework; and the diffusion of innovation and technological adoption models are just a few examples (Raut et al., 2017). These models and frameworks provide useful information and enable attention on essential areas that will undoubtedly be influenced by the cloud, yet they are insufficient. Because of the inadequacy of focusing simply on these approaches, it is impossible to completely comprehend precise technical insights into the cloud service provider (CSP) side, or migration tools that would meet the frameworks' initial expectations.

Lounsbury et al. (2022) state that the actual implementation and upkeep of digital health technology depends first and foremost on human skills and a strong supply chain to deliver the required tools and resources. Both determine whether the digital innovation will be viable after the trial launch in really difficult places. The pattern of funding is a factor in the discontinuous advancements in digital health technology that are frequently made. A connection based on trust and an awareness of the pertinent contextual variables is essential because the work of voluntary organizations and international aid is frequently seen as a series of disjointed transactions. Finally, the significance of engaging regional stakeholders to guarantee that the transfer of digital innovation beyond the pilot phase is greeted with appropriate buy-in.

ACMTs are found in and are a product of cloud service providers - whether they are consultants, cloud service brokers, CSPs, or other cloud service providers. Due to a lack of absorptive capacity (Schilling & Shankar, 2017) and capabilities inside the business or the CSP relevant to the specific cloud migration subtleties and how to address them, even well-laid plans from one of the aforementioned frameworks above may prove hollow. The nuances and mechanics of each organization's cloud migration differ, necessitating further thought.

With the help of cloud computing, many EMRs can be integrated to make it easier for healthcare organizations to share and trade specific medical data. It is a model that provides easy, convenient access to the network with less management work. Disruptive technologies like cloud computing have the potential to help the South African government fulfil its mandate and achieve its policy objectives of a collaborative government, greater internal efficiencies, and improved service delivery. This is because the government is struggling to meet the growing demand for enhanced service delivery while working with a tight budget (Masana & Muriithi, 2019).

Mgozi and Weeks (2015) state that everyone agrees that there are significant roadblocks to the implementation and adoption of the eHealth strategy in South Africa, which the

DoH has identified as difficult. The largest obstacle to the adoption of cloud computing in the health sector is said to be privacy and security. This makes it abundantly evident that privacy and security are two of the key issues that must be handled with care and managed for a successful adoption of cloud computing inside the South African healthcare system (Mukwena & Manyisa, 2022). To address major concerns about privacy and security of sensitive medical data for clinical decision making, the South African government should establish a regulatory policy framework.

2.5 Related Work

Hillestad et al. (2005) examined potential health and financial benefits of Health Information System (HIS); they compared healthcare with the use of IT in other industries. They used the word 'potential', by which they meant 'on the assumption that related and interoperable EMR systems are widely adopted and used successfully'. Thus, their estimates of potential savings are not predictions of what could happen with HIT and relevant improvements in healthcare. They calculated the costs and potential savings of widespread adoption of Electronic Medical Record (EMR) systems, modelled significant health and safety benefits, and came to the conclusion that efficient EMR implementation and networking could ultimately save more than \$81 billion annually by improving the efficiency and safety of healthcare, and that HIT-enabled chronic disease prevention and management could eventually double those savings while increasing health and other social benefits. They recommended that HIT should also make it easier to integrate systems for more extensive optimization, and competitive benchmarking should drive the creation of industry leading models for how to better plan, finance, and deliver healthcare. However, their study did not examine the potential of either the HMS nor the cloud-based HMS.

Khan et al. (2014) presented a paper, in which an architecture for secure cloud-based mobile healthcare employing wireless body area networks (WBANs) was presented. Their research project described two goals: first, it aimed to secure inter-sensor communication

using a multi-biometric key generation scheme in WBAMs; and second, it secured the storage of EMRs in the hospital community cloud while maintaining patient data privacy. As a result of its extremely effective key generation mechanism, the assessment and analysis of the suggested multi-biometric based mechanism reveals that it offers considerable security measures. Their study also revealed that in order to provide quality healthcare, it is important that healthcare providers access the electronic medical records and information in a ubiquitous manner. They pointed out that migrating HMS is essential. Hence, research should focus on this; such is the niche of this study.

Mgozi and Weeks (2015) conducted a research whose objective was to spark fresh, cooperative initiatives for the development of an evidence-based, value-based healthcare system to enhance the delivery of healthcare services; they proposed a theoretical cloud computing architecture that makes use of eHealth. They interviewed people in 15 software companies. Based on testing and a rather advanced usage of cloud computing, the questionnaires were chosen for a thorough study. They also interviewed the relevant stakeholders in order to test the accuracy and comprehensiveness of the suggested model. The results confirm that it is difficult to deal with the sensitive nature of clinical data. Similar to this, the South African government should allay worries about regulatory frameworks for the effective governance of the application of eHealth standards, while also advancing healthcare, particularly in the public health sector. Furthermore, the best methods for using cloud computing platforms within the SA healthcare sector should be investigated and gathered by practitioners and researchers (Mukwena & Manyisa, 2022).

Aijing and Jin (2015) designed and researched a cloud-based HIMS. This system will enable cost-effective and efficient integration of hospital information resources. The management of the out-patient department, in-patient department, dispensary, medical technicians, query and statistics, as well as the management of the auxiliary diagnosis, are all part of the hospital integrated information management; this is clear from the interviews, research, and related materials gathered. The cloud-based integrated information management solution for hospitals were specifically designed for them. Not

only does it achieve the best possible integration of hospital information resources, but it also raises the bar for standard management. Additionally, the hospital's investment in hardware and software is reduced by using the cloud platform. Much as their study went ahead to design a cloud-based HMS, their focus was on designing alone without first establishing the empirical evidence for design. Furthermore, their system was designed in the Chinese context, which is quite different from the South African context.

The goal of the analysis that was conducted by Romero et al. (2016) was to pinpoint personal health records (PHR) system that are integrated, dependable, and cloud-based that are now in use or that are being considered. The approach they used was broken down into 3 steps for the scope review: the searching phase, iterative filtering, and analysis. They analysed 101 articles and identified four areas of research: proposal/developed systems, PHR recommendations for development systems integration and standards, security, and privacy. For each trait that was included in their review question, the ABE mechanism is the most frequently employed method of ensuring reliability. Most cloud-based systems offered service oriented architecture (SOA) and based access to cloud services through web servers, making it easier for mobile devices to use. They discovered that the best method for deploying PHR is the hybrid cloud. The majority of works used Clinical Document Architecture as their default solution for the most recent integration term. The development of a PHR system architecture that satisfies the three essential requirements of integration, reliable, and cloud-based operation while adhering to cutting-edge technological standards is proposed for future work.

Sandy and Mavhandu-Mudzusi (2016) conducted research on pharmacists' attitudes toward a patient management system in a public hospital in Southern Africa. Their study revealed that hospitals in Botswana use the Patient Management System (PMS) to collect and process patients' treatment data. Their study adapted the Guba and Lincoln (1990) framework of trustworthiness, which tests five criteria, namely credibility, dependability, confirmability, transferability, and authenticity. They concluded that pharmacy staff has

limited knowledge of the PMS, including its utilization in data capturing. They recommended that further research is needed to explore factors influencing pharmacy staff use of PMS. Their study did not investigate the opportunities of using cloud-based HMS.

Wright et al. (2017) examined the role and focus of current electronic health information systems in South Africa's public healthcare system. To determine the function of health information systems that are most common in South African public healthcare, a qualitative approach was used. The findings show that support for clinical care, such as radiology and pathology, as well as monitoring, evaluation, and administration objectives, are the most frequent roles of health information systems. There seems to be few systems that facilitate clinical treatment that is patient-centred, even though some systems do gather some limited clinical data. They recommended that the role of health information systems be increased to support direct patient care and enhance personal health outcomes.

Trinkunas et al. (2018) conducted detailed research on HMS integration to the national Electronic Health Record System (EHRS). They indicated that the main problem of integration is the complex processes involved in the development of EHRS. Their study also investigated business processes involved in the integration. Their study provided scientific business processes of healthcare information systems and new EHRS integration architecture was projected and described. The study's statistical analysis showed that implementation of improved business processes influences the better development of an HMS. Much as their study developed integration architecture, it did not base the development on any theoretical framework that is the core for this research.

Srivastava et al. (2019) presented a case study of designing and implementing a cloud-based Generic Medical Equipment Interface (GMEI) along with the state of art in such systems. The solution removed the burden of re-entry of patient's information into the HER and aims to accelerate EMR initiative in India. In laboratories they had more than

one legacy machines, this not only made training and maintenance more difficult, but it also raised the overall cost of operating. With the introduction of GMEI, all machines were able to migrate to a standard interface, resulting in significant cost savings in terms of training, maintenance, and upgrades. Such solutions were tremendously beneficial in expediting the standardizing process across the country and achieving the government's different health priorities. The effectiveness of the cloud-based GMEI was established during its development and implementation. For the operation of such systems and their integration with a HIS for keeping a patient's EHR, a general architecture was provided. Such solutions would be very beneficial in expediting the nation's standardizing process and realizing the government's different health programs.

Adeyelure et al. (2019) looked into the variables affecting the existing information exchange occurring within the South African healthcare system. For data gathering, one of the major healthcare organizations was chosen, and a qualitative research methodology was used in this study. Their research identified the various actors involved in information sharing as well as the networks that support it. Their study also identified the causes of information sharing. Their survey found that the majority of healthcare workers are aware of and use the majority of the tools and practices necessary to allow knowledge sharing inside the business. Since it is a routine component on their jobs, the majority of healthcare workers share knowledge without even being aware that they are doing so. Their study only addressed knowledge sharing-related difficulties.

Ganiga et al. (2020) wrote a paper proposing a security framework for EHR systems, taking into consideration the integrity, availability, and privacy of medical records. The STRIDE modelling tool simulates the threats to the EHR system, and DREAD was used to determine the level of risk. Multiple threats and weaknesses were discovered, and an HER reference design has been established to allow secure data sharing amongst numerous healthcare providers. Their research demonstrated that employing the recommended solutions effectively tackles security concerns such as the compromise of sensitive medical data. The study recommended security mechanisms and

countermeasures that can be used in an EHR system, based on security requirements. Healthcare workers and providers can share patient information at all levels of the healthcare system with the use of a cloud-based HER system.

Karthikeyan and Sukanesh (2020) wrote an article to use cloud computing to sprout SaaS with the goal of bringing the emergency health care industry under one umbrella with physically secure patient records. They created a palm vein pattern recognition-based medical record retrieval solution, leveraging cloud computing. Their work primarily focused on SaaS-Based Solutions for distributing image processing tools for medical professionals and sharing patient history. The software employs a layer design that allows each layer to be adjusted independently of how the other layers perform. The most important item they considered while structuring emergency healthcare treatment was patients' previous health conduct records. As a result, having access to appropriate records at all times is critical. The detection of palm vein patterns guarantees safe patient record access. Similarly, their article offers a quick and easy way to view, edit, and transfer images, which has been a difficult chore for medical professionals in the past. They mentioned that grid computing and cloud computing are two new forms of distributed computing technologies. These new forms will undoubtedly provide IT as a service to the mass of the population. They detailed how these new forms of distributed computing will benefit modern health care sectors in their research. Mobile cloud could be added to their future work. By lowering the amount of paper used in prescription processes between hospitals and pharmacies, such integration benefits the environment. Additionally, it can save a lot of misunderstandings between patients, pharmacists, and doctors. It will lessen medical errors, storage problems, security concerns, and privacy concerns.

Sneider (2021) conducted a research to identify the best leadership practices of multinational corporations (MNCs). The goal of the study was to find out which MNCs have the finest leadership practices when it comes to using automated migration technologies to embrace commercial cloud computing platforms. Cloud computing

adoption is a big technical revolution that is still in its early phases around the world. A meta-analysis research approach concentrating on the triangulation of case studies, cloud computing industry data, and trends from CSP indicated that MNC executives' best practices fall into three primary categories which are awareness, impact, and actions. Furthermore it was discovered that having the most advanced capabilities does not always imply faster cloud value realization for the MNC. They observed that further research on the automation in cloud migration solution deployment will be crucial as ACMT capabilities continue to increase with the continuous development of ACMTs and their growing acceptance.

2.6 Related Information Systems theoretical frameworks

This section discusses theoretical perspectives in relation to technological innovation adoption as well as migration of services to the cloud environment.

2.6.1 Technological Organizational Environmental (TOE)

The TOE framework was developed by DePietro et al. (1990) as a solution to include organization and environmental factors in the adoption and use of technology studies. It identifies three aspects of an organization's context that influence the process of adopting and implementing technological innovations. These are technological context, organizational context, and environmental context. The technological context describes both the internal and external technologies relevant to the organization, whereas the organization refers to those aspects that are related to the enterprise's characteristics and capabilities. The environment context on the other hand refers to the surroundings in which the implementing organizations reside (Chiu, 2017). Researchers who have used TOE - such as Pan and Jang (2008) - observed that its constructs are key in influencing the process by which an organization adopts and implements technological innovations. From this TOE model, all the three constructs, namely technology, organization, and environment were included in the conceptual model of this study.

2.6.2 Diffusion of Innovation (DOI)

Rogers (1995) developed the Diffusion of Innovation (DOI) theory in the mid-90s. Since its inception, DOI has been declared as an extensively used theoretical framework by information System researchers, specifically within technological adoption (Sahin, 2006). Innovation has been defined as a new idea, process, or product (Kim & Juan, 2011). DOI describes the way channels of innovation are communicated within a particular time amongst the members of the social system. DOI has five constructs, namely relative advantage, complexity, compatibility, observability, and triability. Since all DOI's constructs are technological factors, all its constructs will be included in the TOE's technology context.

2.6.3 Unifying of the Fragmented Models of Information System' Implementation theory

The theory of the unifying the fragmented models of information system implementation was developed by Kwon and Zmud (1987) to unify the many theories that had been developed in technology adoption and implementation. The theory indicates that individual factors play a significant role in technology implementation, acceptance, adoption, and use. The theory consists of five constructs, namely individual factors, structural factors, technological factors, task related factors, and the environmental factors. This study will use all of these factors in its conceptual model.

2.6.4 Dempster-Shafer Theory (D-S Theory) of Evidence

The Dempster-Shafer theory of evidence was developed by Dempster and later extended by Shafer (Dempster 1967, 1968; Shafer 1976). The theory has been widely applied for business decisions, auditing, sustainability evaluation, and risk assessment (Beynon et al. 2009). The D-S theory uses the concept of 'degree of belief' for modelling and reasoning under uncertainty and incomplete information. The D-S theory consists of three

basic functions: basic probability assignment functions or m-values, belief functions, and plausibility functions. Rahman et al. (2017), who used the theory to investigate cloud migration, alluded that the risk factor involved when migrating services to the cloud are management competency, service level, security, and cost effectiveness. They, therefore, indicated that risk management in cloud computing is an essential task. They emphasized that it is important to address factors of security, cloud architecture, regulatory compliance, data location, disaster recovery, and provider lock in. They allude that sustainable cloud migration also focuses on the continuity of service, adequate training, and support for administrators and IT professionals and ease-of-use hence vendor and management support is paramount. This research will use security, regulatory compliance, and disaster recovery factors in its conceptual framework.

2.7 The Conceptual Model

From the reviewed literature and the discussed theoretical foundations, a conceptual model was derived. Four theoretical models have been discussed that included TOE, DOI, the unification of the fragmented models of information systems implementation, and the Dempster-Shafer theory. From TOE all the three constructs of technology, organization, and environment were found relevant for this study and are, therefore, included in the conceptual model. On the other hand, from the DOI theory all the five constructs, namely relative advantage, complexity, compatibility, observability, and triability will be integrated into the technological aspects of the model. Similarly, from the unifying of the fragmented models of information systems implementation all its constructs were also included since with the exception of individual characteristics the other constructs cut across the TOE and DOI constructs. Lastly, from the Dempster-Shafer theory, the security, regulatory compliance, and disaster recovery factors have been adapted. The conceptual model is as illustrated in Figure 2.4:

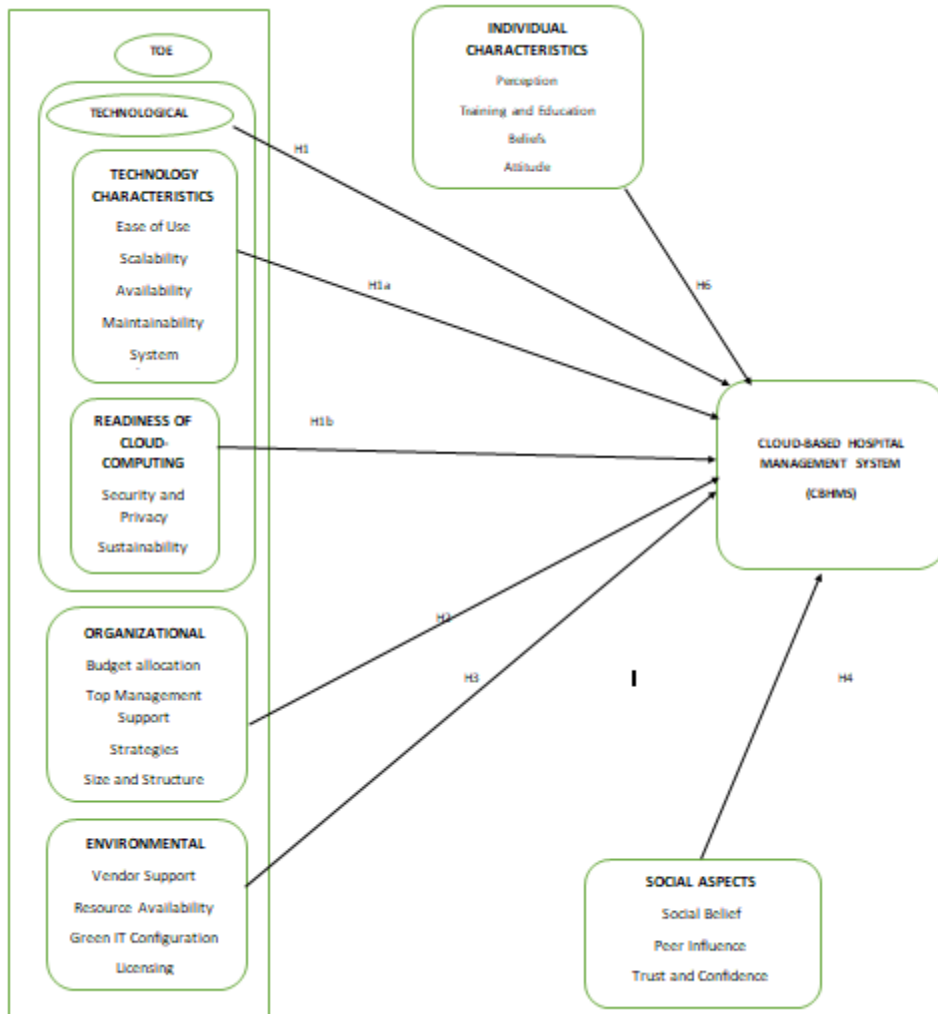


Figure 2.4: Model for cloud based hospital Management system

2.7.1 Operationalization of the constructs and hypotheses development

This section discusses the constructs of the model and the development of the hypotheses.

a) Technological context: In respect to this study this construct relates to the technological components that could be used in the migration of hospital management

system to the cloud. In this study the technological context was looked at from two different perspectives, namely technological characteristics and readiness for cloud computing technology. From these two aspects the first hypothesis (**H1**) and its sub hypotheses (**H1a** and **H1b**) were theorized.

H1: Technological factors influence the development of cloud-based Hospital Management System.

H1a: Technological factors due to technological characteristics influence the development of cloud-based Hospital Management System.

H1b: Technological factors due to organization's readiness for cloud technology influence the development of cloud-based Hospital Management System.

b) Organizational context: This construct relates to the institutional aspects that play a role in the migration of the HMS to the cloud. These include support, training, and financial costs. From this construct the second hypothesis (**H2**) was developed.

H2: Organizational factors influence the development of cloud-based Hospital Management System.

c) Environmental context: This construct relates to the environmental surroundings that influence a hospital to migrate its services, including the HMS, to the cloud. These may include but are not limited to the need to provide faster services by enabling medical personnel access services much faster and efficiently, the support from the government including policies to enable technological innovations for health, and improving the health environment by reducing unnecessary emissions and e-waste. From this construct a third hypothesis (**H3**) was suggested.

H3: Environmental factors influence the development of cloud-based Hospital Management System.

d) Individual characteristics: This construct relates to the features and personal traits of the people dealing with HMS that may make them feel the need for a cloud-based HMS. Such characteristics include perceptions of technological innovations, learnability, skills, and education background. These characteristics may make individuals' perceive cloud-based HMS as easy to use and also to increase their self-efficacy. From this understanding a fourth hypothesis (**H4**) was suggested.

H4: Individual characteristics influence the development of cloud-based HMS.

e) Social dimension: This construct relates to individuals' feelings that are being induced in them due to their peers or society. This includes social beliefs, peer influence, trust, and all related aspects of influence that an individual could be subjected to by others. From this construct a fifth hypothesis (**H5**) was developed.

H5: Social dimensions influence the development of cloud-based HMS.

f) Risk analysis and control: This construct relates to those aspects that deal with all associated risks in the migration of HMS to the cloud and during its use of the cloud-based HMS. This construct involves aspects such as risk management, subjective management, service quality as well as incidental management. From this construct a sixth hypothesis (**H6**) was theorized.

H6: Risk management and control influence the development of cloud-based HMS.

2.8 Summary

In this chapter the basic knowledge of cloud, hospital management systems, and related work was articulated. The chapter discussed the concept of cloud computing including its applications and benefits. Furthermore, the chapter discussed the South African health system and highlighted its challenges. This chapter also discussed the factors influencing the implementation of cloud-based HMS, and the extent to which cloud-based HMS has been implemented in the South African context. Additionally, related work is discussed as well as the theoretical foundations that formed the basis of the development of the study's conceptual model. Lastly, the chapter operationalized the constructs of the conceptual model and discussed how each hypothesis was developed.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

This chapter outlines how the whole process of research was conducted. The chapter aims at explaining the methods that were used in collecting and analysing data for this study. The chapter starts by highlighting the research philosophy that informed the paradigm that was followed by the study. In addition, the chapter highlights the research process of how the quantitative approach was followed to collect and analyse the primary data collected. Lastly, the chapter gives the ethical considerations that were followed during the process of collecting and analysing data.

3.1 Research design

The research design is the process of building a plan in a structured manner to undertake the research project (Leavy, 2017). This study followed a quantitative approach for which data was collected using a close-ended questionnaire and was analysed using statistical methods. The designed conceptual model informed the development of the measuring instrument as well as data analysis. The rest of the chapter flows as follows: first the research philosophy is discussed, followed by the paradigm that governed this study. The methods of data collection and analysis are discussed as well as the reliability and validity of the study. Lastly, the ethical considerations are discussed.

3.2 Research Philosophy

A research philosophy is a viewpoint on the methods that should be utilized to collect, analyse, and apply data regarding a topic. In contrast to doxology, which refers to what is thought to be true, the term epistemology refers to what is recognized to be true. So, the process of changing what is believed in to what is known - from doxa to episteme - is the goal of science. In the Western tradition of science, there are two main research ideologies that have been identified: positivist (also known as scientific) and interpretivist (also known as anti-positivist) (Galliers, 2004).

In the past, researchers have been compelled to choose between the interpretive model, which is connected with qualitative methods, and the positivist scientific model of research, which is associated with quantitative methods. The quantitative or positivist tradition, which was historically dominant in healthcare research and is widely regarded as the gold standard, was founded on the idea that the researcher must be unbiased and objective. Because positivism holds that there is only one reality, it strives to establish casual connections through quantitative analysis and objective measurement (Firestone, 1987). Using large samples to test carefully established hypotheses, the researcher is seen as independent and impartial under the positivist paradigm. According to conventional knowledge, a researcher trained in the positivist tradition can set aside personal values in order to conduct an investigation without bias (Doyle et al., 2009).

Positivism, which has its roots in the natural sciences, emphasizes discovering logical or mathematical proof derived from statistical analysis as well as the scientific testing of hypotheses. Therefore, positivists frequently provide exact, objective, and quantitative data using high sample sizes. The positivism research philosophy serves as the foundation for this investigation. Due to interpretivism's perceived inability to satisfy the needs of social scientists, positivism evolved (Collis & Hussey, 2014). According to the positivist paradigm, actual events may be observed empirically and rationally analysed to provide an explanation (Crossan, 2003).

3.3 Research Paradigm

The word paradigm is used to describe the philosophical presumptions or fundamental set of beliefs that serve as the researcher's compass and shape their worldview in social science (Kaushik & Walsh, 2019). The word paradigm was first used by Thomas Kuhn in 1970 to refer to the generalizations, convictions, and ideals held by a group of experts regarding the nature of reality and knowledge. According to Creswell and Clark (2011), Lincoln (1990), and Rossman and Rallis (2003) worldwide is another word for paradigm

and is defined as 'a way of thinking about and making sense of the intricacies of the real world'.

Modern social work research is structured and organized according to a number of paradigms or worldviews, such as constructivism, positivism, and participatory action frameworks (or pragmatism), but they are all fundamentally philosophical in nature and have the following characteristics:

- Ontology - is the premise that reality is what it is;
- Axiology - is the belief that values and morality have a part in study;
- Epistemology - refers to presumptions about how we know the world, how we learn things, and how the knower and the knowing are related;
- Methodology - a consensus on the most effective ways to learn about the world;
- Rhetoric - the comprehension of the research language as a whole (Lincoln et al., 2011)

Kaushik and Walsh (2019) state that each paradigm approaches the axiology, ontology, epistemology, methodology, and rhetoric of research from a different angle. Positivism is one of the most established methodologies of social research, and is characterized by its emphasis on precision, generalizability, reliability, and replicability as well as its use of quantitative tools and highly formal terminology. Constructivism is generally connected with literary and informal language, qualitative research methodologies, and participant-centred approaches in which the researcher creates subjective interpretations of the phenomenon. Pragmatism is a paradigm that seeks to bridge the gap between naturalistic methods and freewheeling orientation of more recent approaches and the scientific method and structuralized orientation of older approaches (Creswell & Clark, 2011). This study adopted the positivism paradigm. Studies that adhere to positivism typically concentrate on using quantitative methods to identify explanatory associations or casual relationships, and they favour empirically based results from large sample sizes. In this regard, generalizable inferences, replication of results, and controlled experimentation have been guiding principles in positivist science (Park et al., 2020).

3.3.1 Benefits of positivism

Hovorka and Lee (2010) referred to positivism as an observing researcher's formal propositions because it satisfies the rules of formal logic and the rules of empirical testing. The notions and variables used are the sole property of the researcher. The main tenets of positivist thought are determinism, empiricism, parsimony, and generality. Positivism places a strong emphasis on experimentation, observation, control, measurement, dependability, and validity. When studied and discussed, positivism adheres to a clear structure (Tseng et al., 2021). There is no space for error because established laws and rules are observed. It also leaves little room for variance and drastic variable changes (Shirazi, 2020). In order to acquire data on the same issue in many social contexts, theory can be generalized to a great extent.

When a research conclusion has been reproduced across numerous populations and subpopulations, it can be generalized (Johnson & Onwuegbuzie, 2007). Scientific research can be advanced by the use of quantitative data hence researchers can use quantitative data to provide objective information for scientific hypotheses (Johnson, 2014). In the case of this study, the goal was to develop a model for cloud-based HMS hence collecting data based on a quantitative approach did not only help to reach a wider population of healthcare providers but also helped to collect data from them in their free time, keeping in mind that they are always busy during working hours.

3.4 Research Approach

In its most basic form, research is the pursuit of knowledge and the pursuit of reality. Formally speaking, it is a systematic examination of a problem that is attacked by a deliberate strategy that begins with selecting a method for creating a blue print (design), acts upon it in terms of designing research hypotheses, selects techniques, selects or creates tools for data collection, processes the data, interprets the results, and concludes

with presenting a solution or solutions. Depending on the technique, the solutions may be specific to an individual, a sample, a small group, or the entire population. An approach is a set of strategies for conducting research that include anything from general hypotheses to specific techniques for gathering, analysing, and interpreting data (Creswell & Clark, 2011). Which method should be employed to study a subject is the main decision. The philosophical presumptions that an approach brings to the study, the procedures of inquiry (research designs) that the chosen approach necessitates, and the specific research methods of data collection, analysis, and interpretation that are directed by the design all play a role in reaching this decision (Grover, 2014).

The objective of any study is to ensure a thorough investigation that will result in extrapolation and the addition of new knowledge to the field of enquiry (Cohen et al., 2018). In order to achieve the desired goal, it is necessary to determine the association between the theoretical framework's defined constructs. To analyse and explain the results that were found, a unique approach must be used. This study followed a quantitative research approach.

3.4.1 Choice of the selected approach

Assumptions that human behaviour can be described by what we may refer to as 'social facts' that can be explored using procedures that use the natural sciences' deductive logic are what define quantitative research designs. A quantitative approach may be justified if one of the goals of the research is to measure variables that are strong in quantitative research, such as a quantitative assumption regarding the capability of the construction process, which states that processes can be reduced to a set of variables that are somehow equivalent across construction projects, the parties involved, and across situations (Amaratunga et al., 2002).

3.4.2 Advantages of using a quantitative approach

Amaratanga et al. (2002) give the strength of quantitative techniques to include:

- a) Reproduction and comparison are permitted.
- b) Separation between the observer and the object being observed.
- c) Instead of being inferred subjectively through feeling, reflection, or intuition, the subject of the analysis is measured using objective procedures.
- d) Compared to qualitative methods, reliability and validity may be more objectively assessed.
- e) Strong at measuring the subject's descriptive aspects.
- f) Emphasizes the need to form theories for later confirmation.
- g) Helps in the quest for causal explanations and fundamental rules, and generally simplifies the total in order to make analysis easier.

3.5 Research strategy

According to Saunders et al. (2015), a research strategy is a plan of by which a researcher reaches the participants needed for data collection. This study used the survey strategy to collect data. Data for this study was to be collected from various health institutions in different areas. Because medical personnel who were the intended respondents of the study are always busy people, this study opted to use the survey strategy using close-ended questionnaires.

3.5.1 Advantages of using a survey strategy

The reason why a survey seemed more suitable for this research is because it makes it easier to find people who have unconventional or secretive behaviour. The ability to remain anonymous on the internet is said to make it easier to reach people who are typically hard to reach, and they can more readily share their experiences and thoughts. The appeal of computers to specific age groups differ. Conducting surveys with young

people online instead of using paper and pencil usually means response rates may be greater (Saunders et al., 2015).

A researcher can get data from hundreds or even thousands of individuals via the internet in a short amount of time (Rice et al. 2017). Other advantages mentioned by Van Selms and Jankowski (2006), are: bias-free interviewing; data entry is no longer necessary because responders simply input information into an electronic file; and respondents' convenience. Online surveys are, therefore, thought to be helpful when researching sensitive topics (Wang, 2015).

3.6 Data collection methods

Data collection method is the process of assembling and administering data, then analysing the collected data to inform decision-making (Patten, 2016). This study used close-ended questionnaires to collect data. Due to increased restrictions of visitations at many institutions, data was collected online. The questionnaire with close-ended questions was uploaded onto Survey Monkey and the link leading to the survey was sent to the contact person to distribute to the respondents. At each hospital, the researcher got a contact person, mostly from the ICT directorate. For anonymity, the questionnaire on the Survey Monkey was designed in such a way that respondents only needed to click on the submission button and the filled questionnaire was captured on Survey Monkey database with the respondents' particulars on completion of the questionnaire, the filled datasets were exported to the Statistical Package for Social Scientists (SPSS v 25) for analysis. The questionnaire was designed in such a way that neither the particulars of the individual respondents nor those of the health institution were asked, so anonymity was ensured.

3.6.1 Questionnaire development

The questionnaire was developed based on the conceptual model where the seven constructs of the model formed the sections of the questionnaire, and their attributes

formed the question items. The designing of the questionnaire followed a 5-point Likert scale where 5 and 1 represented strongly agree and strongly disagree, respectively; 4 and 2 represented the respective intermediate values, whereas 3 represented neutral. After data collection, the questionnaire was coded, and then transcribed in SPSS v 25 for analysis.

The designed questionnaire was then transcribed into Survey Monkey for online data collection.

When transcribing the questionnaire online, the screen design option was used. In web questionnaires, screen designs offer a variety of interactive options, including automatic jumps between questions that enable the omission of irrelevant questions based on prior responses, the display of missing data messages alerting the respondent to unanswered questions, the presentation of instructions or explanations based on answers provided by the respondent to previous questions, or the adaptation of question text in response to responses given to the previous question. For a respondent to move to the next question they must first submit the answer for the current question and then click 'next'. The last question has a button for submitting the responses on the survey's website.

3.6.2 Questionnaire coding

After data had been captured on the Survey Monkey database, the questionnaire was exported to SPSS. However, for easy analysis the questionnaire was coded in such a way that the constructs and their attributes are shorted to carry meaning while observing originality of the question item and the construct. The seven constructs and their attributes were coded as follows:

- Technological Characteristics was coded as (TechChar) and its five attributes as TechChar1-5

- Readiness for Cloud Computing was coded as (CloudCompRead) and its three attributes as CloudCompRead1- 3
- Organizational Aspects was coded as (OrgAsp) and its six attributes as OrgAsp1-6
- Environmental Aspects was coded as (EnvtAsp) and its four attributes as EnvtAsp1-4
- Individual Characteristics was coded as (IndivChar) and its four attributes as IndivChar1-4
- Risk Analysis Control was coded as (RiskAnCtrl) and its four attributes as RiskAnCtrl1-4
- Social Aspects was coded as (SocAsp) and its three attributes as SocAsp1-3.

3.6.3 Advantages of using a close-ended questionnaire

The benefits of close-ended questions include the opportunity to learn from people's spontaneous responses and avoiding the prejudice that could arise from giving answers to people, which could have happened with open-ended questions (Reja at al. 2003). In the case of this study, the use of close-ended questionnaire helped as follows:

- a) Close-ended questions are typically simpler to answer and are likely to cut down on the time it takes to complete the survey. With respect to this study, the respondents were people who are quite busy due to human resource constraints in their work environments. Hence, using a close-ended questionnaire was good in that these respondents could squeeze time to answer the questionnaire.
- b) Using close-ended questionnaires simplifies work for respondents as they are only asked to choose from a list of responses that best express their views or qualities. This explains why this study had a good response rate despite the fact that respondents were busy.
- c) Close-ended questions require a choice to be made for how to present the answer categories, such as radio button or drop-down box, whereas open-ended

questions demand that a text field or text area be offered on the screen/page for respondents to insert their answer. This increases the possibilities of answering all questions that are presented to the respondents.

3.7 Population and Sampling of the respondents

Since this study followed a quantitative approach, it was prudent to collect as much data as possible from all qualifying respondents of the study.

3.7.1 Population of the study

A population of the study is the entire group about whom you want to make conclusions from. In research, it does not always refer to humans only. It can refer to a collection of whatever you desire to study, including things, organizations, occasions, nations, species, and animals. The population of this study was health personnel in public hospitals that are using HMS in Gauteng Province, South Africa. This study identified three public hospitals that were already using HMS, and these were: DR. George Mukhari Academic Hospital, Jubilee Hospital, and Steve Biko Academic Hospital (Maphumulo & Bhengu, 2019). According to Massyn et al. 's (2020) report, the District Health Barometer, South African hospitals are human resource constrained and on average there are between 30 to 50 medical personnel and health workers in district hospitals and slightly more numbers in provincial hospitals. Hence the population of the study based on the district hospital level was 108 respondents.

3.7.2 Sampling of participants

Sampling is a process of dividing samples into a subset of the units for analysis, and effectively generalizing this sample that is representative of a larger population (Creswell & Clark, 2011). After identifying the population of the study which was 130 medical personnel and health workers, this study used the Krejice and Morgan's (1970) tool for

determining the sample size of a finite population to arrive at the sample size that was needed for this study. The Krejice and Morgan's (1970) is illustrated in Table 3.1.

Table 3.1: Krejice and Morgan's (1970) Tool for Table for Determining Sample Size of a Finite Population

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size.
S is sample size.

As demonstrated in Table 3.1, for a population of 130 a sample size of 108 respondents was needed for data collection. Since data for the study was to be collected online, simple random sampling was used to reach the 108 needed respondents. However, before the survey link was sent out an inclusion criterion was set that the respondents had to be healthcare personnel, and/or a social worker or/ and information technology (IT) employee of the hospital.

3.7.3 Survey link distribution

Due to the fact that this study was following a quantitative approach and wanted to collect as much data as possible from many respondents, more survey links were sent as compared to the needed sample size. Based on a simple random sampling and the set inclusive criteria, the contact people were requested to send to almost all personnel that form the population, but within the inclusive criteria. In total, 130 survey links were sent out to the prospective respondents. Of these, 98 filled questionnaires were captured back on the survey link database, forming a response rate of 75.4%. However, of the captured datasets only 83 were usable and others were discarded due to incompleteness. The cleaned data was exported to SPSS for analysis.

3.7 Data Analysis

Data analysis is the process of making meaning from the collected data by drawing insights that can help in decision-making (Cohen et al., 2018). In this study, the collected data was analysed by using descriptive and inferential statistics. Descriptive analysis was used to explain the frequencies of the participants demographic and situation variables, whereas inferential statistics like correlation and regression were used to analyse the relationship between constructs and the suitability and adaptability of the developed model.

3.7.1 Pilot study

Prior to using a measuring instrument for the major survey, the questionnaire was piloted with medical personnel in a clinic in Soshanguve that was not going to be included in the main survey. Respondents of the pilot study were asked to assist in assessing the completeness of the questionnaire including both the syntax and semantic implications as well as content and face validity assessment. In addition, the piloting of the questionnaire also assisted in correcting typographical and grammatical errors that could

have led to confusion in the interpretation of the question items. Results obtained from the pilot study helped in rectifying typos, and grammatical as well as the syntactical and semantical errors of the questionnaire. These results were used to carry out the analysis of the reliability and validity of the questionnaire.

3.8 Validity and Reliability

Research is conducted to collect relevant information that can be used to solve the identified research problem (Babbie, 2016). Hence, a high level of reliability and validity should be maintained when collecting data. Additionally, the measuring instrument must be designed such that it consistently measures what it is supposed to measure, and research should ensure that while collecting data, the obtained results are trustworthy in order to develop future forecasts (Yin, 2014). Research standards are based on credibility, reliability, and conformity of data hence validity and reliability must be ensured for the quality and research standards.

3.8.1 Validity of the study

Validity refers to a set of tests carried out to ensure truthfulness of the measuring instrument, and is achieved by checking that the measuring instrument is actually measuring what it is supposed to measure (Yin, 2014). In this study, four different checks were carried out to ensure that the measuring instrument meets these validity standards, and these were:

- a) **Face validity:** Face validity was enforced by ensuring that the questionnaire is logically measuring the migration of HMS in the cloud-based environment. In this case the researcher with the study leader carried out personal or on-the-surface judgement of whether or not the research or test measures what it claims to measure. This also included the correction of both the syntax and semantic errors as well as proof reading.

- b) Content validity:** Internal validity aims to create a causal relationship between variables when one circumstance is thought to lead to another (Yin, 2014). In this study, content validity was ensured by checking that the content of the measuring instrument is sound and related to the migration of services and applications to the cloud environment. This also involved the comparison of the measuring instrument with those of previous researchers on migration of services and applications to the cloud.
- c) Criterion-related validity:** According to Babbie (2016), external validity is connected to criterion or predictive validity, which is the degree to which an amount relates to an external norm. To ensure this form of validity, this study carried out tests that included correlation analysis to see how each construct relates to the other.
- d) Construct validity:** This refers to whether a scale or test can accurately assess constructs that are difficult to observe (Yin, 2014). This form of validity was ensured by comparing the constructs used to develop the measuring instrument with other measures and inferring from the pattern of relationships measured in correlation and regression.

3.8.2 Reliability of the study

Reliability refers to the measuring instrument's capacity to produce similar results with duplicated or replicated tests (Yin, 2014). This study used Cronbach's Alpha, also known as Alpha coefficient, to determine the reliability or internal consistency of the questionnaire and its constructs. The overall reliability of the questionnaire with 32 items as demonstrated in Table 3.2 was found to be 0.960 - which reliability was considered good since it was above the recommended threshold of 0.7, and also comparing the number of items in the questionnaire (Heale & Twycross, 2015).

Table 3.2: Overall Reliability statistics of the measuring instrument

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.960	.960	32

After the testing of the overall questionnaire reliability, the reliability of independent constructs was also tested as demonstrated in Table 3.3.

Table 3.3: Reliability Statistics of Constructs

Construct	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
Technological Characteristics (TechChar)	.792	.791	5
Readiness for cloud computing (CloudCompRead)	.818	.819	3
Organizational Aspects (OrgAsp)	.856	.856	6
Environmental Aspects (EnvtAsp)	.846	.847	4
Individual Characteristics (IndivChar)	.862	.862	4
Risk Analysis Control (RiskAnCtrl)	.747	.745	4
Social Aspects (SocAsp)	.755	.755	3

As demonstrated in Table 3.3, the reliability of the independent constructs was all above the recommended threshold, which suggested that all the constructs could be included for further analysis.

3.9 Ethical consideration

Research ethics aims at guiding and guarding researchers against the misinterpretation of research data and promoting truthfulness (Babbie, 2016). According to Adams et al. (2017), there are five ethical considerations that need to be taken care of during research. These are: obtaining informed consent, minimising the risk of harm, protecting anonymity and confidentiality, avoiding deceptive practices, and providing the right to withdraw. This study followed this ethical process during data collection and analysis. More still this study also depended on the guidelines as stipulated in the TUT research ethics guide.

Before data collection, participants had to give their informed consent after being informed of their rights and the study's ethical requirements. This included the freedom to drop out from the research whenever they felt uncomfortable. They were also made aware that taking part in the study was entirely optional. Participants had the option to leave the study without providing a reason and without suffering any repercussions for themselves or their families. Additionally, confidentiality and anonymity were guaranteed in terms of privacy. All respondents were kept anonymous. The questionnaire didn't require any personal details like email or contacts from the respondent.

3.10 Summary

This chapter discussed the approaches this study followed and utilized to solve the research problem. The chapter provided an overview of the research paradigm, methodology, and approach applied in this study. The methods used for data collection have been highlighted, along with how the data was analysed. This chapter concluded by reviewing the risk-related ethical concerns and how they were handled in this study.

CHAPTER FOUR: ANALYSIS AND PRESENTATION OF RESULTS

This chapter presents the findings of the study and the testing of the suggested hypotheses. The chapter first presents the frequencies of the demographic and situational variables of the respondents. Further to that, the chapter presents the inferential statistics for which the correlation and regression analyses are presented. The regressions analysis that explains how each construct contributes to the overall model prediction on cloud-based HMS is presented along with their prediction power. The chapter concludes by presenting the findings of the tested hypotheses.

4.1 Frequencies of participants' demographics

The measuring instrument, which was a close-ended questionnaire, asked respondents to provide specifics about their demographics and situational circumstances. Age, level of education, work experience, job position and cloud awareness were the different demographic and situational variables that were identified as being relevant for this study. Participant's demographics are shown in Table 4.1, which is broken down into the relevant categories.

Table 4.1: Frequencies of participants' demographics

Factors	Items	Frequency	Per cent (%)	Valid Percent (%)	Cumulative Percent (%)
Age	21-30 years	27	32.5	32.5	32.5
	31-40 years	36	43.4	43.4	75.9
	41-50 years	20	24.1	24.1	100.0
	Total	83	100.0	100.0	
Level of education	Grade 12 and below	6	7.2	7.2	77.1
	Diploma	24	28.9	28.9	69.9
	Advanced diploma	7	8.4	8.4	8.4
	Degree	27	32.5	32.5	41.0

	Post Graduate	19	22.9	22.9	100.0
	Total	83	100.0	100.0	
Experience	0-5 years	38	45.8	45.8	45.8
	6-10 years	26	31.3	31.3	100.0
	11-15 years	7	8.4	8.4	54.2
	16-20 years	3	3.6	3.6	57.8
	21-25 years	3	3.6	3.6	61.4
	26 years and above	6	7.2	7.2	68.7
	Total	83	100.0	100.0	
Job Position	Administrator	13	15.7	15.7	15.7
	Cleaner	5	6	6	40.6
	Doctor	8	9.6	9.6	31.3
	Driver	1	1.2	1.2	32.5
	Filing Assistant	1	1.2	1.2	33.7
	Lab assistant	1	1.2	1.2	34.9
	Matron	2	2.4	2.4	37.3
	Nurse	41	49.4	49.4	86.7
	Porter	2	2.4	2.4	89.2
	Surgeon	9	10.8	10.8	100.0
	Total	83	100.0	100.0	
Cloud Computing	No	16	19.3	19.3	19.3
	Yes	67	80.7	80.7	100.0
	Total	83	100.0	100.0	

a) Age and Education level

As demonstrated in Table 4.1, over 67% (n= 56) of the respondents were above the age of 30 years. These respondents had a good level of education with only 28.9% (n=24) having an education level of a diploma. The implication of these findings is that such respondents could make a good decision about the asked question that improved the validity of the results obtained for this study. The age as a demographic variable has been found by other researchers (such as Venkatesh et al., 2012, Kalema, 2013) to be a good predicting factor in the studies of technological innovation implementation. This implies that in terms of migrating HMS in the cloud-based environment, mature individuals are more responsible in observing controls and measures, security rules as well as guidelines. Consequently, this also implies that the questionnaire was answered by

responsible people within the healthcare facilities. The level of education is also presented graphically as illustrated in Figure 4.1.

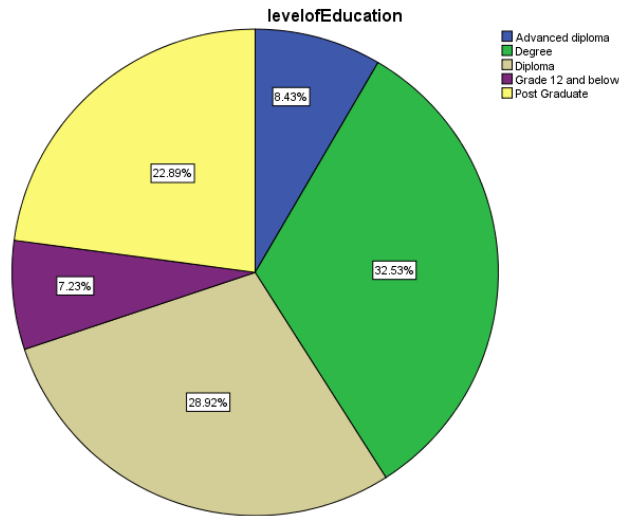


Figure 4.1: Respondents' Level of Education

b) Work experience

Results demonstrated in Table 4.1 indicate that 45.78% (n=38) of the participants have at least 5 years of work experience, 31.33% (n=26) have between 6 and 10 years, 8.43 (n=7) have between 11 and 15 years, 3.61% (n=3) have between 16 and 20 years, 3.61% (n=3) have between 21 and 25 years, and 7.23% (n=6) have more than 26 years. Experience places an individual in a position of responsibility, source of knowledge and wisdom as one with a good experience within an organization is considered a master of processes and operations. Previous researchers (such as Williams et al., 2016, Tripathi, 2018) noted that individuals with good experience are considered as the knowledge base of the organization. This implies that since a good number of respondents of this study - 54.2% (n = 45) - had experience of 6 years and above, it signifies that data for this study was collected from the 'knowledge base' of the hospitals' financial institutions. The work experience of the respondents is also presented graphically as illustrated in Figure 4.2.

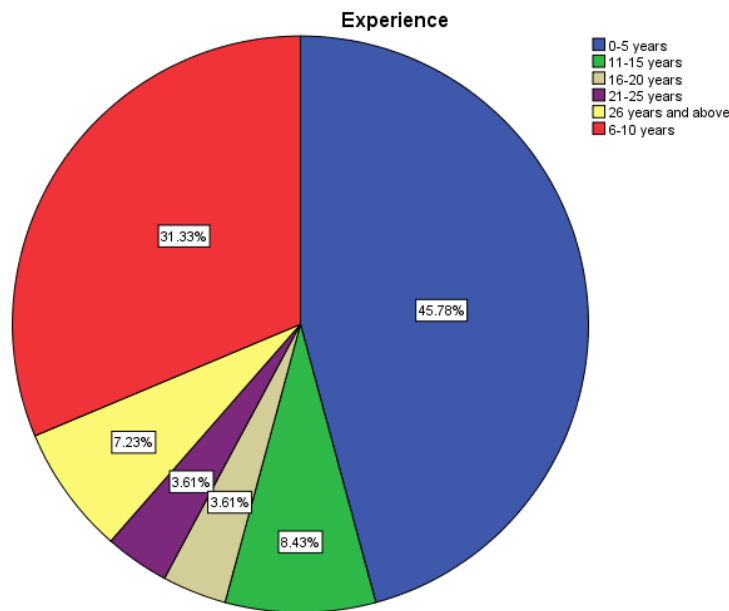


Figure 4.2 overall working experiences

c) Job title

It is demonstrated in Table 4.1 that 15.7% (n=13) of contributions to this study were from Hospital Administrators, 7% (n=5) were from Cleaners, Doctors contributed 9.6% (n=8), Drivers, Filling Assistants, and Lab Assistants each contributed 1.2% (n=1); a contribution of 2.4% (n=2) was from Matrons, Nurses contributed 49.4% (n=41), Porters 2.4% (n=2) and Surgeons contributed 10.8% (n=9). Relevance of the job title as well as seniority plays an important role in maintaining data integrity that leads to better decision-making. The role of an individual's position within an organization has been identified in various technological innovation based studies as being critical and having high interacting effects on the overall prediction of models explaining technology acceptance and use (Venkatesh et al., 2012; Kalema, 2013; Rahim et al., 2022).

d) Awareness of cloud computing

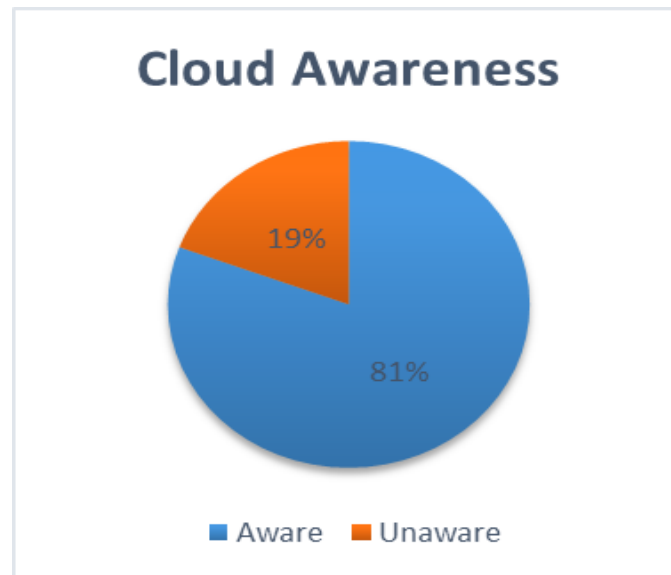


Figure 4.3: Cloud awareness

Figure 4.3 shows that whereas 19.3% (n=16) of participants are unaware of the cloud computing concept, 80.7% (n=67) of the participants have knowledge or are aware of it. When users are aware of a technological innovation, its implementation becomes less complicated as little sensitization will be needed during the implementation process.

4.2 Pearson Correlation of the constructs

Inferential statistics, such as the Pearson correlation coefficient, explain how each construct relates with the other; as well as summarizing the features of a dataset (Turney, 2022). The Pearson rank correlation is a non-parametric version that measures the strength and direction of association between two constructs. This includes the degree of similarity between the constructs as well as the strength of a link between two or more constructs (Creswell & Guetterman, 2018). The correlation coefficient values range from -1 to 1, whereby -1 denotes a perfect negative correlation and 1 denotes a perfect correlation. The link between the constructs was represented in this study using the

Pearson Correlation approach (Schober et al., 2018). Table 4.2 below shows how the various constructs are related.

Table 4.2: Correlations

		TechChar	CloudCom Read	OrgAsp	EnvtAsp	IndChar	RiskAnCtrl	SocAsp	CBHMS
	Pearson Corr	1							
TechChar	Sig. (2-tailed)								
	N	83							
CloudCom Read	Pearson Corr	.735**	1						
	Sig. (2-tailed)	.000							
	N	83	83						
OrgAsp	Pearson Corr	.778**	.733**	1					
	Sig. (2-tailed)	.000	.000						
	N	83	83	83					
EnvtAsp	Pearson Corr	.777**	.722**	.827**	1				
	Sig. (2-tailed)	.000	.000	.000					
	N	83	83	83	83				
IndChar	Pearson Corr	.664**	.660**	.740**	.740**	1			
	Sig. (2-tailed)	.000	.000	.000	.000				
	N	83	83	83	83	83			
RiskAnCtrl	Pearson Corr	.637**	.587**	.713**	.740**	.758**	1		
	Sig. (2-tailed)	.000	.000	.000	.000	.000			
	N	83	83	83	83	83	83		
SocAsp	Pearson Corr	.742**	.637**	.674**	.681**	.778**	.705**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		
	N	83	83	83	83	83	83	83	
CBHMS	Pearson Corr	.391**	.459**	.504**	.437**	.409**	.479**	.207	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.060	
	N	83	83	83	83	83	83	83	83

** . Correlation is significant at the 0.01 level (2-tailed).

Results demonstrated in Table 4.2 indicate that all constructs have good correlation with one another, with cloud computing readiness showing a highly significant correlation with

all other constructs; followed by risk analysis and control, environment aspects, and organization aspects.

4.3 Regression

Regression is a statistical method for examining and simulating the relationship between variables and gives their contribution towards the prediction of the model (Turney, 2022). Regression has several uses and is used in practically every industry. Regression analysis may really be the statistical method that is employed the most frequently (Douglas et al., 2012). Regression analysis comes in many forms, but the main goal is always to look at how one or more independent variables relate to a dependent variable. The contribution of an independent variable to the overall prediction of the model can be ascertained using the regression analysis (Creswell & Geutterman, 2018). The overall prediction of the model for cloud security governance institutions is shown in Table 4.3.

Table 4.3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df 1	df 2	Sig. F Change
1	.371 ^a	.609	.654	.72872	.609	7.422	7	75	.000

a. Predictors: (Constant), SocAsp, CloudComRead, RiskAnCtrl, OrgAsp, TechChar, IndChar, EnvAsp

The results demonstrated in Table 4.3 indicate that the model has a good prediction power of 60.9% ($R^2 = .609$). More discussion of the performance of each independent construct is as illustrated in Table 4.4.

Table 4.4: Regression Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.359	.062		5.790	.000		
TechChar	.429	.218	.139	1.967	.042	.257	3.889
CloudComRe ad	.407	.148	.256	2.756	.023	.370	2.701
1 OrgAsp	.759	.214	.284	3.549	.016	.234	4.272
EnvtAsp	-.136	.205	-.123	-.664	.509	.228	4.387
IndChar	.595	.195	.182	3.051	.017	.263	3.803
RiskAnCtrl	.487	.182	.413	2.681	.009	.331	3.018
SocAsp	-.701	.193	-.600	-3.632	.001	.289	3.458

a. Dependent Variable: CBHMS

Results demonstrated in Table 4.4 indicate that with the exception of environmental aspects, the rest of the constructs show a significant contribution to the successful implementation of the migration of HMS to the cloud environment. Social aspects had the highest contribution to the prediction power of 60% ($\beta = .600$) at $p = .001$; this was followed by risk analysis and control with a prediction power of 41.3% ($\beta = .413$) at $p = .009$. On the other hand, much as the environmental aspects had a good prediction power of 12.3%, this contribution was found not to be significant. Results also included the analysis of the Variance Inflation Factor (VIF) that was intended to determine the existence of collinearity due to the highly significant values of the correlation. The rule of thumb indicates that for collinearity to exist the $VIF > 10$; however, as demonstrated in Table 4.4 all the VIF values were less than 5 which indicated that multicollinearity does not exist.

4.3 Testing the Hypotheses

According to Cohen et al. (2018), a significance level of 0.05 is regarded as acceptable. By providing a relationship between the variables that could be used to predict the values of the independent variables, the set of hypotheses was evaluated using regression analysis, with the findings being reported in Table 4.5.

Table 4.5 Testing the Hypothesis

Hypothesis	Results	Action
H1: Technological factors influence the development of cloud-based Hospital Management System	$P = .001 < 0.05$	Supported
H1a: Technological factors due to technological characteristics influence the development of cloud-based Hospital Management Systems.	$P = .042 < 0.05$	Supported
H1b: Technological factors due to organization's readiness for cloud technology influence the development of cloud-based Hospital Management System.	$P = .023 < 0.05$	Supported
H2: Organizational factors influence the development of cloud-based Hospital Management System	$P = .016 < 0.05$	Supported
H3: Environmental factors influence the development of a cloud-based Hospital Management System.	$P = .509 > 0.05$	Not Supported
H4: Individual characteristics influence the development of cloud-based HMS.	$P = .017 < 0.05$	Supported
	$P = .009 < 0.05$	Supported

H5: Social dimensions influence the development of cloud-based HMS.		
H6: Risk management and control influence the development of cloud-based HMS.	P= .001 < 0.05	Supported

The findings demonstrated in Table 4.5 show that all the hypothesized relationships were accepted, with the exception of environmental aspects.

4.4 Summary

In this chapter, the results of the data analysis were presented along with the indication of the construct's contribution towards the predicting power of the model for cloud-based HMS. The chapter started by presenting the frequencies of the participant demographic and situational variables, which was followed by a detailed inferential statistics analysis that included the correlations and regressions. The chapter concludes with the findings obtained from testing the suggested hypotheses. The results of the study are discussed in the next chapter, along with its limitations and suggestions for further research.

CHAPTER FIVE: DISCUSSION, INTERPRETATION, CONCLUSION, AND RECOMMENDATION

This chapter discusses the findings and their significance in relation to philosophy and practice. In relation to the study's objectives and goal, the findings are also discussed. The findings are discussed in relation to the study's hypotheses, along with their theoretical and practical ramifications. The chapter concludes by highlighting the limitations of this research. The chapter also offers some suggestions and guidelines.

5.1 Overview of the study

This study sought to develop a model that could inform the migration of HMS to the cloud environment. The designed model could assist hospitals to achieve the objective of delivering healthcare services seamlessly to all citizens. The increasing demand for better service delivery in the South African public health sector has become a more immediate challenge than ever before, and such calls for measures that can support the utilization of innovations that have been brought up by the development trends in computing like cloud computing. According to Kalema (2022) the post Covid-19 era and the Fourth Industrial Revolution (4IR) have seen many organizations increasing their investment in technological innovations that allow them to take full advantage of seamless working environments, and cloud migration is one of the top priorities. However, some researchers (such as Sneider, 2021; Singh et al., 2022) note that much as many organizations have accelerated their migration to the cloud since the Covid-19 crisis, they have been facing various challenges that require them to have better guidelines to inform their migration, and as a result many have not reached the reasonable levels of agility they intended to achieve.

Effective transition to the cloud is paramount but organizations that migrate their services and applications without following effective means and procedures could still remain

within the same range of agility as they had before migration (Scout, 2019). Hence to remain competitive, organizations' policy makers need to continue to mature their cloud strategies coupled with the right organizational design as well as better skills development and processes - hence the need for an effective model to be used as a cornerstone (Sneider, 2021). This implies that before migrating to the cloud, organizations need to make informed decisions about cloud deployment and architecture, in addition to knowing how to choose the resources that suit their workloads and budgets.

5.1.1 Lessons learnt from the study

The world-wide healthcare challenge of the 21st Century 'the COVID-19 pandemic' did show the world the crucial and invaluable role of healthcare accessibility and equity and has been a catalyst for operational transformation in the healthcare sector (Fekadu et al., 2021). Leveraging technology and its innovations is, therefore, crucial in shaping the healthcare sector culture - leading to the implementation of transformations in the sector. Development trends in computing like cloud computing are, therefore, expected to play a major role in the current complex and dynamic healthcare environment. The leveraging of technological innovations should be seen as an option intended to link individual capabilities with systems impact, rendering the execution of meaningful decisions.

In addition to the literature review, the results of the study reveal a lot of meaningful information which if put to good use, organizations could benefit from while migrating their services and applications to the cloud. For instance, the results of this study found organizational aspects to be significantly influencing the migration of HMS to the cloud. The implications of this are that organizations need to check their surroundings and characteristics in order to know the level and nature of cloud migration they need. Such characteristics include the standards at the industry level, the nature of work they are doing, regulatory considerations that may dictate how their data is stored, size and structure of the organization as well as the growth within their industry domain. As noted by Singh et al. (2022), knowing the characteristics and nature of the organizational

surroundings is essential in narrowing the focus and in drawing a better building plan for the cloud migration. Such is also important in understanding and having a better methodology of working through the process which is essential in reducing risks and pain points.

Researchers such as Idoga et al. (2019) and Kafhali et al. (2020) observe that migrating the organization's services and applications to the cloud may be a reasonable task but the hard part of it is using those services that have been migrated to the cloud. The results of this study indicate that knowing organizations' technological equipment is as important as knowing who will operate that equipment. For instance, organizations may be having decades of software and processes already in place. It thus is paramount to know the nature and characteristics of the existing technological investments to be moved into the cloud. The information technology team should, therefore, be trained in soft skills to be in position of knowing what needs to be moved to the cloud, how to move it and why. Additionally, much as the technical stakeholders may know what is involved in the migration of these services to the cloud, the non-technical stakeholders will only be interested in knowing the value cloud migration will bring to the organization - hence the balance between risk analysis and control as well as the social aspects of the cloud migration. Based on the model designed in this study, an organization will be in a position to articulate these aspects thus improving the understanding and buy-in from the rest of the organization, including the technical stakeholders. The influence of risk factor analysis and control that emanates from Dempster-Shafer Theory (D-S Theory) was also emphasized by previous researchers who emphasized that its importance should be well considered by management when implementing cloud-based services (Beynon et al. 2009).

5.1.2 Relevancy of the methodology used for study

The specifics of migration of HMS to the cloud depend on the hospital's particular collection of programs, data, and goals. Hence, successful migration to the cloud requires

measurements in understandable terms rather than tech-centric ones (Kafhali et al., 2020). Much as the technical stakeholders will bother to know how much workload is involved, the non-tech stakeholders on the other hand will only be interested to know the 'so what', that is if the change was at all important and which benefits can be deduced from the change. Hence, cloud migration is seen as a technical initiative that is intended to bring business value. Methodologically, this required a measure of causal relationship between the technical and non-technical variables, knowing the relationships between them, and how their combination could bring an effective contribution to the overall process. To achieve this both correlation and regression analysis had to be used to measure the relationships between the constructs. As a result, the methodology used in this study was relevant.

5.2 Discussion and interpretation of findings in relation to the goal and objectives

The goal of this study was to develop a model for cloud-based hospital management systems for the South African public health sector. The objectives were:

1. To determine factors that influence cloud-based HMS implementation.
2. To investigate and determine the extent of cloud-based HMS integration in South African health institutions.
3. To rank and use the identified factors for the development of a cloud-based HMS model for the South African health sector.

The methods and processes followed by this study to achieve these objectives are as discussed in the proceeding sub-sections.

5.2.1 Discussion of the findings in relation to the first objective

The first objective was to determine factors that influence cloud-based HMS implementation. As discussed earlier, the non-technical stakeholders may not need to understand the details of cloud migration, though the technical ones certainly do. There

are many more factors that need to be put into consideration to ensure that the migration is both functional and complete. To achieve this objective, this study used both the literature review and analysis of collected data to come out with a vivid understanding of the factors needed for cloud-based HMS implementation. To this end, this study dedicated Sub-Section 2.1.2 to discussing the factors influencing HMS implementation and Sub-Section 2.4.2 to discussing those factors influencing cloud-based HMS implementation. The identified factors in Sub-Section 2.4.2 were also presented in Table 2.3. In addition, the regression analysis revealed that six constructs of technology characteristics - readiness for cloud computing, organizational aspects, individual characteristics, risk analysis and control, as well as social aspects have factors that are significant to the implementation of cloud-based HMS.

5.2.2 Discussion of the findings in respect to the second objective

The second objective was to determine the extent of cloud-based HMS integration in South Africa's health institutions. As observed by Aijing and Jin (2015) and Abbas et al. (2020), cloud-based systems are inherently distributed and replicated horizontally, which implies that their implementation is somehow more complex as compared to other information systems. Such complexity requires more coordination and integration since each node of coordination and integration could translate into a point of failure. This explains why many health systems have been slow in migrating to the cloud environment. Another point to note is that new deployments introduce change, and such changes could be a potential for code to break and things to go down. To achieve the second objective, this study dedicated Section 2.4 to discussing cloud-based HMS in general, and Sub-Section 2.4.3 to discussing HMS in the South African context.

5.2.3 Discussion of the findings in respect to the third objective

The third objective was to rank and use the identified factors for the development of a cloud-based HMS model for the South African health sector. The factors influencing

cloud-based HMS were tabulated in Table 2.3. Based on these factors, theoretical foundations were discussed, and a conceptual model was designed. The conceptual model was used to collect the quantitative data that was analysed using the regression analysis as illustrated in Table 4.4. The regression analysis presented the Beta (β)-values that ranked the factors according to the contribution to the overall prediction of the model and the critical ratio t-value that ranked the factors according to their level of significance to the prediction of the model.

5.2.4 Discussion and implications of the findings in relation to the goal

The goal of this study was to develop a cloud-based HMS model for the South African public health sector. In order to accomplish this, a section of the literature on the discussion of the factors was discussed in Section 2.6 and a conceptual model was derived and illustrated in Figure 2.1. Afterwards, the hypotheses were developed and tested depending on the significance of the construct's contribution to the overall model. Based on the results obtained after the analyses illustrated in Table 4.4 and 4.5 it was revealed that some constructs were not significant and could not be included in the final model shown in Figure 5.1. It was noted that the factor, risk factor analysis and control that emanated from Dempster-Shafer Theory (D-S Theory) of Evidence as cited (Beynon et al. 2009). Plays a significant role in and its importance should be noted as a major contributing factor for the developed model.

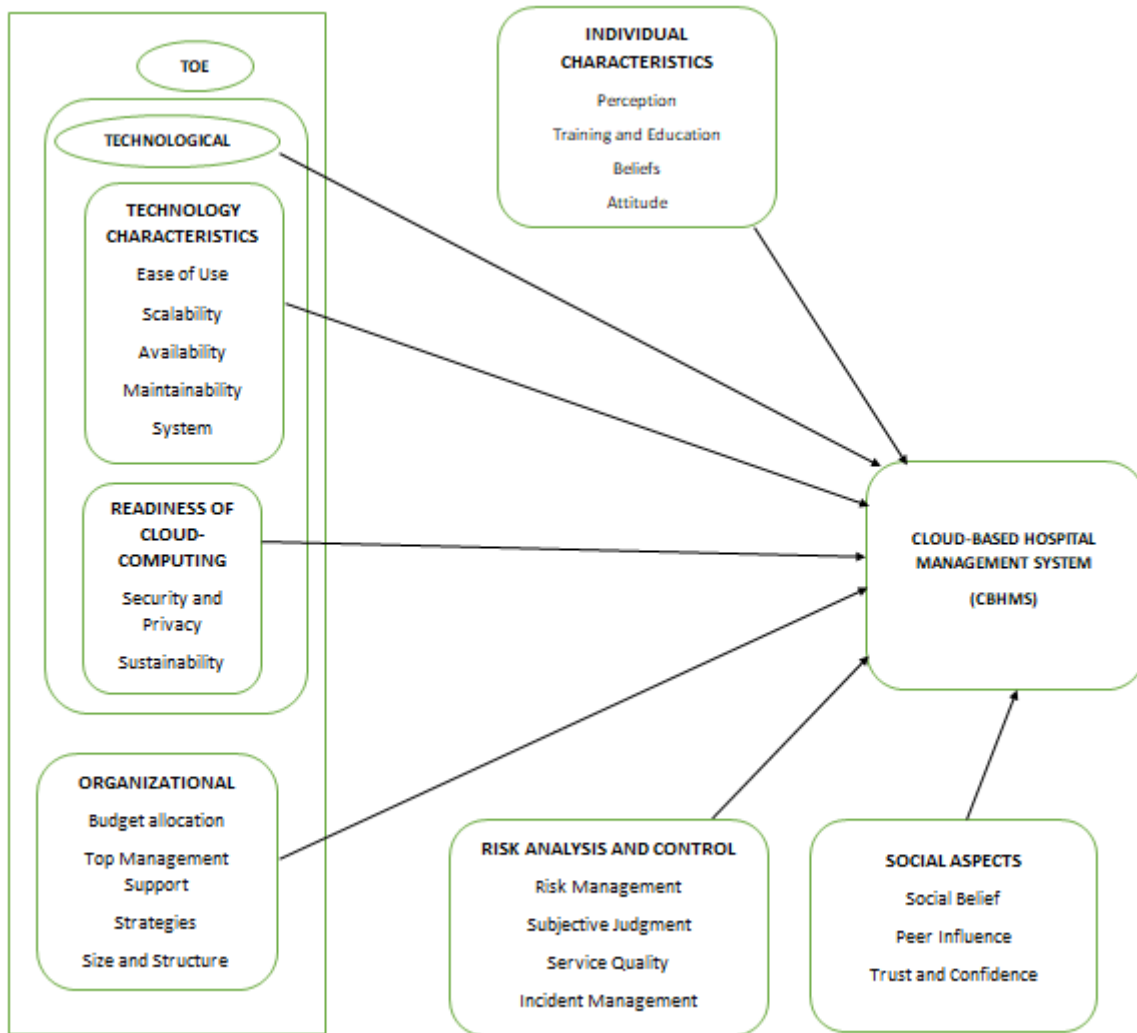


Figure 5.1: The CBHMS model

5.3 Discussion and Interpretations of the findings in relation to the hypotheses

From the conceptual model, seven hypotheses were suggested. In quantitative approach research, various approaches and estimates may be used to test hypotheses and these include parametric statistical techniques such as t-ratio, z-score, and critical ratio as well as standard error depending on the nature of data and tools used. The student parametric t-ratio is mostly used in many studies using regression analysis to prove causal

relationships between constructs. When t-ratio is used, two levels of significance (0.05 and 0.01) are utilized to determine whether a hypothesis is viable and significance is said to be obtained if the t-value ≥ 1.96 at the 0.05 threshold of significance and ≥ 2.58 at 0.01 level. The t-value was used to test the hypotheses for this study at 0.05 level. Results of the tested hypotheses and their implications to theory and practice are discussed in this section.

H1: Technological factors influence the development of cloud-based Hospital Management System: This hypothesis was *accepted*. The implication of this finding is that on average there have been challenges of inadequate health institutions and shortage of healthcare human resource in many developing countries, especially those in Sub-Saharan Africa (Kalema & Busobozi, 2019). Hence, technology and its innovations are seen as one way to bridge the gap of resource constraint by providing remote access capabilities to healthcare resources. The acceptance of this hypotheses confirms the fact that citizens appreciate the value and contribution of technology towards healthcare provision and such good and available technology will boost the migration of HMS to the cloud environment.

On the other hand, technological aspects are perceived to be a major part of cloud technology and a basis for the cloud to change the computing process from using the HMS as stand-alone systems to a networked system that solves the challenges of accessibility and governance, especially in resource-constrained organizations like hospitals. The finding of this study is in agreement with those of previous researchers (such as Idoga et al., 2019; Sadoughi et al., 2019) who also stated that regardless of how technology is looked at as either top-down or bottom-up, its role for cloud migration is enormous. The technology construct was further sub-divided into other sub constructs basing on the characteristics of the technology (H1a) and the institution's readiness for cloud computing (H1b).

H1a: Technological factors due to technological characteristics influence the development of cloud-based Hospital Management System: This hypothesis was

accepted. The implication of this finding is that technology characteristics like ease-of-use, scalability, usefulness, availability as well as maintainability are critical in the migration of services and applications to the cloud. If a system like the HMS is migrated to the cloud, the non-technical stakeholders will only be interested to see that the migration of the system has improved the business process operations, and they would not expect hurdles when using the migrated system (Aijing & Jin, 2015; Abbas et al. 2020). On the other hand, despite the automation of hospital systems for HMS, still the challenges of an intermittent network that causes the slowness of the automated system is prevalent. Stakeholders will expect that if the system is migrated to the cloud environment these challenges will get minimized. Besides, cloud computing technology is expected to improve sufficient computing resources for the growing volume of data generated in the healthcare sector, which makes analytics easy and thus improve decision-making. The findings of this study are in agreement with those of previous researchers (such as Sneider, 2021; Singh et al., 2022) who argued that cloud-based technology could be of benefit and increase healthcare demands if the users perceive it as a solution to technological challenges they face within their organizations.

H1b: Technological factors due to organization's readiness for cloud technology influence the development of cloud-based Hospital Management System: This hypothesis was **accepted.** The acceptance of this hypothesis implies that for any technological innovation's implementation success, the implementing organization should be ready for it and should also have a strong need for the change to the new system. The findings of this study are in agreement with those of Sadoughi et al. (2019) who alluded that when migrating to the cloud environment, the process could be looked at from two different perspectives, namely top-down and bottom-up. In the top-down perspective, the organization is taking a broader view of the systems and applications that are being migrated to cloud. On the other hand, the bottom-up inventory enables an organization to see all the pieces that are being migrated to the cloud. In any of these two perspectives, the organization must be ready and should be having a good need for the migration process and whatever it entails.

H2: Organizational factors influences the development of cloud-based Hospital Management System: This hypothesis *was accepted*. The acceptance of this hypothesis implies that organizational aspects that entail factors like top management support, budgets and finances, employees' empowerment for knowledge creation through trainings, policies and standards, organizational size and structure, measures for collaboration and knowledge sharing, as well as enhanced business processes play an essential role in the migration of services and applications to the cloud. The findings of this study concur with those of many previous others on the migration to the cloud that have found organization aspects to have a stronger significant influence (Idoga et al., 2018; Sadoughi et al., 2019; Alipour et al., 2021). This implies that much as organizations benefit from the cloud services, to realize these benefits organizational aspects need to be examined holistically as one service model of the cloud may not be appropriate to all organizations. For instance, while profit making organizations will be looking for cloud services to gain competitive advantage, the service oriented ones on the other hand will be longing to provide better services for the benefit of the citizens.

Additionally, small sized organizations will find it much easier to migrate their services to the cloud since they have fewer resources, whereas large-sized enterprises will have slightly more challenges in the migration processes due to the large structure of their enterprises. Similarly, small organizations are more centralized making administrative procedures easier, while larger ones are decentralized; the applications may be scattered and may need to be integrated, which could also complicate the migration processes. In relation to hospital structures, large hospitals like provincial hospitals will have a variety of services such as in-patient, out-patient, nursing care, connection to insurance companies as well as pharmacies, whereas small hospital facilities like the local district municipality hospitals will have limited facilities and collaborations. These findings are also in agreement with those of Aijing & Jin (2015) and Abbas et al. (2020) who also indicated that size and structure play a big role in the cloud migration processes.

H3: Environmental aspects influence the development of cloud-based Hospital Management System: This hypothesis was *not accepted*. Environment aspects have been found in various healthcare research of developing countries to be significant, yet they were found not to be significant in this study (Sheykhoteyefeh et al., 2016; Siegfried et al., 2018; Kalema & Busobozi, 2019; Maphumulo & Bhengu, 2019). The implication of this finding is that when services are migrated to the cloud the issue of environment is overshadowed by the organizational aspects. For instance, services will be migrated to the cloud that might reside in a different country or continent and such migration requires more organizational support than the environment characteristics. With good support from the organizational top management in terms of budgets, training of users, employing the right staff, signing good service level agreements (SLA) with vendors to assist with configuration management, provisioning required tools, assisting with log collections, patching systems and ticketing systems, cloud-based activities may have little hindrance as compared to the on-premises IT facilities.

H4: Individual characteristics influence the development of cloud-based HMS: This hypothesis *was accepted*. Individual characteristics have been found in much previous research of technological innovation adoption, implementation and use to be significant (Adler-Milstein et al., 2015; Kalema & Busobozi, 2019). The implication of these findings is that individual characteristics like attitude and beliefs, perceptions, training, and education are crucial for cloud migration because when services are migrated the success of the administrative tasks will depend on the capabilities of the individuals to manage both the migration processes and the operation. Another factor to consider is that migration of HIS to the cloud comes with several advantages for both healthcare providers and patients in terms of quality service delivery and cost-efficient solutions to the patients, as well as having seamless collaborations among healthcare facilities. These findings concur with those of other researchers (Idoga et al., 2019; Singh et al., 2022) who also noted that cloud-based hospital systems support collaborations that bring efficient data exchange with fast feedback for the patients through information sharing,

but such could only be achieved if individuals using the systems have the capabilities and positive perceptions towards the system.

H5: Social aspects influence the development of cloud-based HMS: This hypothesis was *accepted*. The acceptance of this hypothesis implies that cloud migration has a high dependence on information sharing due to its potential to provide remote access to data. The social interaction could be either internal or external and as such supports information sharing and unrestricted flow of information in the cloud-based health system, which leads to effectiveness. Internal social aspects include influence of others to accept, and believe and trust in the system; while the external is related to external collaboration when the system is migrated and support during the use of the system. The findings of this study support those of previous researchers such as (Venkatesh et al., 2012; Sandy & Mavhandu-Mudzusi, 2016; Walker & Walker, 2022) who noted that social aspects play an essential role in voluntary technological innovation implementation, adoption, and use.

H6: Risk management and control influence the development of cloud-based HMS: This hypothesis was *accepted*. The acceptance of this hypothesis confirms the fact that risk awareness starts with identifying and reporting near accidents, incidents, complaints, or other undesirable situations that could be the order of the day in the cloud environment. This implies that risk management in the cloud should embrace a flexible software platform that can record and detail the data and its operations, direct follow up of workflow automation tools, carry out analysis of trends of root causes of risks and associated challenges, manage dashboards to monitor information, as well as monitor improvement actions. The findings of this study concur with those of other researchers (such as Maphumulo & Bhengu, 2019; Alipour et al., 2021; Singh et al., 2022) who also observed that managing risks associated with HIS is paramount in assuring patients' safety regardless of hospital size and structure. Hence, risk management and control is a significant factor for migrating HIS to the cloud and healthcare systems should be mindful of the techniques that they use to migrate their services.

5.4 Limitations, recommendations, and direction for future studies

This section discusses the limitations and recommendations of this study by identifying those areas that should have been covered but due to some constraints this study failed to accomplish them.

5.4.1. Limitations and recommendations

Cloud-based services migration has a lot of implications, such as budgets and costs to technical aspects including maintenance and delivery. This implies that to get a vivid understanding and generalization of findings for the migration of HIS to the cloud environment, this study needed to involve as many stakeholders as possible who interact with the system. However, due to the fact that this study collected online data, some stakeholders couldn't participate in the study for one reason or the other. More so, this study also needed to triangulate the methods during data collection whereby some data would have been collected qualitatively from policy makers, like top hospital administrators, through interviews. This study, therefore, recommends that future research should increase the scope of data collection by increasing the number of participating hospitals in the study and also try to triangulate the methods by using a combination of quantitative and qualitative data collection methods, such as interviewing policy and strategic decision makers.

For conclusiveness of a cloud-based HIS, one needs to do a follow up of what happens after migration. This could also be in the form of observing the adherence to policies and standards as well as assessment of the reduction in the total cost of ownership of the system after migration. This study, therefore, recommends that since a cross-sectional data collection approach was used, a longitudinal research data collection should be used by future researchers in order to be in an actual position to report what happens after

some time. A longitudinal survey will also assist in determining whether medical personnel and healthcare workers are effectively using the system.

Several researchers such as Kalema (2013), Tripathi (2018) and Rahim et al. (2022) note that users of technology may have their perceptions change with time. This implies that analysis of users' demographics and situational variables should go beyond descriptive and analyse the moderating and interacting effects of these variables in order to make a better prediction of what happens after some time interval. Much as this study appreciates this observation, respondent's demographics and situational variables were only analysed using descriptive analysis to show the frequencies. This may cause a limitation in predicting future occurrences in the usage of the cloud services. This study recommends that future research should make effort to analyse the interacting effects of the moderating factors.

5.4.2. Recommendations for policy makers

The findings of this study echoed those of previous researchers (such as Idoga et al., 2019; Kafhali et al., 2020; Abbas et al., 2020 Singh et al., 2022) who also indicated that organizational aspects play an essential role in cloud-based services. Besides supporting IT budgets, it is also important for organizations to develop a culture of advancing the skills and capabilities of their employees through training. This study, therefore, recommends consistent and sustainable training of users of the cloud-based HIS for effective usage. It is also important to note that as data on the cloud-based system scales up, administrative tasks increase. Hence, training becomes paramount not only for IT personnel but for all users of the system.

The findings of this study also stress the importance of the technological factors, including security of the data in the cloud and trust of the system. It is important to note that data security could best be enforced by controlling its access. Management, therefore, needs to devise means of protecting its data by applying several security measures such as

encrypting data when it is at rest, in transit, and even in memory. In addition, even though it is more important to protect the data than its storage systems, it is also essential to ensure that best practices are followed to safeguard the infrastructure's security.

5.4.2. Recommendations for future research

Much as care and effort have been taken in designing the model for this study, its validation has been left out for future research. Another consideration is that as Kalema (2013; 2022) observes, technological innovation may have a higher acceptance rate at its inception but due to growing trends of computing some factors may become less significant while others become salient. This study, therefore, recommends the use of a different approach - either qualitative or mixed methods - to validate the designed model. The validation process may also assist in facilitating continuance usage as well as in identifying new factors that have become salient, in order to improve the models prediction.

5.5 Conclusion

Migrating services and applications to the cloud is a big step. However, it is the first step as migration is one thing and administering the use of the migrated services is another. A successful cloud-based HIS requires the healthcare system to remain active and vigilant, hence the need to train all stakeholders to achieve advanced skills that will enable them to use these migrated services. As emphasized by Sadoughi et al. (2019), keeping and maintaining cloud security is a pain-staking task that needs any organization to remain abreast with technological developments, and to be many steps ahead of its adversaries. Cloud migration complacency may be limiting in informing a successful cloud strategy; hence organizations need to have constant evaluation of what their IT support team can do better and how such can be achieved.

This study revealed that organizational, technological, individual, and social aspects as well as risk control and analysis are important determinants in shaping the perspective of cloud-based HIS users. However, the cloud-based system characteristics such as ease-of-use, relative advantage, scalability, security, and trust are major antecedents in accepting a cloud-based HIS. This implies that an organization needs to simplify the understanding and use of the cloud by users by enhancing their capabilities through training as well as involving them in the decision-making process around the migration to the cloud.

As observed by recent researchers such as Kalema (2022), Abbas et al. (2020) and Singh et al. (2022) in the current era of 4IR, the greatest opportunities as well as the greatest threats are the new trends in computing. This technology 'Big Bang' has and is continuously changing the landscape of every organization, including those in the healthcare sector. Migrating services to the cloud is increasingly becoming the order of the day for those organizations seeking agility. Since such has made the cloud to move faster, the earlier organizations gain diversified expertise in using and administering services in this environment the better is their future survival. As a result, the model designed for this study could be a beneficial guide to empirical research on cloud-based systems, not only for the healthcare sector but also for other sectors. The findings of this study are, therefore, intended to help healthcare decision-makers by increasing their awareness of the cloud-based systems, and to keep in mind the impact of the identified factors on decision-making at all levels within healthcare.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE



Faculty of Information and Communication Technology
Faculty Committee of Research Ethics

17 January 2022

Ref #: FCRE/ICT/2021/06/002(1) Name: TS Magudulela Student #: 209308606

Mr/Ms TS Magudulela c/o
Prof BM Kalema
Department of Informatics
Faculty of Information and Communication Technology
Tshwane University of Technology

Dear Mr/Ms Magudulela

Decision: Final Approval

Name:	Magudulela TS
Proposal Title:	A model for cloudbased Hospital Management System for South African public Health sector
Qualification:	Masters of Computing Informatics
Supervisor:	Prof BM Kalema

Co Supervisor: Dr MA Segooa

Thank you for submitting project documents for ethics clearance.

Approval is granted.

The proposed research project may now continue with the proviso that:

1) The researcher/s will conduct the study according to the procedures and methods indicated in the approved proposal, particularly in terms of any undertakings and/or assurances made regarding informed consent and the confidentiality of the collected data.

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2) The proposal (inclusive of the applicable information leaflet/s, informed consent document/s, interview guide/s and/or questionnaire/s) will again be submitted to the Committee for prospective ethical clearance if there are any substantial changes from the existing proposal, particularly if those changes affect any of the study-related risks for the research participants.

3) The researcher will act within the parameters of any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.

4) It remains the responsibility of the student and academic supervisor to confirm the final study title on the approved PGS01 form and to ensure that the title on the information leaflet and informed consent form and/or cover letter corresponds.

Note:

The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants.

Annual review:

1. The formal ethics approval of all research projects need to be renewed on an annual basis.
2. The current ethics approval expiry date for this project is 17 January 2024.
3. No research activities may continue after the ethics approval expiry date indicated on the formal Research Ethics Committee approval letter.
4. The Research Ethics Progress Report (electronic copy available at the following website: <http://www.tut.ac.za/Other/rnnew/ResearchEthicsCommittees/Pages/default.aspx>) constitutes an application for such ethics approval renewal and must be submitted to the FCRE by 17 January 2024.

C Du (Prof) 
Chairperson: Faculty Committee for Research Ethics
[FCRE ICT Ref# 2021=06=002(1)=MagudulelaTS]

APPENDIX B: QUESTIONNAIRE



**Tshwane University
of Technology**

We empower people

A MODEL FOR CLOUD-BASED HOSPITAL MANAGEMENT SYSTEM IN SOUTH AFRICAN PUBLIC HEALTH SECTOR

QUESTIONNAIRE

This questionnaire consists of three sections.

Section A: Participants general information

Section B: Participants' perceptions about developing cloud based model

SECTION A: GENERAL INFORMATION

PLEASE MAKE A CROSS (X) IN THE APPROPRIATE BOX CORRESPONDING TO THE CHOICE OF YOUR ANSWER TO THE QUESTION.

1. What is your age group?

21- 30 years	<input type="checkbox"/>	31- 40 years	<input type="checkbox"/>	41 -50 years	<input type="checkbox"/>	51 years and above	<input type="checkbox"/>
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2. What is your highest level of Education?

Grade 12 and Below		Diploma		Advanced Diploma		Degree		Post Graduate		Other please specify	
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3. What is your overall working experience?

0-5 years		6-10 years		11-15 years		16-20 years		21-25 years		26 years and above	
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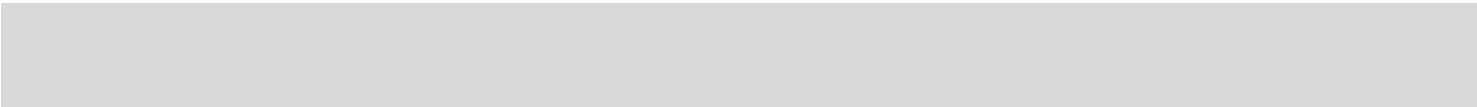
4. What is your job position?

Administrator		Doctor		Surgeon		Nurse		Other please specify	
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5. Are you aware of Cloud Computing?

Yes		No	
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SECTION B: CONSTRUCTS TO MEASURE CLOUD-BASED HOSPITAL MANAGEMENT SYSTEM IN SOUTH AFRICAN PUBLIC HEALTH SECTOR



By using the rating scale from 1-5 where; 1 = Strongly disagree, 2 =Disagree, 3 = Neutral, 4= Agree, 5 = Strongly agree. Indicate your level of agreement or disagreement of the following statements:

6.0 TECHNOLOGICAL (<i>this construct refers to current approaches or how well versed are your organization technically for cloud immigration</i>)		1	2	3	4	5
6.1 TECHNOLOGY CHARACTERISTICS						
6.1.1	I have enough technology expertise to use a Hospital management system when migrated to the Cloud environment					
6.1.2	Our Hospital management system (HMS) is scalable enough to accommodate big volumes of data.					
6.1.3	I believe migrating our HMS into the cloud will make it more s available when we want to use it					
6.1.4	Our organization has a disaster recovery plan in place that will be used to maintain our HMS when migrated to the cloud environment					
6.1.5	I believe that migrating our HMS in the cloud environment will make it more reliable and free from unnecessary break down					
6.2 READINESS OF CLOUD-COMPUTING						
6.2.1	We have access controls to confidential data by various system functions and channels that will safe guard our information when HMS is migrated to the cloud					
6.2.2	We have a skilled IT team that will sustain our HMS in the day to day operations in the cloud environment					
6.2.3	Our HMS has the potential to support each additional customer with the existing infrastructure hence reducing costs for our organization					
7.0 ORGANIZATION DIMENSION (<i>this construct refers to the organizational settings, size and control in relation to cloud immigration</i>)						
7.1	Our organization allocates enough IT budget that will sustain our services when our HMS is migrated to the cloud environment					

7.2	We receive enough support from our Top Management that will sustain our activities in the cloud					
7.3	We have a well-structured organizational monitoring and evaluation process that will ensure quality of information in the cloud environment					
7.4	We have a clear plan for new IT projects and changes that will help us to work in the cloud environment effectively					
7.5	I believe that our IT department will effectively support all structure and the size of our institutions when our HMS is migrated into the cloud					
7.6	I believe our staff will follow the policies and standards of managing data in the cloud environment					
8.0 ENVIRONMENTAL DIMENSION (<i>this construct refers to the environmental impact that can affect cloud</i>)						
8.1	Our institution always have a clear understand with the IT vendors who always support our services					
8.2	I believe that there will be enough available resources to enables us operate in the cloud					
8.3	I believe migrating our HMS into the cloud will contribute to the call for Green IT					
8.4	We always use service providers who are accredited and are licensed					
9.0 INDIVIDUAL CHARACTERISTICS (<i>this construct refers to how human behave individually</i>)						
9.1	Our staff has a positive perception towards introduction of IT innovations					
9.2	Our staff always keen to learn new things that will help to improve the way they do their work					

9.3	We have positive beliefs that migrating our HMS to the cloud environment will improve the quality of our work					
9.4	I believe our staff will have a positive attitude of working with the HMS in the cloud					
10.0 RISK ANALYSIS AND CONTROL (<i>this refers to the potential of identifying, controlling and preventing risks and integrity of the data used</i>)						
10.1	We have disaster recovery plan in place.					
10.2	Our IT staff have enough expertise to detect all possible causes of risks to the data we use for decision making					
10.3	I believe migrating our HMS in the cloud will help us to improve the quality of our services and to make quick decisions					
10.4	We have a proper plan for improving data quality management and to mitigate risks in case they happen					
11.0 SOCIAL DIMENSION (<i>this refers to the individual beliefs relative to those who influence them</i>)						
11.1	We have a general understanding that using technology is good for improving our working environment					
11.2	My workmates believe that migrating our HMS to the cloud environment is a good idea					
11.3	We have a good trust and confidence in the cloud environment					

SECTION C: PERCEPTION CLOUD-BASED HOSPITAL MANAGEMENT SYSTEM IN SOUTH AFRICAN PUBLIC HEALTH SECTOR

12. In your view, experience how do you perceive the possibility of migrating HMS in the cloud environment?

ITEM	Extremely impossible	Impossible	Fairly possible	Possible	Highly possible
From the Technological perspective					
From the Organisation perspective					
From the Individual perspective					

Thank you