



Investigating the impact of cloud-based systems as solutions for business operations at a selected university

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for the degree *Master of Business Administration* at the North-
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DECLARATION

I, Willem Hendrik van Jaarsveld, declare herewith that the mini-dissertation entitled *Investigating the impact of cloud-based systems as solutions for business operations at a selected university of South Africa*, which I herewith submit to the North-West University in partial compliance with the requirements set for the degree: Master of Business Administration, is my own work, has been text-edited in accordance with the requirements, and has not already been submitted to any other university.

A handwritten signature in black ink, appearing to read 'Jaarsveld', with a large, stylized initial 'J'.

Willem Hendrik van Jaarsveld

27 November 2024

ABSTRACT

Cloud computing offers a transformative opportunity for higher education institutions, providing benefits such as cost efficiency, scalability, enhanced research capabilities, and improved administrative processes. However, the adoption of cloud computing also faces challenges, including financial constraints, data privacy concerns, and integration issues with legacy systems. This research explores the perspectives of existing literature and university stakeholders to gain a deeper understanding of the impacts of cloud computing on university operations.

This study aimed to investigate these impacts, focusing on the benefits, challenges, and strategies necessary for successful adoption. The research employed a qualitative methodology. Insights were derived using an inductive approach from semi-structured interviews conducted with five participants involved in cloud initiatives at a South African university. These participants included IT staff providing insights into various aspects of cloud adoption. The thematic analysis, based on systematic coding and categorisation, highlighted important aspects of cloud adoption at the university, including flexibility, financial aspects, technical challenges, organisational behaviour, and strategic innovation.

The findings reveal a small gap between theoretical frameworks and practical implementation, with overlap between literature-based studies and insights gathered from interviews. The interviews underscored the importance of training and awareness programs, the need for well-defined strategies, and the need to address cultural resistance. They also highlighted a lack of structured adoption frameworks. Furthermore, stakeholders observed that universities often adopt large-scale cloud solutions without careful, incremental planning, which can exacerbate resource limitations.

This study identifies gaps where the university can leverage cloud computing to enhance their operations, including the development of innovative teaching models, the streamlining of administrative processes, and the expansion of research collaboration. Additionally, it recommends actionable strategies to tackle key challenges, such as funding shortages, compliance with privacy laws, and the integration of cloud systems. By aligning institutional goals with strategic cloud adoption frameworks, universities can navigate these complexities and position themselves for long-term growth in a technology-driven educational environment.

Key terms: Cloud Computing, Higher Education, Cost Efficiency, Data Privacy, Strategic Adoption, University Operations.

LIST OF ABBREVIATIONS

Abbreviation	Meaning
POPIA	Protection of Personal Information Act
AI	Artificial Intelligence
LMS	Learning Management System
IAM	Identity and Access Management
SaaS	Software as a Service
PaaS	Platform as a Service
HaaS	Hardware as a Service
IaaS	Infrastructure as a Service
FaaS	Function as a Service
SLAs	Service-Level Agreements
R&D	Research and Development
ISO	International Organisation for Standardisation
IT	Information Technology
CPU	Central Processing Unit
GPU	Graphics Processing Unit
API	Application Programming Interface
IoT	Internet of Things
AWS	Amazon Web Services
FTE	Full-Time Equivalent

PAIA	Promotion of Access to Information Act
GDPR	General Data Protection Regulation
DPA	Data Processing Agreement
OPS	Operating Systems
DOI	Digital Object Identifier
NWU	North West University
CSPs	Cloud Service Providers

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CHAPTER 1 NATURE AND SCOPE OF THE STUDY

1.1 CHAPTER OVERVIEW

This chapter introduces the nature and scope of the study, outlining the primary focus, objectives, and significance of the research. It provides a clear understanding of the study's purpose, key areas of exploration, and the research questions that guide the investigation. The chapter also discusses the context in which the research is situated, highlighting the relevance of the study within the broader academic and practical fields. This chapter sets the stage for the detailed exploration that follows, ensuring clarity on the direction and scope of the research efforts.

1.2 INTRODUCTION TO THE STUDY

In the realm of higher education, cloud computing has emerged as a transformative force in the digital age. The National Institute of Standards and Technology (NIST) defines cloud computing as a model that offers on-demand access to configurable computing resources over the Internet, thereby liberating businesses from the need to manage on-premises Information Technology (IT) infrastructure. This shift towards cloud computing promises scalability, cost-efficiency, and flexibility, as noted by Mell and Grance (2011:50). Cloud services, delivered by Cloud Service Providers (CSPs), enable businesses to tailor solutions to their unique needs (AWS, 2023; Rani *et al.*, 2015:26).

While South African universities have embraced cloud computing to some extent, particularly for file sharing, operational and learning platforms remain localised. The COVID-19 pandemic has accelerated global shifts, compelling universities to explore cloud solutions. However, significant implementation challenges persist, as identified by Odeh *et al.* (2017).

This study will focus on identifying the challenges and what strategies can be implemented to prevent them from having a negative impact on the implementation of cloud computing solutions. Investigating these obstacles and understanding cloud-based solutions with their current issues is essential. With this understanding, universities can adopt cloud computing solutions with lower risk by implementing effective adoption procedures.

1.3 BASICS OF CLOUD COMPUTING

According to the NIST, cloud computing can be defined as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources”. In other words, cloud computing is a technological resource that is available and accessible over

the internet. These resources can be servers, storage, software, and other applications that are accessible without having the physical infrastructure on-premises (Mell & Grance, 2011).

Cloud computing enables businesses to focus on their core operations rather than managing IT infrastructure. This provides more cost-efficient, scalable, and flexible solutions for organisations. These IT services are provided by a CSP and they can provide different types of services. These services can include Infrastructure (IaaS), Platform (PaaS), and Software as a Service (SaaS). This allows organisations to choose solutions that fit their needs without having to buy the physical infrastructure (AWS, 2023; Rani *et al.*, 2015:26).

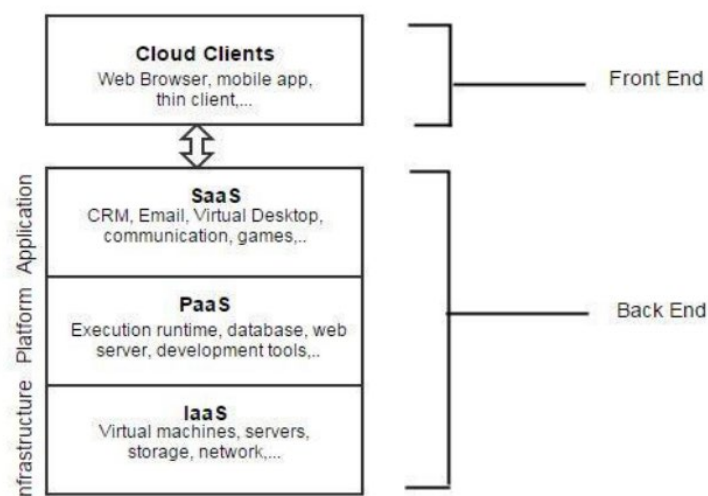


Figure 1-1: Basic Cloud Solution Types

Source: Rani *et al.* (2015)

Cloud computing can be divided into four categories of deployment models, namely Public, Private, Community, and Hybrid. Public models are provided by CSP and resources are shared based on need. Private models are dedicated by CSP for specific resource allocation to an organisation. The community is a shared resource between different companies. Finally, a Hybrid is a combination of the above-mentioned models (Rani *et al.*, 2015:26-27). These deployment models can differ based on the needs and requirements of business implementing the cloud solutions.

1.4 BENEFITS AND DISADVANTAGES OF CLOUD COMPUTING

Mosweu (2019a:5) has done detailed studies regarding the benefits of cloud computing. Benefits can be the following:

- Reliability can be enhanced, and resources are more available.
- Can give users and companies more flexibility, which can cut costs.
- Make it easier for companies to scale up or down.
- Helps improve business processes by increasing accessibility to resources.
- Enhanced protection against data corruption or loss.
- Able to collaborate more precisely and widely.
- Allows for better disaster recovery and business continuity.

According to Odeh *et al.* (2017:923), businesses in developing countries are suffering from the following barriers that can be disadvantages:

- Cost of services and payments.
- The switching to cloud computing might be costly
- If CSP is in another country payments may have drastic effects.
- Lack of electricity stability or slow broadband may affect connectivity and data integrity.
- Some countries lack awareness of new technologies.
- Concerns regarding the protection of data in the cloud.

Various implementation models for cloud computing services have been developed to assist businesses in making informed decisions about adopting cloud computing. These models are tailored to consider different aspects of a business and aid in making accurate trade-off decisions (Rani *et al.*, 2015).

1.5 BACKGROUND AND JUSTIFICATION OF THE STUDY

There are universities in South Africa that already use cloud computing to a certain degree. Most of the file structure and sharing are cloud-based. However, it seems that certain operation and learning platforms are still locally based (Odeh *et al.*, 2017; Scholtz & Atukwase, 2020)

The exploration of cloud computing adoption within South African universities is critical for comprehending the potential of these technologies to enhance institutional operations and promote long-term sustainability. The benefits are significant for universities aiming to refine their overall business models through infrastructure optimisation and the delivery of superior services to both students and staff.(Scholtz & Atukwase, 2020)

The urgency surrounding the adoption of cloud technologies has intensified in the aftermath of the COVID-19 pandemic, which emphasised the necessity for remote learning platforms and digital business solutions. As universities endeavour to strengthen their competitive positions and

business models, cloud computing emerges as a viable solution that can enhance administrative operations, foster collaboration, and ensure business continuity.

However, universities encounter obstacles in their efforts to adopt cloud computing solutions. As highlighted by Odeh *et al.* (2017), challenges can impede the successful deployment of cloud-based systems, particularly in developing nations, and it present considerable barriers to adoption. This research aims to investigate these challenges in detail, focusing on the specific hurdles faced by South African universities in their transition to cloud technologies, with the objective of identifying strategies to mitigate risks and facilitate smoother adoption processes.

Through a comprehensive analysis of how cloud computing can improve the business dimensions of universities, this study can elucidate the benefits of transitioning to cloud-based platforms, extending beyond mere enhancements to IT infrastructure. Additionally, the research can address the implementation challenges that, if effectively managed, could yield significant improvements in university operations, thereby facilitating enhanced resource management and strategic growth.(Scholtz & Atukwase, 2020)

1.6 PROBLEM STATEMENT

Despite these recognised benefits of cloud computing, universities face several challenges in adopting these solutions, including security concerns, resistance to technological change, and integration complexities. However, it is still unclear how significantly these challenges impact a selected South African university and whether they hinder its ability to fully leverage cloud technologies. This study aims to investigate these potential barriers and assess their effects on the university's operations. The goal is to identify strategies that support a smoother adoption and optimisation of cloud computing solutions.

1.7 RESEARCH OBJECTIVES

1.7.1 Primary Objective

To investigate the impact of cloud-based systems as solutions for business operations at a selected university of South Africa.

1.7.2 Secondary Objectives

- To investigate the factors influencing cloud computing adoption in the selected university, including the associated benefits, challenges, and obstacles during implementation

- To evaluate strategies used by the university to implement cloud computing solutions, focusing on their effectiveness in mitigating challenges and navigating the implementation process.

1.8 SCOPE OF THE STUDY

1.8.1 Field of Study

This study pertains to the field of Information Communication and Technology (ICT) management, with a particular focus on cloud computing technologies and their adoption. This research area is of great significance due to the growing trend of educational institutions embracing technological advancements to improve their operational efficiency. Cloud computing represents an advanced technology that universities can leverage to enhance their effectiveness and competitiveness.

1.8.2 Sector/Industry/Business under Investigation

This study aims to investigate the adoption of cloud computing solutions in the higher education sector of South Africa, with a specific focus on universities. This sector has unique requirements pertaining to the support, administration, and academic business processes.

1.8.3 Geographical Demarcation

This study aims to concentrate solely on a university situated within the geographical boundaries of South Africa. It intends to evaluate the university's business operations and investigation will focus on them as they are in the process of implementing cloud computing solutions. The selected university in this case is the North-West University (NWU) of South Africa.

1.9 CONTRIBUTION OF STUDY

The primary objective of this research is to enhance the knowledge of cloud-based solution implementation for universities in South Africa. The study aims to advance the understanding of the process of implementation, identifying potential challenges, and proposing strategies to mitigate risks of failure. The research outcomes will potentially aid university staff in preparing for the challenges or having necessary structures in place to minimise the risks of failure during implementation.

Furthermore, the study intends to provide a basis for decision-making and planning for universities, thereby enhancing their understanding of the implementation process. The research outcomes will help universities to have policies in place for potential risk areas in terms of cloud restrictions or data agreements. Additionally, the implementation of cloud-based solutions will aid universities in being more successful in terms of competitiveness and innovation.

The study aims to contribute to the advancement of the IT and business field for universities in South Africa. It will create opportunities for further research in the field for students to invest in.

1.10 RESEARCH DESIGN

This study will consist of two research parts. The first phase will focus on literature to gain insight into the technology, business environment, and how it integrates. The second phase will be an empirical study to determine the indicators and challenges that impact the business environment of universities in South Africa by implementing cloud computing solutions.

1.10.1 Literature Review

The aim of the literature is to address gaps in knowledge or potential focus areas of the research. The first step is to develop a comprehensive understanding of all the terminology used within the field. This includes a clear definition of cloud computing, a thorough examination of its distinguishing features in comparison to traditional computing, and an exploration of the structural differences between the two. It is also essential to analyse the implementation process, particularly as it pertains to universities, in order to gain insight into how new technologies are integrated into existing systems.

A deeper exploration into the subject will provide a basis for identifying the challenges that universities may face when transitioning to cloud computing, including an analysis of the advantages and disadvantages of this technology. By examining the struggles that are associated with the implementation of cloud computing, it becomes possible to gain a clearer understanding of how these challenges may impact business operations.

Building upon this foundation, a review of case studies detailing both successes and failures will help to focus the data collection process. Case studies from other companies within the education sector will be particularly useful in this regard, enabling a more detailed analysis of the potential impact and process points.

Lastly, to facilitate this research, a range of resources may be utilised, including publications, journals, articles, past interviews with industry specialists, press releases, and data resources containing referable information on the topic. To conclude this all, an overview of the challenges and strategies will be given, to help fill in some of the gaps that may exist in the research materials.

1.10.2 Empirical Study

The primary objective of this research is to investigate the challenges and strategies associated with the maintenance and implementation of computer systems and technology frameworks in universities. The study aims to obtain input from stakeholders in the field, which is expected to provide insightful and informative data for analysis.

The research will adopt a qualitative approach that is centered on the interpretation of the matter under investigation. Qualitative research methods such as life stories, interviews, personal experiences, observations, and case studies will be used to gather a variety of empirical data (Denzin & Lincoln, 2003).

1.10.3 Methodology

To guide this qualitative study, an interpretive paradigm will be used to explore the personal experiences of stakeholders facing challenges in adopting cloud computing solutions. An inductive research approach will allow for the formation of patterns and themes, derived from semi-structured interviews with IT personnel and stakeholders, to reveal obstacles and strategies for adoption. An exploration strategy will guide the research, using a cross-sectional time horizon to capture current stakeholder experiences. The study population will include IT department members directly involved in decision-making for cloud adoption, selected through convenience sampling to ensure participation of those with relevant expertise.

The measuring instrument will be a detailed, semi-structured interview guide, designed to gather comprehensive insights on cloud adoption. The interview structure will cover aspects like cloud computing benefits, obstacles faced, and best practices. Sections will address legal, ethical, and data privacy concerns, as well as strategies recommended by participants. Each interview, conducted professionally and ethically, will ensure confidentiality and comply with South Africa's Protection of Personal Information (POPI) Act. Additional rounds of interviews may be conducted if initial data proves insufficient.

1.10.4 Collection of Data

In order to collect data for the research, certain participants who hold roles deemed relevant to the study will be selected and invited through email to participate on a voluntary basis. A formal consent form will be developed and administered to ensure that participation is not mandatory and that participants have a clear understanding of the expectations of their involvement. The current research will be conducted at the IT department. The target population in this study is all the employees attached to the IT department.

Convenience sampling will be used with sample size determined by reaching the point of saturation plus one. The employees not attached to IT will be excluded and only those employed under the IT department will be included. The participants will be recruited through the office of the Chief Director and an invitation email with the informed consent form attached will be sent to the IT department employees from the director's office.

Upon receipt of consent, the participants will have the opportunity to schedule a meeting at their convenience. The data will be collected through interviews conducted either face-to-face or via remote video conference. Throughout the process, personal preferences and individual considerations will be taken into account to ensure the comfort and well-being of the participants.

The resulting recordings will be transcribed and subjected to data analysis for the research, with all personal or sensitive data being excluded from transcription to protect the confidentiality and interests of the participants.

1.10.5 Analysis

For this study, thematic analysis will be used to delve into the data and identify patterns and themes. The thematic analysis involves the categorising, coding, and interpreting of responses to conclude meaningful insights. This should provide indicators for which obstacles and strategies are currently influencing the adoption of cloud computing solutions.

1.10.6 Reliability and Validity (Trustworthiness)

Upholding the trustworthiness of this study can be done by background checks of selected stakeholders and by maintaining audit trails for the research. To ensure the validity of stakeholders, a member check or peer debrief can be used. To ensure the correct data is collected, a constant process of evaluation of responses can be done to ensure the interview answers the questions. Keeping track of questions and answers and notable responses can help protect data reliability.

1.11 ETHICAL CONSIDERATION

1.11.1 Obtaining Consent

This study relies on human participants for data collection. In order to maintain ethical standards, it is vital that participation in the study is voluntary. For this purpose, a consent form has been developed to be sent out to potential participants to obtain their consent to participate in an

interview and to allow for the collection of data. Annexes contains the Informed Consent Form that will be used to obtain consent from participants.

1.11.2 Data Protection

Data protection is of utmost importance in this study. During the interview, some personal information may be recorded. However, any personal information obtained during the interview is protected under the POPI Act of South Africa. Furthermore, any sensitive and personal information revealed during the interview will not be documented or distributed. Only the relevant data to the research will be documented. The collected data will be made available to the participants with concerns. If a participant wishes to withdraw from the study, they may do so and their data will be removed. The protection of the participants, their employer, and the data received from them is maintained confidential.

1.11.3 Conflict of Interest

Conflict of interest is a possibility in any research study. However, in this study, the possibility of a conflict of interest is minimal since the data will be gathered on an open sampling demarcation group. In case a conflict of interest arises, the participant may withdraw from the study or allow for a conflict of interest form to be signed.

1.11.4 Procedures for Handling Potential Problems

Procedures for handling potential problems need to be in place. The voluntary participation of the participants in the study means that their right to decline or withdraw from the study should be respected. Proper consent must be obtained, and data handling must be carried out appropriately to protect both the participants and the research. Maintaining good documentation is vital for this research. In the event of any problems, having proper documentation in place is crucial to resolve the problem. Any potential issues will be reported to the university and supervisors with all evidence in regard to the problem or participant.

1.12 LIMITATIONS OF STUDY

The data collection process is subject to several limitations, including sample size, collection constraints, data quality, and interpretation accuracy. A small sample may not provide the insights needed for comprehensive analysis, and constraints, such as those protecting company interests, can hinder data gathering. Additionally, poor data quality, interpretation errors, and language or cultural barriers may affect the findings. The study also faces resource limitations, including time constraints, participant availability, and limited historical material, as the topic is relatively new.

External factors, such as legal, ethical, or policy changes, or unforeseen global events, may further impact the research. Lastly, the study is confined to employees at NWU, which may limit its broader academic contribution, particularly given South Africa's socio-economic challenges and the potential value of cross-country comparisons.

1.13 LAYOUT OF STUDY

The following is a basic layout of the research document, which outlines the key sections of the study. The sections of the research document are as follows:

CHAPTER 2 will explore essential concepts and prior research on cloud computing adoption in universities. Topics include benefits, challenges, influencing factors, and South Africa's legal framework. It reviews theoretical models and identifies gaps in the current literature.

CHAPTER 3 will describe the research design, which combines literature review and qualitative empirical study. It details the qualitative approach, data collection via interviews, sampling strategy, and ethical considerations. It concludes with data analysis methods and validity measures.

CHAPTER 4 will present findings from interviews, organised by research objectives, using thematic analysis to identify patterns and compare them to existing literature and concluding with a summary of findings to prepare for the discussion in the next chapter.

CHAPTER 5 will discuss how the findings address the research objectives. The chapter analyses the benefits, challenges, and key factors in cloud adoption, as well as ethical concerns. It evaluates findings with reference to theoretical models and provides practical insights for management.

CHAPTER 6 will offer practical recommendations for cloud adoption in universities, including strategies for overcoming challenges, proposing a framework for implementation and suggesting policies. The chapter concludes with ideas for future research to address remaining gaps.

CHAPTER 7 will summarise key findings, emphasising the impact of cloud computing on university operations and the practical strategies for effective adoption. It highlights the study's contribution to the field and provides closing remarks on the future of cloud computing in higher education.

1.14 CHAPTER SUMMARY

This chapter outlines the study's focus on investigating the challenges and strategies surrounding the adoption of cloud computing technologies in South African universities. It emphasises the growing importance of cloud computing in enhancing institutional operations, especially after the COVID-19 pandemic, which highlighted the need for remote learning and digital solutions. It explains how the research aims to explore obstacles and propose strategies to facilitate smoother cloud adoption, ultimately helping universities improve their business operations, reduce risks, and support long-term sustainability.

CHAPTER 2 LITERATURE REVIEW

2.1 CHAPTER OVERVIEW

The literature study provides a foundation for understanding cloud computing adoption in higher education by examining research, frameworks, and case studies. It identifies benefits, challenges, and regulatory implications of cloud implementation, highlights knowledge gaps, and aligns findings with practical challenges faced by universities. This understanding is required for addressing the complexities of cloud adoption and guiding decision-making.

2.2 INTRODUCTION TO CLOUD COMPUTING

2.2.1 Definition of Cloud Computing

Cloud computing has emerged as a transformative paradigm in modern technology, changing how computing resources are delivered and utilised. The NIST (2011) provides a comprehensive definition, describing cloud computing as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources ... that can be rapidly provisioned and released with minimal management effort or service provider interaction.” This definition encapsulates the essence of cloud computing, emphasising its core features of flexibility, accessibility, and efficiency in resource management.

Islam *et al.* (2023:55) further elaborate on the practical aspects of cloud computing, defining it as “the on-demand availability of computer system resources, particularly data storage (cloud storage) and processing power, without direct active management by the user.” This description underscores the automation and user-friendly nature of cloud services, where complex infrastructure management is abstracted from the end-user. Additionally, Islam *et al.* (2023:55) point out that large cloud systems often operate across multiple data centers, ensuring robustness and scalability in service delivery.

The dynamic and evolving nature of cloud computing is highlighted by Kabata (2012), who defines it as “a form of distributed storage involving shared hardware or several virtual machines running on a physical machine.” This perspective focuses on the underlying architecture of cloud computing, emphasising virtualisation and shared resource utilisation.

Adding another layer of complexity, Rani *et al.* (2015) emphasise the goal-oriented nature of cloud computing. They describe it as an approach designed to “provide the consumer or end-user with a computing environment with Quality of Service (QoS) based on dynamic requirements, utilising

distributed resources to solve complex, large-scale computation problems and achieve higher throughput.” This definition aligns with an application-driven perspective of cloud computing, where scalability and QoS are prioritised to effectively meet varying user demands.

Mosweu *et al.* (2019a) mentioned that American Records Management Association (ARMA) noted the definition of cloud computing remains fluid, as “it means different things to different people,” reflecting its versatility and the diverse ways it is adopted across various industries. This statement remains true as the cloud computing environment grows and adapts to requirements and availability of resources.

In short, cloud computing is a complex and evolving technology characterised by its adaptability, scalability, and efficiency. While its foundational principles, such as on-demand access, resource sharing, and virtualisation, remain consistent. The interpretations and applications of cloud computing vary based on different contexts and user needs. These definitions together highlight the versatility of cloud computing as a crucial enabler of modern technological advancements.

2.2.2 Scope of Cloud Computing

Cloud computing in scope is defined by key characteristics, service models, deployment models, underlying architecture, and its significant role in enabling future technological advancements. Based on Mell and Grance (2011:2), the definition of cloud computing highlights five essential characteristics that define the scope of cloud computing:

- **On-Demand Self-Service:** Users can independently provision computing resources without requiring human intervention from the provider.
- **Broad Network Access:** Cloud services are accessible over the internet through various devices, including smartphones, tablets, and laptops.
- **Resource Pooling:** Providers dynamically allocate resources across multiple users using a multi-tenant model, optimising efficiency and minimising costs.
- **Rapid Elasticity:** Resources can automatically scale to meet changing demands, ensuring flexibility.
- **Measured Service:** Usage is monitored and billed based on actual consumption, promoting cost transparency and optimisation.

Figure 2-1 illustrates the broad scope of cloud computing, showcasing various components and deployment models that highlight its versatility. Cloud Computing is depicted as the core hub, connecting to essential resources and services, including storage, server, mobile, applications,

and database. These connections represent the cloud's capability to provide on-demand access to various computing resources, supporting diverse applications and data storage needs.

It also emphasises cloud deployment models: Private Cloud, Public Cloud, and Hybrid Cloud, each offering distinct configurations for resource management and accessibility based on user requirements. The combination of resources and deployment options underscores cloud computing's flexibility, scalability, and adaptability in serving different organisational needs and workloads. (Mell & Grance, 2011)

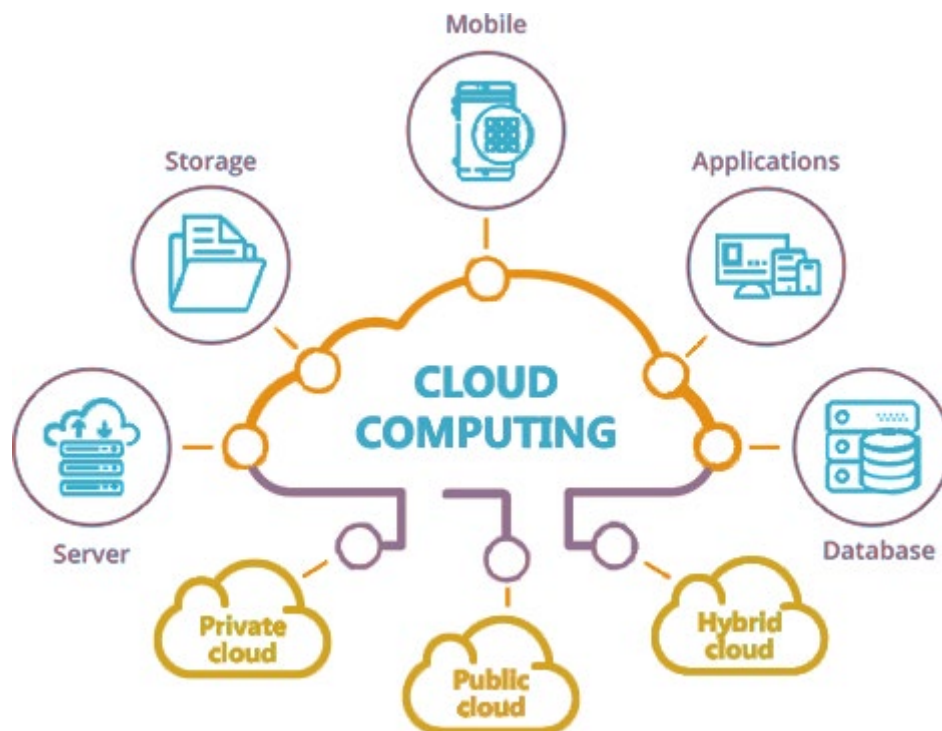


Figure 2-1: Scope of Cloud Computing

Source: Netwriks Unlimited (2019)

2.2.3 Service Models in Cloud Computing

According to Rani *et al.* (2015), the scope of cloud computing is further delineated through its various service models, which cater to diverse user needs by providing different levels of abstraction and control.

Figure 2-2 highlights key components within cloud computing infrastructure. **Identity and Access** involves managing user identities, permissions, and authentication protocols to ensure secure access. **Data** encompasses all digital information stored and processed, such as files and

databases. **Applications** are software programs that provide specific functionalities to users without needing local installation. The **Runtime Environment** supports application execution by providing necessary libraries and dependencies. The **Operating System (OS)** manages hardware resources and interfaces with applications, while **Virtualisation** enables multiple virtual environments to run on a single physical machine, optimising resource use. **Servers** supply the processing power needed for application operations, while **Storage** provides space for data, allowing for scalable capacity. Finally, the **Network** connects users, servers, and storage, ensuring efficient data transmission and seamless communication across the system. Each of these components plays a crucial role in supporting the flexibility, scalability, and functionality of cloud computing. (QIM Info, 2023)

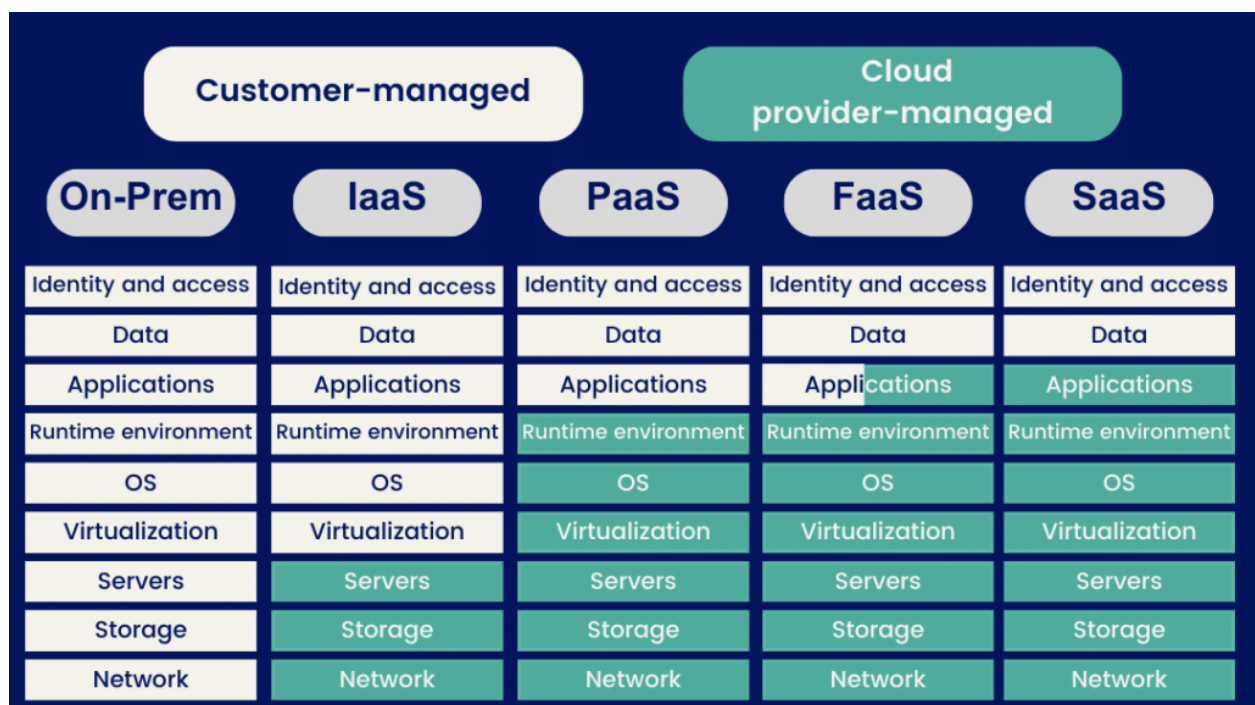


Figure 2-2: Cloud Service Models' Overview

Source: QIM Info (2023)

From **Figure 2-2**, there are four major cloud service models: IaaS, PaaS, FaaS, and SaaS. Below each of these modules are discussed and explained.

Infrastructure as a Service (IaaS)

IaaS offers essential computing resources such as virtual machines, storage, and networking, allowing organisations to build and manage their IT infrastructure with flexibility. For example, Amazon Web Services (AWS) provides scalable computing power and storage solutions, Google Compute Engine supports large-scale data processing and virtualised computing, and Microsoft Azure delivers virtual machines for various workloads. IaaS is particularly advantageous for businesses in need of scalable and cost-effective infrastructure to support their operations (Mell & Grance, 2011; QIM Info, 2023; Rani *et al.*, 2015:25).

Platform as a Service (PaaS)

PaaS provides a platform for developers to build, test, and deploy applications without the complexities of managing hardware or operating systems. This model fosters innovation by streamlining the application development process. Examples include Google App Engine, which provides a scalable environment for web application development, and Microsoft Azure, which offers integrated tools for creating and deploying software solutions. Additionally, Force.com enables developers to build enterprise applications with minimal effort. By concentrating on development instead of infrastructure, PaaS accelerates the delivery of software products. (Mell & Grance, 2011; QIM Info, 2023; Rani *et al.*, 2015:25)

Function as a Service (FaaS)

FaaS, a component of serverless computing, focuses on executing specific functions or code snippets in response to events without the need for server management. Platforms such as AWS Lambda allow code to run automatically when triggered by events like HTTP requests, while Google Cloud Functions support event-driven application architectures. Similarly, Microsoft Azure Functions enable automatic scaling of workloads. FaaS simplifies application development by abstracting infrastructure management, offering a cost-effective and scalable solution for microservices and event-driven scenarios. (QIM Info, 2023)

Software as a Service (SaaS)

SaaS allows users to access fully developed software applications over the internet without the need to manage the underlying infrastructure or handle application updates. This model is widely utilised for tasks related to productivity, collaboration, and customer relationship management (CRM). For instance, Microsoft Office 365 offers cloud-based productivity tools, Google Workspace facilitates collaborative workflows, and Salesforce.com delivers comprehensive CRM solutions. These applications aim to simplify software access and management for users, making

SaaS one of the most popular models in cloud computing. (Mell & Grance, 2011; QIM Info, 2023; Rani *et al.*, 2015:25)

According to QIM Info (2023), FaaS became a large focus in recent years and is therefore now part of the major four service models. There are, however, models like Container as a Service (CaaS) and other “as a Service” models available. Here are some the most common ones:

Container as a Service (CaaS) serves as a connection between IaaS and PaaS by utilising virtualisation and container technologies. It reduces the memory-intensive demands associated with traditional virtualisation by allowing for efficient deployment of containers. Customers have access to platforms that enable them to manage container engines and computing resources. An example of this is the AWS Elastic Container Service, which facilitates the management of Docker containers. (QIM Info, 2023)

License as a Service (Laas) is a service that simplifies the management of software licenses through online configuration, allowing providers to control the usage terms. (QIM Info, 2023)

Data as a Service is a model that delivers big data applications over the Internet, utilising advancements in cloud storage and bandwidth. (QIM Info, 2023)

Business Process as a Service involves outsourcing various business processes, such as payroll, payments, and financial management. (QIM Info, 2023)

Desktop as a Service (DaaS) is a service that provides virtual desktops hosted by cloud providers, which can be accessed via the Internet. (QIM Info, 2023)

Network as a Service (NaaS) allows customers to rent networking services without the need to maintain physical infrastructure. (QIM Info, 2023)

Storage as a Service is an offering that provides public cloud-based file storage, which is commonly used for backup and file sharing. (QIM Info, 2023)

Communication as a Service includes tools for voice and video communication, which are essential for remote work scenarios. (QIM Info, 2023)

The scope of cloud computing, with its diverse services, makes it highly adaptable to various needs. Its scalability, cost-efficiency, and ability to deliver infrastructure, platforms, and applications on demand showcase its versatility, solidifying its role in driving innovation and efficiency across industries. (Mell & Grance, 2011)

2.2.4 Deployment Models in Cloud Computing

According to Rani *et al.* (2015), deployment models in cloud computing describe the different ways cloud infrastructure can be organised and accessed. Each model offers unique advantages and caters to specific organisational needs, balancing aspects such as control, scalability, and cost. Here are the different models and their aspects:

Public Cloud

The public cloud features a shared infrastructure managed by third-party providers like Amazon Web Services (AWS), Microsoft Azure, and Google Cloud. In this model, resources are available to multiple organisations (tenants) over the internet. This arrangement offers high scalability, as resources can be easily adjusted based on demand, and is often more cost-effective since infrastructure costs are distributed among many users. However, the shared environment may pose security and compliance risks for organisations handling sensitive data. Public clouds are ideally suited for businesses that require flexible, on-demand resources without significant initial investments in infrastructure. (Mell & Grance, 2011; QIM Info, 2023; Rani *et al.*, 2015:26)

Private Cloud

A private cloud is dedicated to a single organisation and can be hosted on-premises or managed by a third-party provider. This model provides greater control, security, and customisation since resources are isolated and available only to the specific organisation. Private clouds are commonly used in sectors with strict regulatory requirements, such as healthcare and finance, where data privacy and compliance are essential. The trade-off is that private clouds are generally more expensive to establish and maintain, as they require dedicated resources and potentially higher management efforts. (Mell & Grance, 2011; QIM Info, 2023; Rani *et al.*, 2015:26)

Hybrid Cloud

Hybrid cloud models integrate public and private clouds to offer a flexible solution that leverages the benefits of both environments. In a hybrid setup, sensitive data or core operation can be maintained in a private cloud while non-sensitive workloads are processed in a public cloud. This allows organisations to scale resources as needed. For example, an e-commerce company might use a private cloud for handling payment processing and a public cloud to accommodate increased website traffic during peak shopping seasons. Hybrid clouds provide high flexibility and control but require careful management and integration between the two environments to ensure seamless functionality. (Mell & Grance, 2011; QIM Info, 2023; Rani *et al.*, 2015:26)

Community Cloud

A community cloud is a collaborative model where the infrastructure is shared by multiple organisations with similar needs or regulatory requirements, such as government agencies or research institutions. This model can be managed internally by one of the member organisations or by a third-party provider. The shared infrastructure in a community cloud helps ensure compliance with common standards and policies, making it a cost-effective solution for organisations with shared goals. However, customisation options may be limited compared to private clouds due to the shared nature of the environment. (QIM Info, 2023; Rani *et al.*, 2015:26)

These four are the main development models to be considered when transitioning to cloud computing service. However, there are other development models that are important to consider for the transformation process. These are called inter-clouds models.

Inter-Clouds

According to Rani *et al.* (2015), Inter-Clouds is a framework connecting multiple cloud environments to create a “cloud of clouds.” This model is inspired by the idea of the Internet as a “network of networks” and aims to establish a unified cloud ecosystem that mitigates the limitations of individual cloud platforms. Inter-Clouds address the finite resources of single clouds by enabling resource sharing, enhancing interoperability, and improving resilience across various cloud providers, ultimately offering a more adaptable and robust solution for businesses and users. (QIM Info, 2023; Rani *et al.*, 2015:26)

The need for Inter-Clouds arises from the inherent limitations of isolated cloud environments. Individual clouds have finite computational and storage resources, which can restrict scalability and resilience, especially during periods of peak demand. Inter-Clouds permit cloud providers to share resources across different geographical locations, increasing service availability and improving application resilience. Additionally, this model minimizes vendor lock-in, allowing clients the flexibility to switch between providers or use multiple providers simultaneously without being constrained to a single vendor’s ecosystem. (QIM Info, 2023; Rani *et al.*, 2015:26)

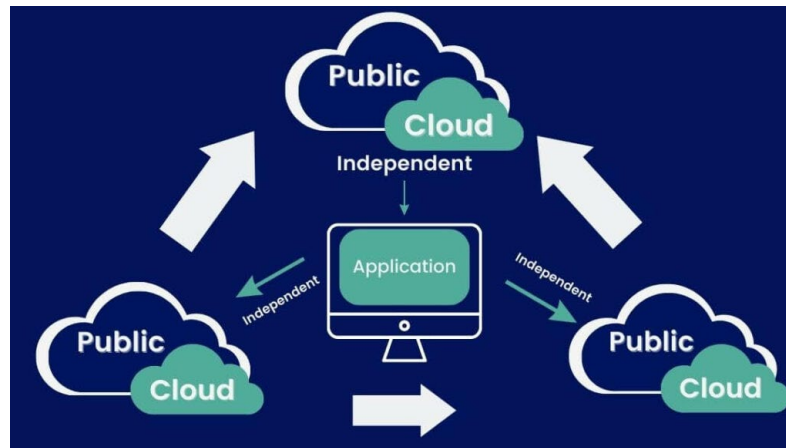


Figure 2-3: Representation of an Inter-Cloud

Source: QIM Info (2023)

Rani *et al.* (2015) stated that Inter-Clouds can be categorised into two types: Federation Clouds and Multi-Clouds. Federation Clouds involve voluntary collaboration among cloud providers who share resources based on mutually beneficial agreements; this is often seen in government or private cloud portfolios. In contrast, multi-clouds refer to the independent use of multiple clouds by clients who manage their own resource provisioning without collaboration between providers. This arrangement is commonly adopted by organisations that strategically select different clouds according to specific service requirements or cost considerations (QIM Info, 2023; Rani *et al.*, 2015:26).

The topologies of Inter-Cloud architectures differ based on how resources are shared and managed. In a Peer-to-Peer Federation, cloud providers negotiate directly with one another using distributed directories for resource brokering. Centralised Federation involves a central entity that acts as a registry, facilitating resource sharing among clouds. Multi-Cloud Services rely on external or in-house brokers to assist clients in accessing and coordinating multiple clouds, while Multi-Cloud Libraries provide developers with unified cloud APIs, such as Apache LibCloud or JClouds, to enable seamless integration across different cloud platforms (QIM Info, 2023; Rani *et al.*, 2015:26).

Inter-Cloud computing also presents several challenges. Key areas of focus include developing predictive models for application behaviour to support dynamic scaling, creating flexible mappings of services to resources for cost efficiency and QoS, and designing economic models to optimise resource usage and deployment strategies. Moreover, the integration and interoperability between on-premises systems and cloud services, as well as scalable monitoring for distributed environments, are critical areas that require attention. Addressing these challenges will be

essential for realising the full potential of Inter-Clouds and building a resilient, efficient, and interconnected global cloud ecosystem (QIM Info, 2023; Rani *et al.*, 2015:26).

2.2.5 Summary of Cloud Computing

To recap, cloud computing is a technology model that provides on-demand access to a shared pool of configurable computing resources, including storage, servers, applications, and networks, over the internet. This model allows businesses and users to quickly scale resources while only paying for what they use, making it both cost-effective and flexible.

Cloud computing offers unparalleled scalability, supports remote work, and enables advanced applications such as AI, big data analytics, and disaster recovery solutions. However, it is inherently complex, involving various service models like SaaS, PaaS, IaaS, and FaaS, as well as different deployment models, including public, private, hybrid, and community clouds. Each of these models serve distinct needs.

Integrating these models into existing infrastructure can be challenging, especially when managing data security and ensuring interoperability between platforms, particularly in multi-cloud or Inter-Cloud setups where resources are shared across different providers. Therefore, successful cloud implementation requires solid processes for planning, resource management, data privacy, and performance optimisation. Effective processes enable organisations to navigate the technical, operational, and strategic complexities of cloud computing, ultimately maximising its benefits.

2.3 BENEFITS OF CLOUD COMPUTING IN HIGHER EDUCATION

The research done by Ali *et al.* (2021) bring a lot of perspective for the benefits of cloud computing in Higher Education. The following benefits can be observed.

2.3.1 Cost Efficiency and Resource Optimisation

According to Ali *et al.* (2021), one of the main advantages is the reduction in infrastructure costs since institutions no longer need to invest in expensive on-premises servers, software, or IT infrastructure. Wu and Plakhtii (2021) stated that by utilising cloud services, institutes can access resources on a pay-as-you-go basis, transforming capital expenditures into operational expenses. This shift allows institutions to allocate funds more effectively, allowing them to focus on core educational activities instead of on IT maintenance.

Additionally, cloud computing offers substantial operational savings. The maintenance, updates, and management of IT systems are handled by cloud providers, which reduces the reliance on specialised in-house IT teams and lowers overall operational expenses. Through shared resources enabled by multi-tenancy, institutions can share infrastructure costs while maintaining privacy and customisation, further optimising their expenditures (Ali *et al.*, 2021:3-4; Wu & Plakhtii, 2021:80).

Cloud platforms also support open-source software, granting access to free educational tools and applications, which reduces the need for costly proprietary software licenses. Moreover, the elimination of large data centers or server rooms results in energy and space savings, as institutions no longer incur costs for electricity, cooling, and physical storage space. Together, these factors make cloud computing a highly efficient and resource-optimised solution for organisations looking to modernise their operations (Ali *et al.*, 2021:3-4; Wu & Plakhtii, 2021).

2.3.2 Scalability and Accessibility of Resources

Cloud computing offers unmatched scalability and flexibility, allowing institutions to efficiently adapt to changing needs. With dynamic resource allocation, institutions can adjust computational power and storage in real-time based on demand. This ensures optimal resource use during peak times, such as enrolment or exam periods, while reducing costs during off-peak times (Wu & Plakhtii, 2021:5). Such adaptability enables institutions to meet a variety of needs, including accommodating increased student enrolments, launching new programs, or supporting complex research projects, all without requiring significant investments in physical infrastructure (Ali *et al.*, 2021:3).

Furthermore, cloud platforms provide access to advanced tools and systems that can be easily scaled to implement learning management systems (LMS) or virtual labs, creating a solid foundation for modern education (Zhang, 2021:80). The flexibility of cloud systems also supports geographically distributed learning, allowing students and educators to access resources from anywhere in the world, which fosters global collaboration (Wu & Plakhtii, 2021:7)

Additionally, the cost-effective expansion capabilities of cloud platforms enable institutions to seamlessly add users or services as needed, facilitating growth and innovation without incurring excessive costs (Ali *et al.*, 2021:5). These features make cloud computing an essential tool for building responsive and future-ready educational environments.

2.3.3 Improved Accessibility and Enhanced Collaboration

Enhanced collaboration tools, such as shared documents, messaging platforms, and video conferencing systems, encourage teamwork and interactive learning among both students and educators (Ali *et al.*, 2021:10). These tools allow users to access resources from any location, ensuring continuity in education during emergencies like pandemics (Wu & Plakhtii, 2021:7).

Additionally, cloud platforms support real-time interaction, enabling synchronous communication for live lectures, discussions, and group projects through applications like Blackboard Collaborate (Wu & Plakhtii, 2021:8). Centralised data and resource sharing make it easier to distribute educational content such as e-books, lecture notes, and multimedia, saving time and improving efficiency (Zhang, 2021:80).

Furthermore, cloud computing facilitates collaboration across institutions, allowing researchers and educators to share data and work on joint projects seamlessly. This breaks down barriers to academic partnerships and fosters innovation (Ali *et al.*, 2021:11). These capabilities make cloud computing an essential tool for enhancing accessibility and collaboration in modern education.

2.3.4 Enhanced Learning Experience

Cloud computing enhances the learning experience by introducing innovative tools and fostering personalised and flexible educational approaches. Platforms like Blackboard Learn integrate teaching tools such as virtual labs, gamified learning, and adaptive technologies, which boost engagement and improve knowledge retention (Wu & Plakhtii, 2021:5). Additionally, cloud systems support both synchronous and asynchronous learning, enabling real-time interactions through video conferencing and discussion forums, while also offering recorded lectures and self-paced activities for greater flexibility (Wu & Plakhtii, 2021:7).

Moreover, cloud computing facilitates personalised learning by leveraging analytics and machine learning algorithms to tailor learning paths based on individual student needs, which enhances performance outcomes (Ali *et al.*, 2021:11). Students and educators gain access to a wealth of resources, including extensive digital libraries, multimedia content, and collaborative tools, enriching the educational experience (Wu & Plakhtii, 2021:5).

Furthermore, global classroom experiences enabled by cloud technology promote cultural exchange and broaden perspectives by connecting geographically diverse learners (Ali *et al.*, 2021:10). Collectively, these features make cloud computing a transformative force in modern education.

2.3.5 Data Security and Backup

According to Zhang (2021), enhanced data confidentiality and security are achieved through advanced encryption methods, including both symmetric and asymmetric algorithms. These techniques protect data during storage and transmission (Zhang, 2021:78-83). Additionally, cloud platforms offer real-time monitoring and management capabilities, providing centralised oversight that allows for the prompt detection and mitigation of potential security breaches (Wu & Plakhtii, 2021:11). Many cloud services comply with industry standards and legal frameworks, such as GDPR, ensuring adherence to stringent data protection requirements and building trust among users (Ali *et al.*, 2021:2).

Cloud computing also stands out in providing reliable and scalable backup solutions. Automated backup and recovery processes minimise manual errors and ensure quick data restoration during technical failures or disasters (Zhang, 2021:80). The scalability and flexibility of cloud systems enable organisations to expand their backup storage as their data needs to grow, eliminating the necessity for costly hardware upgrades. Moreover, disaster recovery is enhanced by distributed data storage across multiple locations, ensuring data availability and security even during localised disruptions (Ali *et al.*, 2021:4).

2.3.6 Support for Distance Learning

Looking at the research of Wu and Plakhtii (2021), cloud computing significantly enhances distance learning and teaching by integrating advanced tools and features that cater to a variety of educational needs. Platforms like Blackboard Learn offer interactive teaching tools that support both synchronous learning—such as video conferencing and collaborative sessions—and asynchronous access to course materials, assignments, and reminders. These features make education more engaging and accessible, accommodating diverse teaching methods and learning preferences. (Wu & Plakhtii, 2021:11)

Additionally, enhanced collaboration tools—including email, blogs, messaging platforms, and video conferencing solutions like Skype—enable seamless interactions across geographical boundaries. This fosters a connected and engaged learning environment, allowing students and teachers to collaborate effectively. (Wu & Plakhtii, 2021:11)

Educators also benefit from the customisation options available on cloud platforms, which allow for the creation of adaptable educational content in various formats, including text, video, and images. Advanced monitoring features, such as plagiarism checkers and customisable tests, enable tailored teaching approaches that meet individual student needs. Furthermore, centralised

resource access simplifies the distribution and retrieval of teaching materials by providing students and educators with a unified repository for resources, such as e-libraries and digital content, accessible from any device (Wu & Plakhtii, 2021:9).

Cloud platforms also support lifelong learning by empowering learners to pursue self-paced education and professional skill development through flexible tools like MoodleCloud. Finally, real-time feedback and analytics capabilities allow instructors to monitor progress and provide immediate, personalised feedback, enhancing academic outcomes and fostering a more effective learning process (Wu & Plakhtii, 2021:11).

2.4 CHALLENGES OF CLOUD ADOPTION IN HIGHER EDUCATION

Unfortunately, cloud computing, with all the values it can add, also have a lot of challenges. The work of Ali *et al.* (2021) have discussed some of the major challenges faced.

2.4.1 Security and Privacy Concerns

According to Zhang (2021), the biggest concern and challenges for institutions to adopt to cloud computing is the fact that they are unsure about the security of their data. These concerns are relevant and can be stopper to adoption. However, there are methods of mitigating these risks and challenges.

Multi-tenancy in cloud computing involves different organisations sharing the same physical resources. This can lead to unauthorised data access if vulnerabilities exist in the isolation mechanisms. For instance, side-channel attacks on shared CPU resources can leak sensitive information. To mitigate these risks, enhanced encryption, virtual machine isolation, and secure hypervisors are recommended. (Zhang, 2021:77)

Meeting industry standards such as ISO/IEC 27001, SOC 2, and GDPR is crucial for establishing trustworthiness. Non-compliance can result in penalties and damage to an organisation's reputation. Service providers must integrate compliance monitoring and auditing into their operations to facilitate adherence (Ali *et al.*, 2021:5)

APIs are essential for cloud service integration but are susceptible to attacks such as cross-site scripting (XSS) and Distributed Denial-of-Service (DDoS). Regular penetration testing and the adoption of secure development practices can help reduce API vulnerabilities. (Islam *et al.*, 2023:54)

Employees or contractors misusing their access can result in data breaches. Implementing strict Identity and Access Management (IAM) policies along with behavioural analytics can aid in detecting and preventing such activities (Wu & Plakhtii, 2021:8).

2.4.2 Integration with Legacy Systems

Effective cost management in cloud computing is essential because inadequate oversight can lead to significant financial inefficiencies. A major challenge organisations face is unexpected expenses, which can result from fluctuating demands, inefficient resource usage, or unanticipated data transfer costs. These issues can lead to budget overruns. To help manage these situations, organisations can use cloud cost management platforms such as AWS Cost Explorer or Azure Cost Management. These tools provide detailed insights into spending patterns, allowing for better forecasting and expense control (Wu & Plakhtii, 2021:7).

Another challenge is the overhead associated with idle resources. When unused resources remain active during non-peak hours, they create waste. By implementing autoscaling and scheduled start/stop mechanisms, organisations can ensure that resources are allocated only when needed, thereby reducing unnecessary costs (Islam *et al.*, 2023:54).

Additionally, while cloud providers offer appealing pay-as-you-go pricing models, long-term subscription costs can accumulate and sometimes exceed the costs of on-premises infrastructure. Therefore, it is essential to conduct a thorough evaluation of the total cost of ownership (TCO) before adopting cloud solutions to prevent unforeseen financial burdens (Ali *et al.*, 2021:6).

Lastly, a lack of resource optimisation is a common issue, as organisations often over-provision resources to avoid performance bottlenecks, leading to underutilisation. Monitoring tools like Google Cloud's Recommendations Engine can help address this problem by identifying underused resources and suggesting optimisations (Ali *et al.*, 2021:78).

2.4.3 Integration and Compatibility

Integration and compatibility present significant challenges for organisations adopting cloud computing, especially when working with legacy systems and multi-platform environments. Integrating legacy systems often requires re-architecting older applications or implementing compatibility layers to ensure they function smoothly with cloud platforms. This process can lead to downtime and increased costs, highlighting the importance of careful planning to minimise disruptions. (Aruleba *et al.*, 2022:175)

Vendor lock-in is another major issue, as organisations that choose proprietary cloud services frequently encounter high costs and technical obstacles when trying to switch vendors due to incompatible APIs and dependencies. To mitigate this risk, organisations can adopt hybrid cloud strategies and utilise open standards to maintain flexibility (E-Learning in Cloud) (Wu & Plakhtii, 2021:8).

Additionally, platform interoperability across multiple cloud providers is complicated by non-standardised interfaces, making tool integration challenging. Middleware solutions, such as Apache Camel, can help bridge these gaps, facilitating smoother integration across diverse platforms. (Ali *et al.*, 2021:79)

Finally, migration downtime poses a significant challenge when transferring data and applications to the cloud. Service interruptions during this phase can disrupt operations, but these risks can be minimised through parallel migration techniques or pilot testing. This allows organisations to identify and resolve issues before full implementation (Islam *et al.*, 2023).

2.4.4 Skill and Training Requirements

The shortage of skilled personnel represents a significant barrier. As demand for expertise in hybrid and multi-cloud environments continues to grow, organisations require a diverse set of skills across multiple platforms. To address this gap, companies can invest in employee training or outsource to managed service providers that specialise in these areas (Zhang, 2021:78).

Training deficiencies further exacerbate the issue, as transitioning IT staff to cloud-focused roles requires specialised knowledge in areas such as Kubernetes, serverless architectures, and cloud security. Continuous learning programs are essential for equipping employees with these crucial skills and ensuring the smooth adoption of cloud technologies (Ali *et al.*, 2021:6). However, the high attrition rates among cloud experts, driven by industry demand, make it challenging to retain skilled personnel. Offering competitive benefits and implementing effective retention strategies can help mitigate this issue (Wu & Plakhtii, 2021:9).

Additionally, resistance to change from employees accustomed to traditional IT systems can delay cloud adoption and increase training costs. To address this resistance, organisations can employ clear communication, phased implementation, and targeted training, all of which can help accelerate the transition to cloud-based workflows (Islam *et al.*, 2023:55).

2.4.5 Regulatory and Compliance Challenges

Regulatory and compliance challenges present obstacles to the adoption of cloud computing, especially for organisations that handle sensitive data. Data sovereignty issues, where governments require that sensitive data remains within national borders, complicate storage strategies. Cloud providers that offer localised data centers help address this challenge, ensuring compliance with local laws while maintaining operational efficiency (Islam *et al.*, 2023:55).

Changing regulatory requirements, such as updates to GDPR or HIPAA, necessitate constant monitoring and adaptation, which can strain organisational resources. Automated compliance tools like AWS Config streamline this process by ensuring that systems align with evolving regulations (Zhang, 2021:79).

In emerging markets, a lack of standardised policies creates uncertainty for businesses. Establishing consistent regulatory frameworks is vital for promoting cloud adoption and providing clear compliance guidelines (Ali *et al.*, 2021:5).

Additionally, the cost of regulatory audits—which are essential for ensuring compliance with data protection laws—adds to operational expenses. Audit-friendly logging and monitoring systems can mitigate this burden by simplifying the audit process and maintaining transparent records (Wu & Plakhtii, 2021:8).

2.5 THEORETICAL FRAMEWORKS SUPPORTING CLOUD ADOPTION

2.5.1 Overview of Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is a theoretical framework developed by Davis (1989), based on the Theory of Reasoned Action by Fishbein and Ajzen (2009). TAM is widely recognised for its ability to predict and explain the acceptance of information systems and technology. It emphasises two critical factors that influence user acceptance: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). These factors shape users' attitudes, which ultimately determine their intention to use the technology (Al-Adwan *et al.*, 2023; Islam *et al.*, 2023).

Since its inception, TAM has evolved significantly and has been applied across various fields, including healthcare, education, business, and finance. Over the years, extensions of TAM have introduced external variables, such as social influence, self-efficacy, and enjoyment, to address its limitations and enhance its explanatory power. For example, TAM 2 and the Unified Theory of Acceptance and Use of Technology (UTAUT) build upon its foundational constructs to incorporate additional behavioural and technological attributes. (Al-Adwan *et al.*, 2023; Singh *et al.*, 2019)

2.5.2 Applying The Technology Acceptance Model (TAM)

According to Islam *et al.* (2023), applying the TAM involves a systematic, step-by-step approach to understanding how users perceive the usefulness and ease of use of a technology. These perceptions, in turn, influence their attitudes and intentions toward using it.

The TAM provides a structured for assessing user acceptance of technology by focusing on two key constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). The evaluation process begins by defining the research context, which includes the specific technology and the target population. This is followed by the development of research objectives. (Al-Adwan *et al.*, 2023:1,6; Islam *et al.*, 2023:10-19).

TAM often incorporates additional constructs such as Attitude Toward Use (ATU) and Behavioural Intention to Use (BI), along with external factors such as social influence, which can be tailored to fit specific contexts. Data collection typically involves surveys that use a Likert scale, with sample questions aimed at assessing PU and PEU. (Al-Adwan *et al.*, 2023:1,6; Islam *et al.*, 2023:10-19).

Once data is collected, various statistical analysis techniques, such as regression or Structural Equation Modeling (SEM), are utilised to examine the relationships between these constructs. The insights generated from the analysis can lead to specific recommendations, such as improving the user interface if PEU scores are low, or emphasising productivity benefits if PU ratings are inadequate. This process is iterative, enabling TAM to be reapplied for improved versions of the technology to enhance user acceptance continually. (Al-Adwan *et al.*, 2023:1,6; Islam *et al.*, 2023:10-19).

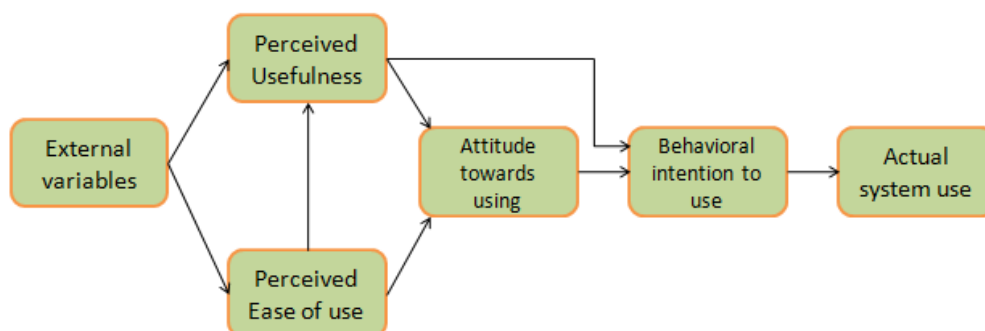


Figure 2-4: TAM Overview

2.5.3 Using Technology Acceptance Model (TAM) in Cloud Adoption

According to Amron and Noh (2021:4), TAM provides a structured framework to encourage the adoption of cloud computing solutions by focusing on key factors that influence user acceptance. One crucial factor is PEU; users are more likely to embrace cloud computing if they find the interfaces intuitive and easy to navigate. By simplifying cloud interfaces, offering training, and emphasising user-friendly designs, organisations can significantly enhance PEU, which in turn positively affects PU and users' BI.

PU is a strong predictor of adoption. To boost PU, it is essential to demonstrate the tangible benefits of cloud computing, such as increased productivity, improved collaboration, and real success stories that highlight its advantages. External factors, including security and the learning environment, also play a vital role in shaping attitudes toward cloud computing. Addressing security concerns by implementing robust data protection measures and effectively communicating these protocols to users can help alleviate issues related to trust and privacy. Additionally, fostering a supportive and collaborative learning environment—especially within educational institutions—can enhance acceptance. Tools that are customised to meet users' learning and operational needs further contribute to positive attitudes toward cloud solutions (Amron & Noh, 2021:5-6).

2.5.4 Overview of The Diffusion of Innovation (DOI) Theory

The Diffusion of Innovation (DOI) Theory, proposed by Rogers (2003), provides a comprehensive framework for understanding how new technologies and ideas spread within social systems. Diffusion is defined as “the process by which an innovation is communicated through certain channels over time among the members of a social system.” This process is not instantaneous; it involves multiple stages: awareness, interest, evaluation, trial, and adoption. These stages help potential adopters decide whether to embrace the innovation (Goh & Sigala, 2020:5,14-19; Pablo & Edirisinghe, 2022:11-13).

Several key factors influence the rate at which innovations are adopted. Relative advantage, which refers to the degree to which an innovation is perceived as superior to existing solutions, is a critical determinant. Innovations that provide clear benefits, such as increased efficiency or cost savings, are more likely to be adopted. Compatibility also plays a significant role: it assesses how well the innovation aligns with users' existing values, needs, and experiences. Technologies that integrate seamlessly into users' routines tend to face fewer barriers to adoption (Goh & Sigala, 2020:5,14-19; Pablo & Edirisinghe, 2022:11-13).

Complexity can hinder adoption; innovations that are highly technical or difficult to use may deter potential users. In contrast, trialability—the ability to experiment with the innovation on a limited basis—can encourage adoption by reducing perceived risk. Lastly, observability, or the extent to which the benefits of using an innovation are visible to others, can promote adoption through social proof (Goh & Sigala, 2020:5,14-19; Pablo & Edirisinghe, 2022:11-13).

DOI further categorises adopters based on their readiness and approach to adopting innovations. Innovators, who make up the first 2.5% of adopters, are risk-takers who eagerly adopt new technologies. They are followed by early adopters (13.5%), who often serve as opinion leaders and influence others by showcasing the benefits of adoption. The early majority (34%) adopts more deliberately, typically after observing positive outcomes among early adopters. The late majority (34%) adopts primarily due to peer pressure or external influences, often after the innovation has become standard. Finally, laggards (16%) are the most resistant, generally due to scepticism or satisfaction with existing solutions (Goh & Sigala, 2020:5,14-19; Pablo & Edirisinghe, 2022:11-13).

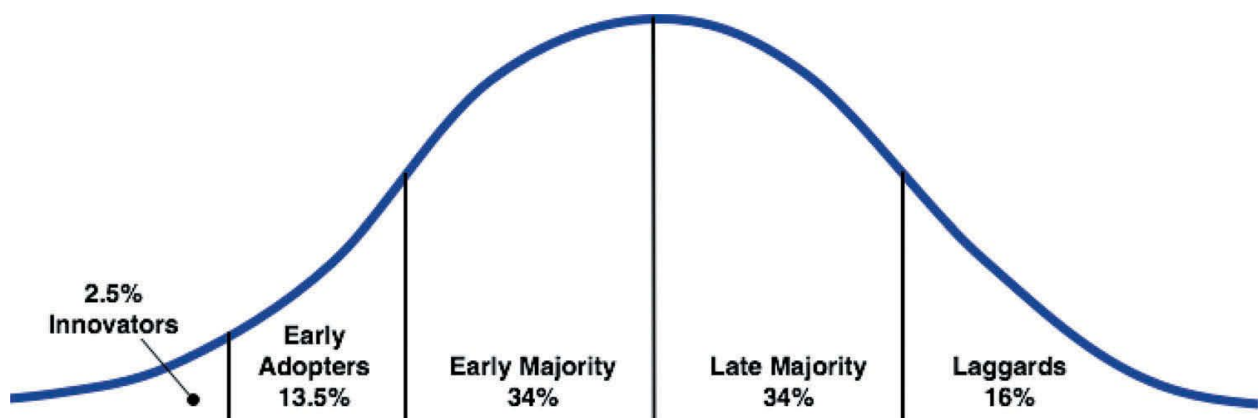


Figure 2-5: Diffusion of Innovation Adaptors

Source: Goh and Sigala (2020)

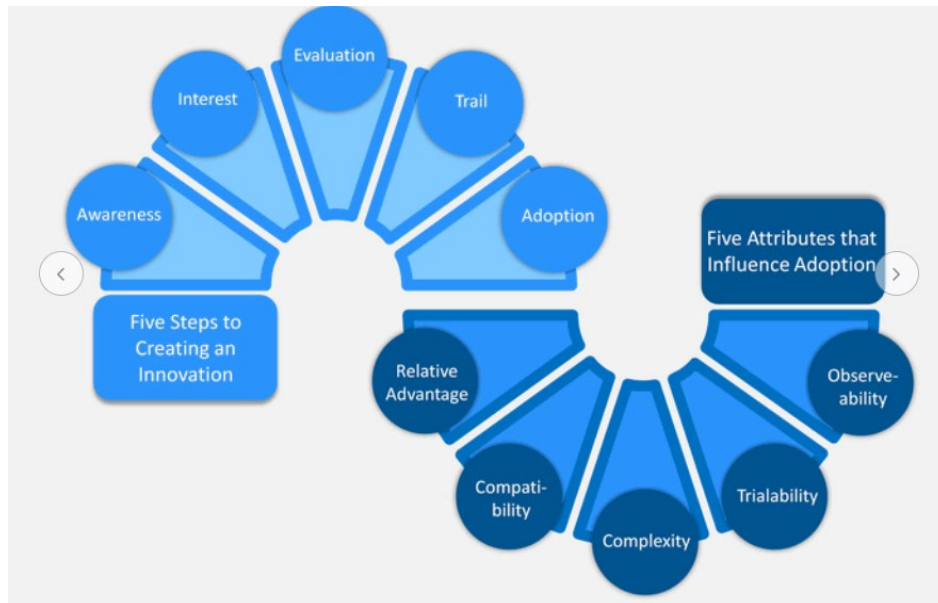


Figure 2-6: Diffusion of Innovation Theory Components

Source: Rogers (2003)

2.5.5 Using The Diffusion of Innovation in Cloud Adoption

The DOI Theory offers valuable insights for promoting cloud computing adoption within organisations. By focusing on key attributes such as the relative advantages of cloud solutions—like cost efficiency and scalability—organisations can mitigate resistance and enhance acceptance. Ensuring compatibility with existing workflows and simplifying complexity through user-friendly interfaces and comprehensive training are vital steps. Additionally, providing trial opportunities through pilot programs and showcasing success stories can increase confidence among stakeholders, further facilitating adoption (Goh & Sigala, 2020).

Innovators and Early Adopters can serve as champions for cloud computing, influencing the Early Majority through testimonials and demonstrated success. Clear communication through workshops and peer discussions is essential for ensuring that stakeholders understand the benefits of cloud adoption. Addressing barriers such as security concerns and providing seamless migration tools can also ease the transition. (Goh & Sigala, 2020).

2.5.6 Overview of The Unified Theory of Acceptance and Use of Technology (UTAUT)

According to Aytekin *et al.* (2022), the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh *et al.* (2003) offers a strong framework for understanding and predicting how technology is adopted and used. By integrating elements from eight earlier theories of technology acceptance, UTAUT provides a comprehensive approach to examining the

factors that shape user intentions and behaviours regarding technology use. This model is especially valuable in both organisational and societal contexts, where adopting new technologies is crucial for achieving operational or educational objectives.

The framework identifies four primary constructs that influence user acceptance. Performance Expectancy (PE) refers to the extent to which individuals believe that the technology will enhance their job performance, making it a significant predictor of behavioural intention. Effort Expectancy (EE) focuses on the perceived ease of use of the technology and is particularly influential during the early stages of adoption. Social Influence (SI) captures the impact of others' opinions and perceived expectations on an individual's decision to use the technology. Facilitating Conditions (FC) represents the extent to which users perceive that adequate organisational and technical infrastructure is in place to support their use of the technology. (Aytekin *et al.*, 2022:80-83)

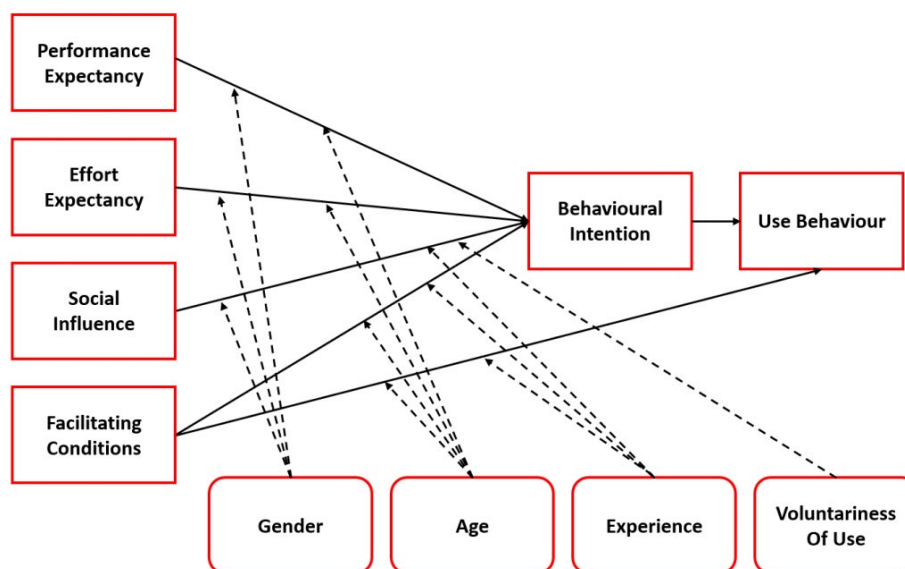


Figure 2-7: Basic Overview of UATUT 1

Source: Innovation Acceptance Lab (2023)

These constructs provide a detailed understanding of both internal and external factors that shape technology adoption. UTAUT also incorporates moderating variables such as gender, age, experience, and voluntariness of use, which help explain how these factors differently influence acceptance and usage behaviours. For example, younger users may prioritise effort expectancy, while older users may be more influenced by facilitating conditions. Additionally, the voluntariness of use affects the strength of social influence on adoption, with mandatory settings amplifying its role compared to voluntary contexts. (Aytekin *et al.*, 2022:80-83)

In practical applications, UTAUT has been widely used across various domains. In education, the framework has been employed to analyse the adoption of mobile learning platforms, identifying ease of access and perceived educational benefits as key drivers. In healthcare, UTAUT has been applied to understand the acceptance of telemedicine and electronic health records, with facilitating conditions such as technical support and infrastructure emerging as critical factors. Similarly, in the mobile technology sector, the model has informed strategies to enhance user engagement by emphasising ease of use and performance benefits (Aytekin *et al.*, 2022:80-83; Rosli *et al.*, 2022:6-8).

The comprehensive nature of UTAUT makes it a versatile tool for designing interventions to promote technology adoption. Organisations can leverage the model to identify specific barriers and drivers relevant to their context, allowing them to develop tailored strategies. For instance, enhancing technical training can address concerns related to effort expectancy, while robust support systems can strengthen facilitating conditions. By systematically addressing these factors, UTAUT enables organisations to promote greater acceptance and sustained use of technology across diverse user groups (Aytekin *et al.*, 2022:80-83).

UTAUT can be expanded into UTAUT 2 to incorporate consumer-specific factors such as Hedonic Motivation, Price Value, and Habit. This extension aims to enhance the prediction of behavioural intentions in non-organisational settings. Despite facing criticism for its complexity, the UTAUT model's strong explanatory power makes it a valuable tool for assessing and supporting technology implementation processes across various contexts, including both organisational and consumer environments (Innovation Acceptance Lab, 2023).

2.5.7 Using UATUT in Cloud Adoption

The UTAUT offers a practical framework for promoting the adoption of cloud computing by focusing on essential factors. For PE, it is vital for demonstrating the advantages of cloud computing, including scalability, cost-efficiency, and improved collaboration, all of which can significantly enhance operational performance. EE can be addressed by simplifying cloud interfaces and providing user training, which reduces the perceived difficulty of transitioning to cloud services. SI is important as well; engaging organisational leaders or tech-savvy team members as advocates can help build trust and encourage broader adoption. Establishing a strong FC, such as reliable networks (internet), effective data migration tools, and robust security measures, is crucial to ensuring a smooth transition to cloud solutions.

Cloud adoption strategies can also benefit from UTAUT's emphasis on moderating variables like user experience and voluntariness of use. Experienced users may quickly recognise the flexibility

and accessibility offered by cloud systems, while less experienced users can gain from training and user-friendly features. In scenarios requiring mandatory adoption, emphasising cloud-specific advantages—such as real-time data access, remote collaboration, and disaster recovery—can help alleviate resistance.

2.6 REGULATORY AND LEGAL CONSIDERATIONS IN SOUTH AFRICA

2.6.1 Overview of Protection of Personal Information Act (POPIA)

The Protection of Personal Information Act (POPIA), enacted in 2013 and fully enforced by 2020, is South Africa's main legislation for personal data protection. It applies to all public and private entities that process personal information within South Africa or utilise data processing systems located in the country, providing comprehensive coverage across various sectors. POPIA broadly defines personal data to include identifiers such as race, gender, and health information, and it offers detailed guidelines for processing sensitive data. (Staunton *et al.*, 2020:9)

POPIA is based on key principles designed to protect personal information. The principle of accountability requires organisations to assign responsibilities for data protection and demonstrate compliance with POPIA's conditions. Purpose specification ensures that data collection serves explicit and legitimate purposes, limiting further processing to activities that align with the original intent. Additionally, security safeguards mandate organisations to implement robust technical measures to prevent unauthorised access, alteration, or destruction of data, and they require mandatory breach reporting to reinforce compliance. (Staunton *et al.*, 2020:9)

Despite its comprehensive nature, POPIA presents challenges, especially regarding the regulation of cross-border data transfers. Chapter 9 of the Act requires that recipient countries provide equivalent data protections, and that explicit consent is obtained from data subjects. This creates compliance hurdles for global cloud services managing South African data. (Mohlameane & Ruxwana, 2020:3)

2.6.2 Overview of Promotion of Access to Information Act (PAIA)

The Promotion of Access to Information Act (PAIA) is a fundamental aspect of South Africa's dedication to transparency and accountability in data governance. Enacted to foster openness, PAIA ensures that the public can access information held by both public and private entities. However, it also maintains a crucial balance by restricting access to personal data unless there is a clear justification, such as public interest or safety concerns. This approach is vital for building trust in how information is managed and governed.

To implement its principles, PAIA requires entities to appoint information officers who are responsible for processing data requests and ensuring compliance. It also mandates the creation of public manuals that outline the procedures for accessing information. Importantly, PAIA works alongside the POPIA to incorporate privacy safeguards. For example, it limits the use of personal information to purposes that are deemed necessary, thereby complementing PAIA's transparency objectives with POPIA's privacy protections.

Together, these two acts establish a balanced framework that promotes openness while safeguarding confidentiality, ensuring both accountability and the protection of individual privacy rights in South Africa.

2.6.3 Overview of Cybercrime Act

The Cybercrimes Act establishes a comprehensive legal framework in South Africa aimed at combating various cyber offenses, including hacking, phishing, ransomware, and identity theft. By criminalising these activities and imposing severe penalties—ranging from fines to imprisonment for up to 15 years—the Act emphasises the seriousness of cybercrime and its potential to harm individuals and organisations. (Snail ka Mtuze & Musoni, 2023:309-315)

The Act contains specific provisions to address emerging threats. It criminalises the unauthorised possession or distribution of data and requires service providers to promptly report cybercrime incidents to the authorities. This enhances the detection and prevention of cyber offenses. Additionally, the Act prioritises the protection of critical infrastructure by implementing measures to safeguard systems against ransomware and DDoS attacks, ensuring their resilience. (Snail ka Mtuze & Musoni, 2023:309-315)

However, challenges remain in enforcing the Act. A shortage of skilled cybersecurity professionals and limited infrastructure, particularly in small and medium-sized enterprises (SMEs), hinder effective implementation. Addressing these gaps is crucial for fully realising the potential of the Cybercrimes Act in mitigating cyber threats and securing South Africa's digital landscape.. (Snail ka Mtuze & Musoni, 2023:309-315)

2.6.4 Overview of Electronic Communications and Transactions Act (ECTA)

The Electronic Communications and Transactions Act (ECTA, 2002) is crucial to South Africa's legal framework for regulating technology use, especially regarding electronic communications and digital transactions. ECTA establishes fundamental principles for consumer protection, liability management in digital transactions, and the promotion of modern technologies. Its provisions are particularly relevant to the regulation of cloud services, which depend heavily on

strong electronic communication standards and secure transaction frameworks. However, the Act needs significant updates to align with global cloud-specific standards, addressing the unique challenges posed by distributed and cross-border data management. (Mohlameane & Ruxwana, 2020:4-5)

Besides its broad technological scope, ECTA includes important provisions related to cryptography and cybercrime. It requires the registration of cryptography providers to enhance the security of digital communications and transactions, ensuring that encryption standards are consistently high. Despite this, the Act struggles to keep pace with advancements in cloud-based encryption technologies, where dynamic and scalable cryptographic solutions are essential. These limitations emphasise the need for ECTA to adapt alongside technological advancements, particularly in cloud computing and global data security frameworks. While ECTA remains a vital component of South Africa's digital economy, its continued relevance will depend on proactive legislative updates to address emerging technologies and cybersecurity threats. (Mohlameane & Ruxwana, 2020:4-5)

2.6.5 Overview of National Integrated ICT Policy White Paper

The National Integrated ICT Policy White Paper (2016) is a strategic document designed to enhance digital inclusion and foster integration within South Africa's digital economy. A primary objective of the White Paper is to improve broadband access and quality, which is essential for bridging the digital divide and promoting greater participation in the digital economy. However, the White Paper offers limited attention to emerging technologies such as cloud computing and the Internet of Things (IoT), which creates significant gaps in its relevance to the evolving technological landscape. (Mosweu *et al.*, 2019a:6)

Additionally, the document points out critical regulatory gaps, particularly in areas related to cloud computing. It inadequately addresses issues such as the complexities of cloud computing contracts, the risks associated with vendor lock-in, and the challenges of cross-border data transfers. As a result, these matters have been left to fragmented regulatory efforts, leading to inconsistencies and uncertainties for businesses and organisations that adopt cloud technologies. (Mosweu *et al.*, 2019a:6)

To remain relevant and effective, the National Integrated ICT Policy White Paper needs updates that reflect the rapid advancements in cloud computing and other emerging technologies, ensuring it comprehensively supports South Africa's digital transformation.

2.6.6 Compliance Challenges for Universities

Higher education institutions in South Africa face significant challenges in achieving compliance with the country's regulatory frameworks for data protection, cybersecurity, and technology use. Education institutions handle vast amounts of sensitive personal information, making compliance with the POPIA particularly difficult. Meeting the act's requirements for accountability, purpose specification, and security safeguards often requires costly system upgrades and training. Additionally, the need to ensure cross-border data protection complicates operations for institutions using global cloud providers, as compliance demands can be resource-intensive and challenging to fulfil without robust data transfer agreements (Staunton *et al.*, 2020:3).

The cybercrime adds further complexity by mandating that intuitions protect against cyber offenses such as hacking, ransomware, and phishing attacks. These threats disproportionately affect higher education, where limited budgets and expertise hinder the adoption of advanced cybersecurity measures. Many institutions struggle to retain skilled IT staff or implement effective cybersecurity infrastructure, leaving them vulnerable to breaches. (Snail ka Mtuze & Musoni, 2023:309-315)

Furthermore, reliance on cloud computing and IoT devices exacerbates risks, with fragmented regulatory guidelines under frameworks like the ECTA and the National Integrated ICT Policy providing insufficient clarity on issues such as vendor lock-in and cross-platform compatibility (Mohlameane & Ruxwana, 2020:4-6).

Education intuitions also face the challenge of balancing compliance costs against educational priorities. Implementing data protection and cybersecurity solutions often diverts resources from academic programs and infrastructure enhancements. These constraints, coupled with the rapid evolution of technology and regulations, require institutions to constantly adapt their policies, technologies, and workflows to remain compliant. (Wu & Plakhtii, 2021)

This ongoing struggle highlights the need for targeted support, including government subsidies, partnerships with technology providers, and clearer, unified regulatory frameworks tailored to the needs of higher education. Without such measures, compliance will continue to be a significant challenge, limiting the sector's ability to fully leverage technological advancements while safeguarding its critical data assets.

To address the compliance challenges posed by data protection regulations and cybersecurity risks, higher education institutions in South Africa must adopt a multi-faceted approach. Implementing robust data protection measures, enhancing legislative practices, and fostering

public awareness are essential for mitigating risks and ensuring adherence to regulations such as the POPIA, the Cybercrimes Act, and other relevant frameworks.

2.6.7 Best Practices for Data Protection

Institutions should establish comprehensive security protocols, including encryption, multi-factor authentication, and role-based access controls, to protect sensitive student and institutional data. Regular vulnerability assessments and auditing systems can help prevent unauthorised access and ensure compliance with POPIA and international standards. (Oladoyinbo *et al.*, 2023:226-227)

Systematic risk evaluations are crucial for identifying potential vulnerabilities, attacks or weaknesses in encryption. These assessments should consider legal aspects, including data sovereignty and cross-border restrictions, to ensure alignment with regulatory requirements. This will facilitate informed decision-making when selecting cloud service providers.(Oladoyinbo *et al.*, 2023:224)

Proactive breach response mechanisms should include immediate notification systems for affected stakeholders, in compliance with POPIA and the Cybercrimes Act. Institutions must ensure that their cloud service providers adhere to stringent reporting standards and have clear action plans for breach containment and recovery.(Oladoyinbo *et al.*, 2023:229)

Encryption is essential for protecting data during storage and transmission, ensuring confidentiality and integrity. Moreover, adopting e-discovery solutions that maintain comprehensive records can aid in legal investigations and compliance with litigation obligations, thereby safeguarding institutions from legal penalties. (Oladoyinbo *et al.*, 2023:227-228)

2.6.8 Recommendations for Legislative Practices

South Africa's regulatory frameworks, including the ECTA and the National Integrated ICT Policy, should be updated to address the complexities of cloud computing, the IoT, and emerging technologies. Harmonising these frameworks with global standards can simplify compliance with cross-border data flows, thus reducing legal barriers for universities operating in international contexts. (Mohlameane & Ruxwana, 2020:4; Oladoyinbo *et al.*, 2023:229)

Institutions need to negotiate contracts with cloud service providers that clearly define responsibilities regarding data protection, breach reporting, and jurisdiction. Service Level Agreements (SLAs) should specify uptime guarantees, data recovery protocols, and compliance

with the POPIA and other relevant regulations. This clarity will help mitigate operational risks. (Oladoyinbo *et al.*, 2023:226-230)

Awareness campaigns and training initiatives can educate staff and administrators about their responsibilities under POPIA and the Cybercrimes Act. Targeted programs will equip institutions with the necessary skills to navigate complex compliance landscapes and implement best practices in data governance and cybersecurity. (Mohlameane & Ruxwana, 2020:5)

Engaging in international conventions, such as the Budapest Convention, can enhance South Africa's ability to tackle cyber threats and facilitate cross-border data sharing. These collaborations will enable institutions to access global resources and expertise, thereby strengthening their cybersecurity posture. (Snail ka Mtuze & Musoni, 2023:320)

2.7 CASE STUDIES ON CLOUD COMPUTING IN HIGHER EDUCATION

2.7.1 Case Study: Higher Education Institutions in Malaysia

This case study of Wu and Plakhtii (2021) of the higher education institutions in Malaysia have embraced cloud-based e-learning systems as part of a nationwide initiative to modernise and digitalise education. The goal of this initiative is to integrate advanced technology into teaching, learning, and administrative processes to enhance academic outcomes and improve operational efficiency.

The primary objective of this transformation is to elevate the quality of education delivery by utilising cloud-based Learning Management Systems (LMS). These systems are designed to facilitate collaborative learning, enable real-time sharing of academic resources, and streamline course management. Moreover, institutions aim to reduce operational costs by outsourcing IT maintenance to cloud service providers.

Their Challenges:

- **Resistance to Change:** Faculty and administrative staff initially expressed resistance to the new technology due to their unfamiliarity with cloud systems.
- **Data Security Concerns:** A significant challenge was ensuring the privacy and security of sensitive academic and student data.
- **Infrastructure Limitations:** Some institutions struggled with inadequate internet connectivity and IT infrastructure, particularly in rural areas, which hindered seamless cloud adoption.

Their Motivators:

- **Cost Efficiency:** Transitioning to cloud solutions decreased the need for expensive on-premises servers and IT support staff.
- **Collaboration and Access:** The ability to access resources and collaborate in real-time across campuses encouraged acceptance among both students and educators.
- **Government Support:** Strong government backing for digital transformation in education motivated institutions to adopt cloud solutions.

Despite initial challenges, the implementation of cloud-based systems successfully enhanced education delivery. Campuses reported improved academic collaboration, lighter administrative workloads, and significant cost savings. The successful adoption of cloud solutions has served as a model for digital transformation across other sectors of Malaysia's education system.

The case highlights the importance of addressing stakeholder resistance, investing in digital infrastructure, and ensuring data security to maximise the benefits of cloud technology in higher education.

2.7.2 Case Study: Slovakian Knowledge Management System

According to Ali *et al.* (2021), Slovakia has implemented a cloud-based knowledge management system across its higher education institutions to improve collaboration and streamline the management of academic resources. This initiative is part of a broader strategy to modernise educational operations and enhance learning outcomes through digital innovation.

The primary aim was to create a centralised knowledge management system that provides seamless access to educational resources for both faculty and students. The system intends to foster collaborative learning environments, enhance resource sharing, and improve overall operational efficiency within the institutions.

Their Challenges:

- **Initial Investment:** The adoption process required significant financial resources for system setup, posing challenges for institutions with limited budgets.
- **Training and Adoption:** Faculty and students needed training to use the system effectively, as many lacked experiences with cloud-based tools.
- **Technical Issues:** Integration with existing legacy systems proved complex and time-consuming.

Their Motivators:

- **Enhanced Collaboration:** The potential for improved teamwork and communication among students and faculty was a key motivator.
- **Operational Efficiency:** The cloud system promised to reduce administrative burdens by streamlining academic and administrative workflows.
- **Resource Optimisation:** The centralised platform offered efficient resource utilisation, minimising redundancy in academic materials and research outputs.

The knowledge management system was successful in improving collaborative learning and streamlining administrative functions. The centralised repository provided easy access to academic resources, enhancing teaching and learning efficiency. The project demonstrated how strategic investments in cloud technology could yield substantial long-term benefits, despite initial challenges.

This case highlights the importance of proper training, stakeholder engagement, and meticulous planning for technical integration to ensure the successful implementation of cloud solutions in higher education.

2.7.3 Case Study: Indian Academic Libraries and Cloud Solutions

Indian academic libraries, highlighted by Agbaglo and Bonsu (2022), is the Indian academic libraries which have been exploring the adoption of cloud-based systems to modernise their operations, improve resource management, and expand access to digital resources. The initiative aims to transition traditional library systems to cloud-based platforms, thereby enhancing efficiency and user experience.

The primary goal of this transformation is to create an integrated, scalable system for managing both digital and physical library resources. Additionally, the initiative seeks to enable remote access to academic materials, facilitate better collaboration among institutions, and reduce infrastructure costs by outsourcing to cloud service providers.

Their Challenges:

- **High Initial Costs:** The setup and migration to cloud platforms require substantial initial investments, making it challenging for many institutions to adopt the system.
- **Skill Gaps:** A shortage of trained personnel familiar with cloud systems hinders effective implementation and management of these platforms.

- **Regulatory Compliance:** Ensuring compliance with data protection laws concerning academic records presents challenges, particularly for institutions with limited legal expertise.
- **Internet Infrastructure:** Inadequate internet connectivity, especially in rural areas, creates barriers to seamless cloud adoption.

Their Motivators:

- **Increased Accessibility:** The potential to provide students and researchers with 24/7 access to library resources from various locations is a significant motivator.
- **Cost Efficiency in the Long Run:** Despite high initial investments, cloud technology promises reduced expenses related to physical storage and IT maintenance over time.
- **Collaboration Opportunities:** Cloud platforms enable the sharing of academic resources between libraries, fostering inter-institutional collaboration.

The initiative has yielded mixed outcomes. While some institutions successfully transitioned to cloud systems and improved resource accessibility, many faced challenges that prevented them from achieving their objectives. Issues such as funding limitations, lack of technical expertise, and infrastructure challenges hindered broader success. The difficulty in scaling these systems effectively across diverse institutions underscores the need to address foundational challenges, including internet connectivity and workforce training.

The experience of Indian academic libraries demonstrates that successful cloud adoption requires more than just technology; it necessitates adequate funding, robust infrastructure, and skilled personnel. While cloud systems offer significant potential for academic libraries, addressing these underlying challenges is essential to fully realise their benefits.

2.7.4 Case Study: Scalability Failure in a Chinese University's E-Learning Platform

Discussed by Odeh *et al.* (2017), a Chinese university implemented a cloud-based e-learning platform to enhance digital education and improve remote learning capabilities. The initiative aimed to support large-scale adoption of e-learning during peak academic periods and was seen as a model for modernising the nation's educational infrastructure.

The primary goal was to provide a scalable, reliable, and accessible e-learning environment that could accommodate a large number of students simultaneously. The platform sought to address growing demand for remote learning tools, especially during emergencies like the COVID-19 pandemic.

Their Challenges:

- **Underestimation of User Load:** The platform's initial design failed to account for the high number of simultaneous users during peak periods, such as exam preparation or mass online lectures.
- **Insufficient Infrastructure:** The cloud infrastructure lacked adequate servers and bandwidth to handle sudden spikes in user activity, resulting in frequent crashes and disruptions.
- **Testing Deficiencies:** The platform was deployed without thorough stress testing under realistic usage scenarios, which led to unforeseen bottlenecks.
- **Delayed Technical Support:** The university struggled to resolve issues quickly due to a lack of trained personnel and slow response times from the cloud service provider.

Their Motivators:

- **Urgent Need for Remote Learning:** The pandemic created an immediate need for scalable online education tools, pushing the university to adopt a cloud solution rapidly.
- **Government Pressure:** National policies encouraging digital transformation in education provided incentives for institutions to modernise their learning platforms.

This implementation is regarded as a failure due to its inability to handle high user demand effectively. The frequent system crashes during critical academic activities led to student frustration, loss of trust in the platform, and a reliance on alternative, non-integrated tools like Zoom and WeChat. The university incurred additional costs for emergency upgrades and technical support, which further strained its budget.

The scalability failure in this case highlights the importance of robust infrastructure planning, realistic stress testing, and proactive technical support in cloud-based e-learning implementations. While cloud solutions offer flexibility, their success depends on addressing scalability from the outset and investing in resilient system architecture.

2.7.5 Lessons Learned from Cloud Adoptions

The COVID-19 pandemic highlighted the critical need for proactive cloud adoption in higher education institutions, revealing both successes and challenges. In Malaysia, the rapid implementation of cloud-based learning management systems and, in India, digital library solutions ensured educational continuity. However, these efforts also exposed gaps in infrastructure integration, regulatory compliance, and staff training.

In Slovakia, cloud-based knowledge management systems enhanced collaboration, yet they lacked sufficient cybersecurity measures, resulting in data vulnerabilities. In contrast, the Chinese university's failure to transition to a scalable cloud infrastructure led to a system collapse under increased demand, severely disrupting teaching and learning.

These examples illustrate that delaying cloud adoption can lead to inefficiencies, security risks, and operational challenges. The key takeaway is clear: proactive investment in cloud solutions—focusing on regulatory compliance, scalability testing, and robust security measures—is essential for building resilience and adaptability in higher education.

2.8 CHAPTER SUMMARY

This chapter provided a comprehensive overview of cloud computing, covering its introduction, benefits, challenges, frameworks, case studies, and the regulatory landscape in South Africa. It highlighted the scalability, cost efficiency, and accessibility offered by cloud technologies while addressing challenges such as cybersecurity vulnerabilities, compliance with data protection laws like the POPIA, and the risks associated with delayed adoption. Case studies from global higher education contexts demonstrated the importance of proactive cloud adoption to ensure seamless operations and resilience, particularly during disruptions like the COVID-19 pandemic. The chapter also emphasised the need for aligning institutional strategies with regulatory frameworks and industry best practices to fully harness the potential of cloud computing in education.

As the researcher is actively engaged in a cloud computing project, he has observed significant gaps in institutional preparedness that present considerable challenges. These gaps—whether in compliance, security, or scalability—hinder the effective adoption of cloud technologies and limit their benefits. With this literature review as a foundation, he is well-positioned to further investigate these issues within his institution, identify shortcomings, and develop new strategies for improvement. He aims to contribute to the successful and sustainable implementation of cloud computing in higher education, ensuring that institutions can fully leverage its potential.

CHAPTER 3 RESEARCH DESIGN

3.1 CHAPTER OVERVIEW

This chapter presents the research methodology adopted for this study, offering a comprehensive overview of the research design, approach, strategy, and methods employed to achieve the research objectives. The methodology is informed by Creswell and Creswell (2018) foundational insights into research design, which emphasise the importance of aligning philosophical assumptions, research paradigms, and methodological choices with the nature of the research problem.

This study will utilise a qualitative case study design within an interpretivist paradigm, guided by inductive reasoning and thematic analysis. This methodological framework is selected to explore and understand the challenges and strategies associated with cloud computing adoption in a university setting. It aims to provide a comprehensive investigation that is based on the subjective experiences of the participants.

3.2 RESEARCH PHILOSOPHY

According to Creswell and Creswell (2018), research paradigms—characterised by distinct ontological, epistemological, axiological, and methodological assumptions—significantly influence the conduct and interpretation of research studies. Each paradigm offers a different perspective on reality, knowledge, and the role of values, which in turn affects the selection of methods for data collection and analysis.

For example, positivism asserts that an objective reality can be discovered through quantitative measurements, emphasising detached observation and hypothesis testing. In contrast, constructivism views reality as subjective, co-constructed by researchers and participants through qualitative interactions. This approach prioritises depth and context in understanding phenomena.

These paradigms help researchers frame their inquiries—whether through a positivist lens, which seeks measurable and generalisable results, or through an interpretivist perspective, which explores the complexities of human experience and meaning-making. The choice of paradigm not only determines the methodological approach—quantitative for positivists and qualitative for constructivists—but also reflects deeper philosophical commitments regarding the nature of knowledge and reality. This alignment ensures that research designs are coherent and philosophically consistent, allowing researchers to address their questions with the most suitable tools and perspectives.

This study investigates the implementation of cloud computing in South African universities using an interpretivist approach. This paradigm is particularly effective for understanding the complex and subjective experiences of IT personnel within these institutions. By adopting a constructivist (interpretivism) perspective, the research suggests that reality is shaped by individual perceptions and that knowledge is co-constructed between the researcher and participants through qualitative methods, such as semi-structured interviews. This approach enables an in-depth exploration of how stakeholders perceive and navigate the challenges and strategies associated with cloud technology, recognising that these perceptions significantly influence their actions and decisions. Through this lens, the study captures diverse viewpoints and provides valuable insights into the organisational dynamics impacting technological adoption.

3.3 RESEARCH APPROACH

Creswell and Creswell (2018) state that research approaches provide frameworks for generating, testing, and refining knowledge, each designed for different research objectives.

Inductive reasoning begins with specific observations or data and moves toward broader generalisations or theories, following a bottom-up approach. It is commonly used in exploratory research and qualitative methods, such as interviews, to uncover patterns and develop new theoretical insights.

In contrast, deductive reasoning starts with existing theories or hypotheses and tests them through structured observations, employing a top-down approach. This method is often associated with quantitative research, where the goal is to validate or refute hypotheses and generalize findings.

Abductive reasoning serves as an iterative process, linking unexpected or incomplete data with plausible explanations. It combines qualitative and quantitative methods to enhance understanding and foster innovative insights, making it particularly effective for addressing complex problems.

This study uses an inductive approach to investigate the challenges and strategies related to cloud computing adoption. Inductive reasoning is particularly well-suited for this research because it emphasises building knowledge from specific observations and qualitative data to identify patterns and develop broader theoretical insights. As there is prior research in the area of cloud computing adoption in universities, this exploratory approach enables the discovery of themes and insights that are directly based on the experiences of IT personnel and stakeholders.

3.4 METHODOLOGICAL CHOICE

According to Creswell and Creswell (2018), methodological choice in research refers to selecting an overarching approach to inquiry that forms the foundation for how data is collected, analysed, and interpreted. Three primary methodologies—qualitative, quantitative, and mixed methods—offer distinct ways of addressing research questions, each with its unique characteristics and applications.

Qualitative focuses on exploring and understanding the meanings that individuals or groups assign to specific phenomena. It is particularly effective for examining complex, contextualised realities and uses open-ended data sources, such as interviews, observations, and textual materials. Strategies within this approach include narrative research, phenomenology, grounded theory, ethnography, and case studies, emphasising the generation of rich, descriptive insights through inductive analysis.

Quantitative adopts a systematic and structured approach to investigate phenomena using measurable data. It typically involves testing hypotheses or theories through numeric data collection and statistical analysis, prioritising objectivity and replicability. Common strategies include experimental research, correlational studies, survey research, and causal-comparative studies, all grounded in a deductive reasoning process aimed at generalising findings to larger populations.

Mixed Method combines both qualitative and quantitative approaches to provide a more comprehensive understanding of research problems. By integrating numeric and narrative data, this approach capitalises on the strengths of both methodologies to address complex research questions. Mixed methods strategies include convergent designs, where qualitative and quantitative data are collected and analysed separately before being combined in interpretation; explanatory sequential designs, which begin with quantitative data followed by qualitative exploration; and exploratory sequential designs, which reverse this order.

This study adopts a qualitative approach, which is particularly effective for exploring and understanding the subjective experiences and meanings that individuals or groups associate with phenomena. The qualitative approach aligns with the study's inductive reasoning and interpretivist paradigm, emphasising open-ended, exploratory methods. Data will be collected through semi-structured interviews, allowing participants to share in-depth narratives about their experiences. This highlights the contextual and subjective nature of the phenomenon, employing thematic analysis to identify patterns and develop an understanding of the complexities involved.

3.5 RESEARCH STRATEGY

From Creswell and Creswell (2018), qualitative research strategies provide structured methods for exploring complex phenomena, guiding the design, data collection, and analysis processes. They identified five primary strategies: narrative research, phenomenology, grounded theory, ethnography, and case study, each suited to different research objectives and contexts.

Narrative research explores individual stories to understand how people interpret their experiences. This approach often involves in-depth interviews or the analysis of personal documents to construct thematic or chronological narratives.

Phenomenology focuses on examining lived experiences to uncover the essence of a phenomenon, emphasising shared themes found in participants' accounts.

Grounded theory aims to generate new theories through an iterative process of coding and analysis, making it particularly suitable for areas with limited existing theoretical frameworks.

Ethnography studies cultural groups in their natural settings. Researchers immerse themselves in these environments and use participant observation to grasp shared behaviours and meanings.

Case study research offers an in-depth exploration of a bounded system—such as an organisation or event—by combining multiple data sources to achieve a detailed contextual understanding.

This study utilises a case study approach with exploratory elements to investigate the adoption of cloud computing. The case study method provides an in-depth understanding of the environment within a specific university, capturing the complexities of real-world challenges and strategies. By incorporating exploratory components, the study permits open-ended investigation, revealing unexpected patterns and themes through interviews and the analysis of documents. This combined approach ensures a balance between depth and flexibility, aligning with the qualitative methodology of the study to generate rich and meaningful insights into this complex phenomenon.

3.6 TIME HORIZON

According to Creswell and Creswell (2018), time horizons refer to the timeframe during which data is collected in a research study, significantly influencing the insights that can be derived. They can be broadly classified into two categories: cross-sectional and longitudinal studies, each suited for different research objectives and contexts.

Cross-sectional studies collect data at a single point in time or within a short timeframe, providing a “snapshot” of variables, relationships, or phenomena. This approach is cost-effective, quick to implement, and effective for understanding current states or comparing groups. However, it cannot capture changes or trends over time. Cross-sectional studies are commonly used in surveys to assess opinions, demographics, or trends at a specific moment.

In contrast, longitudinal studies involve collecting data from the same subjects over an extended period. This method is valuable for tracking changes, trends, or developments and can uncover cause-and-effect relationships. Longitudinal studies offer richer, more dynamic insights but require significant resources, time, and strategies to manage participant attrition.

This study adopts a cross-sectional time frame, providing a snapshot of stakeholders’ perspectives on cloud computing adoption. By gathering data at a single point in time, this approach effectively aligns with the study’s objective of exploring current challenges and strategies.

3.7 STUDY POPULATION AND SAMPLING

In qualitative research, the study population is purposefully selected to provide rich and detailed insights into the research problem, as emphasised by Creswell and Creswell (2018). Unlike quantitative research, which often relies on large, random samples for generalisability, qualitative research focuses on participants or sites that are directly relevant to the phenomenon being studied. This purposeful selection ensures that the population can offer meaningful perspectives to effectively address the research questions, with the sample size determined by saturation—when no new themes or information emerge.

The characteristics of a study population in qualitative research are inherently context-specific. Participants are chosen based on their connection to the phenomenon, ensuring relevance and depth in the insights gathered. Creswell and Creswell (2018) note that sample sizes vary according to the research strategy: narrative studies may involve 1 to 2 individuals, phenomenological studies may include 3 to 10 participants, and case studies typically consist of 4 to 5 cases. This flexibility allows researchers to tailor the population to the study’s goals, focusing on either shared meanings or diverse perspectives within natural contexts.

Recruitment of participants often follows strict inclusion and exclusion criteria to maintain focus and relevance. Researchers must also consider ethical access, ensuring that the population can be approached respectfully and feasibly. Ultimately, the study population in qualitative research

is chosen to provide data that facilitates in-depth exploration, leading to the development of patterns, themes, and potentially new theories. This makes it a cornerstone of qualitative inquiry.

This study focused on a specific population of individuals involved in the implementation of computing solutions within universities. This population was comprised of system administrators, IT specialist, and managers or employees who play a significant role in the decision-making process concerning the adoption of new systems and technology. Inclusion criteria for participant selection was based on their relevance to the implementation processes of computing solutions. The current research was conducted at the IT department. The target population in this study is all the employees attached to the IT department. The employees not attached to the IT were excluded and only those employed under the IT department will be included.

Convenience sampling was used with sample size determined by reaching the point of saturation plus one. It depends on the participants openness and the constraints involved around each participant. If the collected data is determined to be insufficient, additional rounds of interviews may be deemed necessary. This course of action would only be pursued in instances where the initial data collection process failed to yield satisfactory results.

3.8 DESIGNING THE MEASURING INSTRUMENT

To conduct an in-depth exploration of individual experiences and perspectives on the adoption of cloud computing solutions, semi-structured interviews of thirty minutes each were undertaken. The interview guide was designed in a comprehensive manner, aiming to explore the stakeholders' views on various aspects, including benefits, concerns, challenges, decisions, and ethical considerations. The interview design was flexible enough to adapt to certain focus points based on experience and profession, allowing different perspectives to fill in the gaps that might exist in the research.

The interview comprised various sections. Each section will contain probes that can go into more detail of how the participants respond to the major questions being asked. The breakdown sections of the instrument can be as follows:

- **Introduction:** This section provided an overview of the study's purpose and significance.
- **Basic Participant Information:** This section collected participants' personal information, which was only used for participation responses and not concluded as research results. This data is protected by the Protection of Personal Information (POPI) Act of South Africa.
- **Understanding Cloud Computing:** This section aimed to understand the participants' background on cloud computing and their understanding of it.

- **Benefits and Opportunities:** This section elicited participants' views on what they consider beneficial or not in cloud computing.
- **Obstacles to Cloud Computing Adoption:** This section explored the participants' personal experiences with implementing cloud computing solutions and the obstacles they faced.
- **Strategies and Best Practices:** This section asked participants to recommend strategies or practices for successful implementation of cloud computing solutions.
- **Legal, Ethical, and Data Privacy Concerns:** This section aimed to identify the participants' concerns related to legal, ethical, and data privacy issues during and after cloud computing implementations.
- **Conclusion:** This section provided an opportunity for participants to recap their views and add any additional insights based on their experiences.

The semi-structured interviews were conducted in a professional and ethical manner, ensuring confidentiality and anonymity of the participants.

3.9 DATA COLLECTION PROCEDURES

In order to collect data for the research, certain participants who hold roles deemed relevant to the study was selected and invited through email to participate on a voluntary basis. A formal consent form will be developed and administered to ensure that participation is not mandatory and that participants have a clear understanding of the expectations of their involvement. The participants was recruited through the office of the Chief Director and an invitation email with the informed consent form attached will be sent to the IT department employees from the director's office.

Upon receipt of consent, the participants had the opportunity to schedule a meeting at their convenience. The data was collected through interviews conducted either face-to-face or via remote conference. Throughout the process, personal preferences and individual considerations was considered to ensure the comfort and well-being of the participants.

The resulting recordings was transcribed and subjected to data analysis for the research, with all personal or sensitive data being excluded from transcription to protect the confidentiality and interests of the participants.

3.10 DATA ANALYSIS TECHNIQUE

Thematic analysis is a widely used method for analysing qualitative data, focusing on the identification, organisation, and interpretation of patterns or themes within a dataset. According to Creswell and Creswell (2018), it is a flexible and accessible approach that works across various

theoretical frameworks, making it ideal for exploratory studies conducted within an interpretivist paradigm. By examining the experiences and perspectives shared by participants, thematic analysis provides a structured yet adaptable process for deriving insights directly from the data.

This method emphasises a rigorous yet iterative approach, where the researcher moves between familiarising themselves with the data, coding, and developing themes. Thematic analysis is particularly valuable for capturing both explicit content and underlying meanings, allowing researchers to explore complex and subjective phenomena. It is well-suited for studies aiming to understand nuanced challenges, strategies, or social processes, as it enables a rich, contextual understanding of the data.

Moreover, thematic analysis is practical and transparent, offering a clear framework for organising and reporting findings. This makes it an effective choice for analysing interview data, where participants' diverse viewpoints are essential for addressing research questions. Its flexibility allows researchers to adapt the process to the specific aims of their study while maintaining methodological rigor.

This study followed this process to analyse data collected from semi-structured interviews. First, the interview transcripts will be reviewed several times to become familiar with the content, capturing initial impressions and ideas. Next, the data was coded to identify significant phrases or segments that relate to the research objectives. These codes were then grouped into preliminary themes based on their patterns and relationships.

The themes had undergone a review process where they will be refined and validated against the data to ensure they are coherent and accurately represent the participants' perspectives. Once finalised, the themes were clearly defined and named, encapsulating the key insights they represent. Finally, the themes were reported with direct quotes from the transcripts to illustrate their relevance and connection to the research questions. This iterative process ensures that the findings remain grounded in the data while providing meaningful insights.

3.11 VALIDITY, RELIABILITY, AND ETHICAL CONSIDERATIONS

Ensuring the validity and reliability of this study is essential for establishing its trustworthiness and rigor. Validity refers to how accurately the findings reflect participants' perspectives and the phenomena being investigated. To enhance validity, this study will incorporate member checking, allowing participants to review and verify the accuracy of their interview transcripts and the interpreted data. Additionally, peer debriefing will provide external feedback on the data analysis process, helping to reduce potential researcher bias. Maintaining a thorough audit trail that

documents each stage of the research process will further enhance the transparency and credibility of the findings.

Reliability, which refers to the consistency and dependability of the research methods, will be ensured through a systematic approach to data collection and analysis. The use of a semi-structured interview guide will standardise the data collection process, ensuring that all participants address the same core questions while also allowing flexibility for a deeper exploration of individual perspectives. Regular evaluation of interview responses and careful documentation of coding and theme development during the thematic analysis will help maintain consistency across the dataset.

Ethical considerations are integral to the research process, particularly in ensuring the rights, privacy, and dignity of participants. This study will adhere to South African data privacy laws, including the POPI Act, by safeguarding all personal data and ensuring confidentiality. Participation was entirely voluntary, with informed consent obtained before data collection. Participants will have the right to withdraw at any time without facing any consequences. Data will be securely stored and anonymised in all reports to protect participants' identities.

3.12 CHAPTER SUMMARY

This chapter details the research methodology used to explore the topic, based on Creswell's insights and the research onion framework. The study operates within an interpretivist paradigm and employs an inductive reasoning approach to identify themes and patterns from qualitative data. A case study strategy was selected to provide an in-depth understanding of a specific context, with data collected through semi-structured interviews and analysed using thematic analysis. The research employs a cross-sectional time horizon, capturing a snapshot of current challenges and strategies.

Key considerations include convenience sampling to ensure the selection of relevant available participants, as well as measures to enhance validity and reliability, such as member checking and audit trails. Ethical safeguards have been implemented to comply with data privacy laws. Collectively, these methodological choices ensure that the research is rigorously designed to generate meaningful, context-specific insights into the challenges and strategies associated with implementing cloud computing in higher education.

CHAPTER 4 DATA ANALYSIS

4.1 CHAPTER OVERVIEW

This study utilises a bottom-up thematic analysis approach, following Creswell's adaptation of the Saunders Research Onion framework. Grounded in an interpretivist paradigm and guided by inductive reasoning, the analysis generates themes directly from the responses of participants in five semi-structured interviews. With participant consent, the interviews were recorded, transcribed, and will be analysed independently of any pre-existing knowledge to uncover new methods or gaps that had not been previously addressed. This approach ensures that the findings are driven by participants and are contextually relevant, aligning with the study's goal of revealing new insights into the adoption of cloud computing. Due to time constraints and gatekeeper approvals, only five interviews could be conducted in the timeframe.

4.2 INTERVIEW NOTES

Offering a brief background and summary of the interview notes for each candidate provides valuable context for understanding the collected data. These profiles enrich the analysis and discussion by placing the insights within the unique perspectives and experiences of the participants.

4.2.1 Candidate 1

Candidate 1 displayed a strong enthusiasm for participating in the interview, highlighting their expertise and interest in stakeholder engagement and addressing diverse business needs within systems. Their primary focus is at the management level, emphasising the development of strategies to facilitate digital transformation within the university. Throughout the interview, Candidate 1 provided detailed and thoughtful responses, approaching questions from a strategic perspective with a forward-looking emphasis on future developments. The conversation was conducted in a calm and open manner, fostering an environment of collaboration and understanding, with no signs of discomfort or tension observed.

4.2.2 Candidate 2

Candidate 2 actively participated in the interview, offering valuable insights as a developer specialising in creating integration links between systems for the university. They have extensive experience working closely with cloud service providers and focusing on securing data during transit. Throughout the interview, Candidate 2 provided direct and clear answers, often using

examples to effectively illustrate their views and opinions. The discussion was open and engaging; however, the candidate occasionally seemed unprepared, pausing briefly to think before responding to some questions. Despite this, the interview maintained a collaborative and constructive tone, resulting in meaningful insights.

4.2.3 Candidate 3

Candidate 3 is currently overseeing the implementation of a cloud-based solution for the university, focusing on business process integration and the migration of data to the SaaS system. During the interview, their responses revolved around their current experiences and the impact of the implementation on the university and its employees. Although they expressed a willingness to participate, their enthusiasm was tempered by the time pressures and tight deadlines they are facing. Nevertheless, their insights were valuable and informative, offering practical perspectives on the challenges and dynamics of the ongoing cloud implementation project.

4.2.4 Candidate 4

Candidate 4, a member of the management team, is dedicated to raising awareness initiatives within the university, focusing on training and collaboration among employees to support a smooth transition during digital transformation implementations. During the interview, they expressed scepticism about the current implementation processes. They identified challenges in training personnel and noted limitations in the IT department's ability to effectively meet the diverse needs of the university. While eager to share their insights, they conveyed mixed feelings about the management of these processes, pointing out significant gaps that must be addressed to ensure the success of the initiatives.

4.2.5 Candidate 5

Candidate 5, the cloud engineer for the university, is focused on the technical processes and tools necessary for effectively implementing cloud solutions. As a technical expert, their responses were expected to be more process-oriented than strategy-focused. During the interview, the candidate provided brief answers, often emphasising specific technical aspects. However, their tone suggested some discontent with the university's current approach to digital transformation. Their input highlighted practical, process-oriented insights while also revealing potential dissatisfaction with how these implementations are being managed.

4.3 DATA ANALYSIS

The data analysis in this study follows Creswell's framework for qualitative research and employs an iterative thematic analysis approach to ensure a structured and rigorous examination of the interview data. The analysis consisted of three key stages: data familiarisation and coding, the generation of subcategories and categories, and theme development. Each stage was designed to systematically build insights from the raw data, aligning with the study's inductive and bottom-up methodology.

4.3.1 Theme Formulation

The process began with data familiarisation, where interview transcripts were read repeatedly to develop a deep understanding of the material. During this phase, meaningful segments of text were identified and coded. These codes were categorised into three distinct types: general codes, which recurred across multiple participants and highlighted common patterns; unique codes, which were specific to individual participants and offered personal perspectives; and odd codes, which represented rare or unexpected insights that provided new and exploratory directions for the research.

In the next stage, the codes were organised into categories, each addressing specific aspects of cloud computing adoption, such as financial barriers, security concerns, or integration challenges. This structured approach ensured that all significant data points were captured and contextualised within relevant domains.

Finally, the broader categories were synthesised into five overarching themes, which encapsulated the key findings of the study: Cloud Computing as a Flexible Solution, Financial Barriers and Opportunities, Addressing Technical Challenges, Human and Organisational Dynamics, and Strategic Opportunities. This bottom-up approach ensured that the themes emerged organically from the participants' experiences and perspectives, avoiding the imposition of pre-existing theoretical constructs and maintaining the integrity of the inductive methodology.

4.3.2 Theme 1: Cloud Computing as a Flexible Solution

Figure 4-1 outlines the breakdown of codes and categories associated with this theme. These codes were analysed from the interviews, with relevant quotes linked to each code. Grey codes represent statements made by all participants, while gold codes are unique statements providing specific contexts that were not mentioned by others. Red codes reflect unusual and particular opinions expressed by a candidate. Each participants response is colour coded when being used to build a code structure.

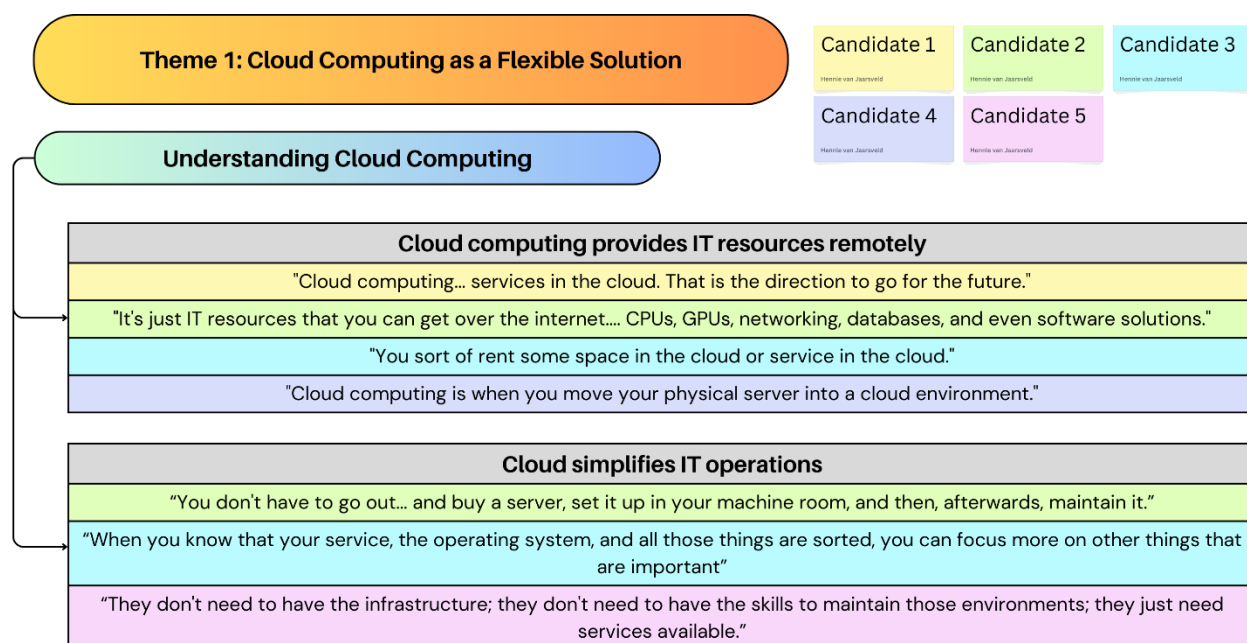


Figure 4-1: Theme 1 – Understanding Cloud Computing

The interviews highlight the flexibility of cloud computing as a transformative tool in higher education. Participants frequently emphasised how cloud systems simplify IT operations by eliminating the need for physical infrastructure. Statements like “you don’t have to go out and buy a server” illustrate the perceived ease of transitioning to cloud-based solutions, which reduces technical complexity and frees up resources for strategic priorities.

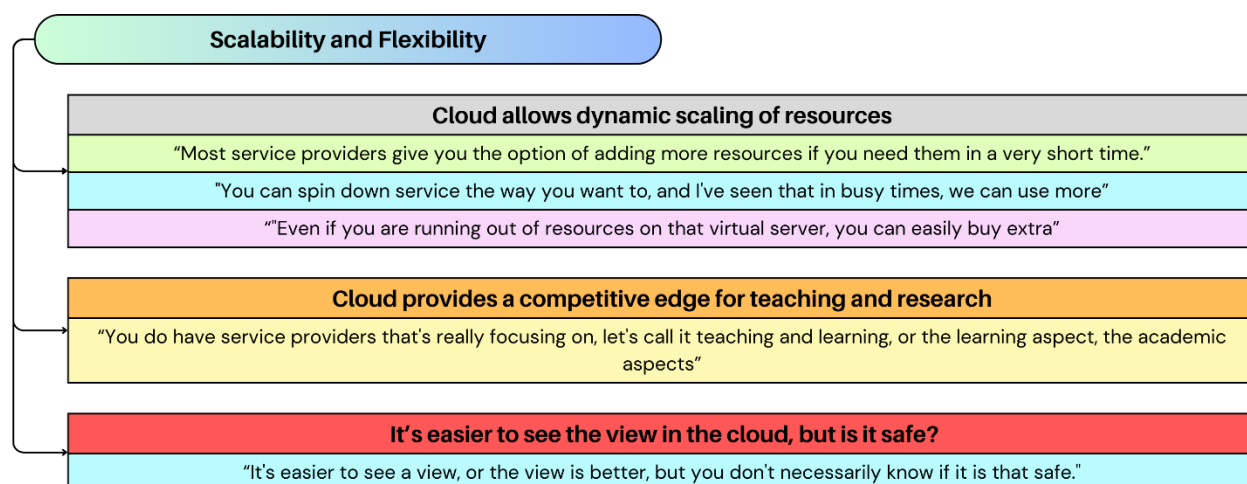


Figure 4-2: Theme 1 - Scalability and Flexibility

Scalability was another prominent point discussed. Participants underscored the ability to dynamically adjust resources to meet varying demands. Quotes such as “you can spin down

services the way you want to” reflect the adaptive nature of cloud solutions, which are particularly valuable for managing fluctuating academic and operational needs. This adaptability ensures that institutions can efficiently scale services without overcommitting to fixed infrastructure.

Furthermore, the data indicates that participants view cloud platforms as enablers of innovation in teaching and research. Observations that focus on “teaching and learning” highlight the strategic value of cloud solutions in supporting academic goals and fostering collaboration. However, concerns about security were evident, with participants noting that while cloud systems offer enhanced visibility, uncertainties about their safety and reliability persist. This emphasises the need for robust security measures.

4.3.3 Theme 2: Financial Barriers and Opportunities

The analysis of this theme reveals that while cloud computing offers significant financial opportunities, it also presents substantial challenges that institutions must navigate. This theme highlights the duality of financial implications, focusing on initial barriers, operational costs, optimisation benefits, and unique considerations related to future strategic direction and advantages for smaller institutions.

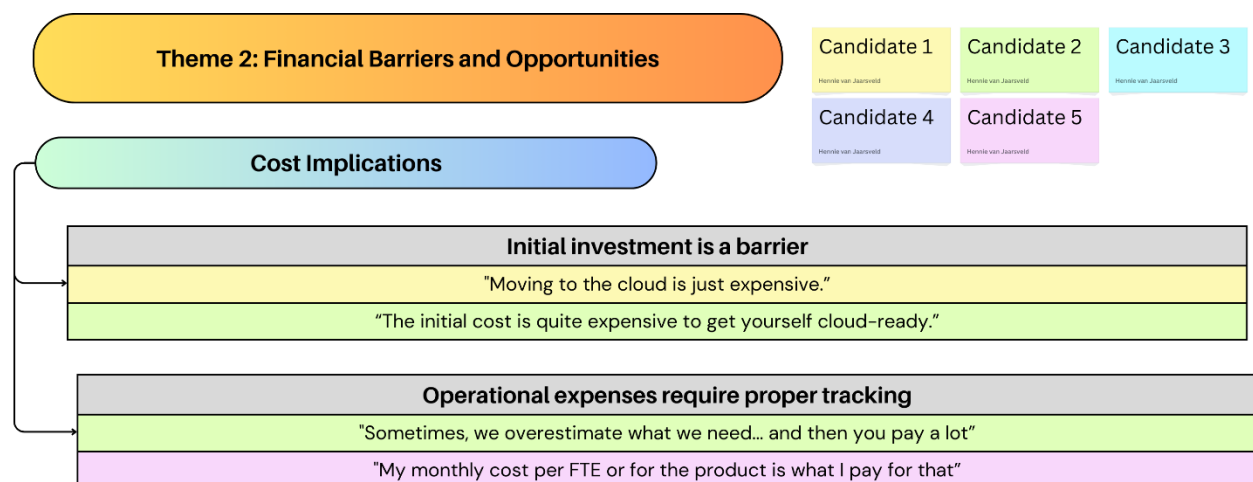


Figure 4-3: Theme 2 - Cost Implications

The data indicates that the initial investment required for cloud adoption remains a major barrier. Statements like “moving to the cloud is just expensive” emphasise how the upfront costs to become “cloud-ready” can deter institutions. These costs include expenses for migration, staff training, and transitioning infrastructure. Additionally, operational expenses require careful tracking, as overestimating needs can lead to unnecessary costs. Comments such as “sometimes, we overestimate what we need ... and then you pay a lot” suggest that institutions

may lack adequate financial oversight tools, making budgeting and expenditure tracking critical areas for improvement.

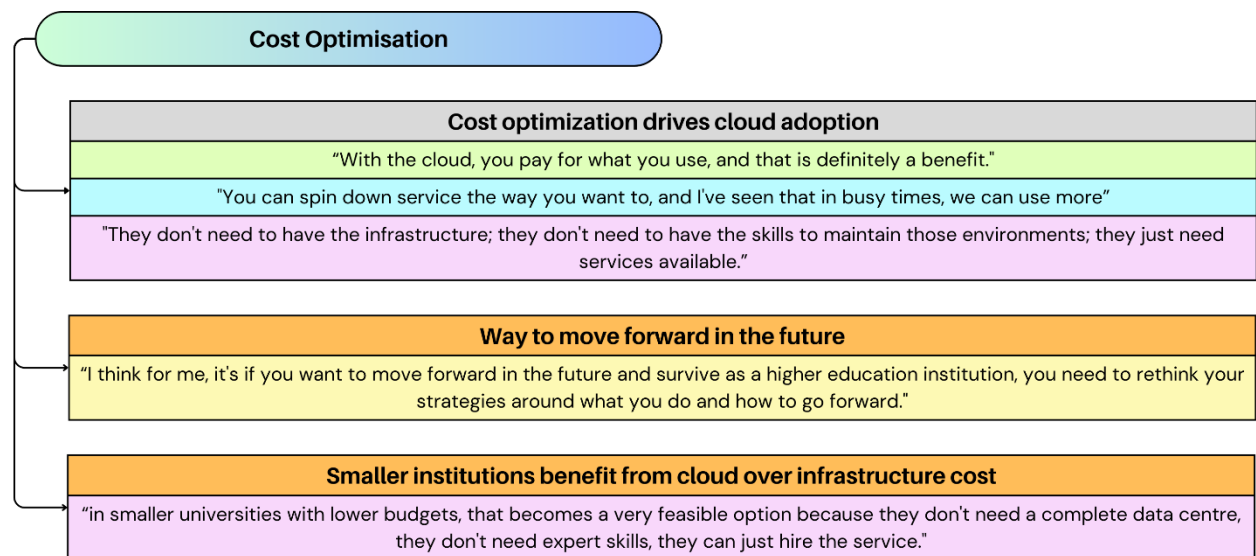


Figure 4-4: Theme 2 – Cost Optimisation

Despite existing barriers, the benefits of cost optimisation are evident in the data. Participants have pointed out the advantages of the “pay-for-what-you-use” model, which allows institutions to align spending with actual usage. This flexibility reduces waste and supports dynamic resource scaling. For example, the ability to “spin down service the way you want to” reflects the adaptability that cloud computing offers during peak and off-peak periods. Moreover, cloud solutions eliminate the need to maintain on-premises infrastructure, freeing institutions from the financial and technical burden of hiring in-house IT experts.

The data also reveals unique insights regarding the strategic role of cloud computing. The sentiment that “if you want to move forward in the future and survive as a higher education institution, you need to rethink your strategies” indicates that cloud adoption is not merely a financial decision; it is a necessary evolution for competitiveness and sustainability in higher education. Smaller institutions, in particular, stand to benefit significantly, as cloud solutions provide an affordable alternative to building and maintaining costly infrastructure. The ability to “just hire the service” without requiring extensive IT expertise makes cloud adoption a feasible and transformative option for resource-constrained universities.

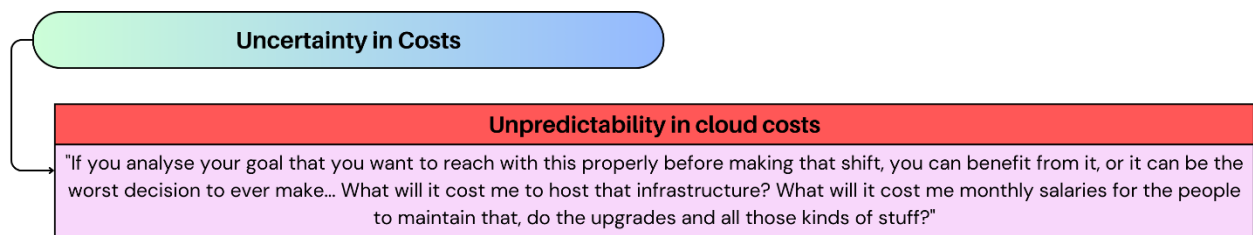


Figure 4-5: Theme 2 - Uncertainty in Costs

An unusual aspect identified is the unpredictability of cloud costs, which complicates financial planning. The statement, “if you analyse your goal ... it can be the worst decision to ever make,” highlights the inherent risk of unanticipated expenses, such as data transfer fees, over-provisioning, or unexpected scaling needs. This unpredictability underscores the importance for institutions to carefully assess their goals and adopt cloud cost-management strategies to mitigate financial risks.

4.3.4 Theme 4: Addressing Technical and Data Challenges

The analysis of this theme highlights the various technical and regulatory challenges associated with cloud computing in higher education. Participants identified key issues such as integration, performance, security, and data regulations, providing insights into the obstacles institutions face when implementing cloud solutions.

Integration challenges remain a significant barrier to cloud adoption, as participants noted the complexities involved in aligning new cloud systems with existing infrastructure. Comments like “integration will always be an issue” reflect the technical difficulties of ensuring seamless data flow between cloud-based and on-premises systems. Additionally, reliance on international hosting can introduce latency issues; participants observed delays when services are hosted in distant locations like Ireland. This highlights the need for localised cloud options to reduce latency and improve performance.

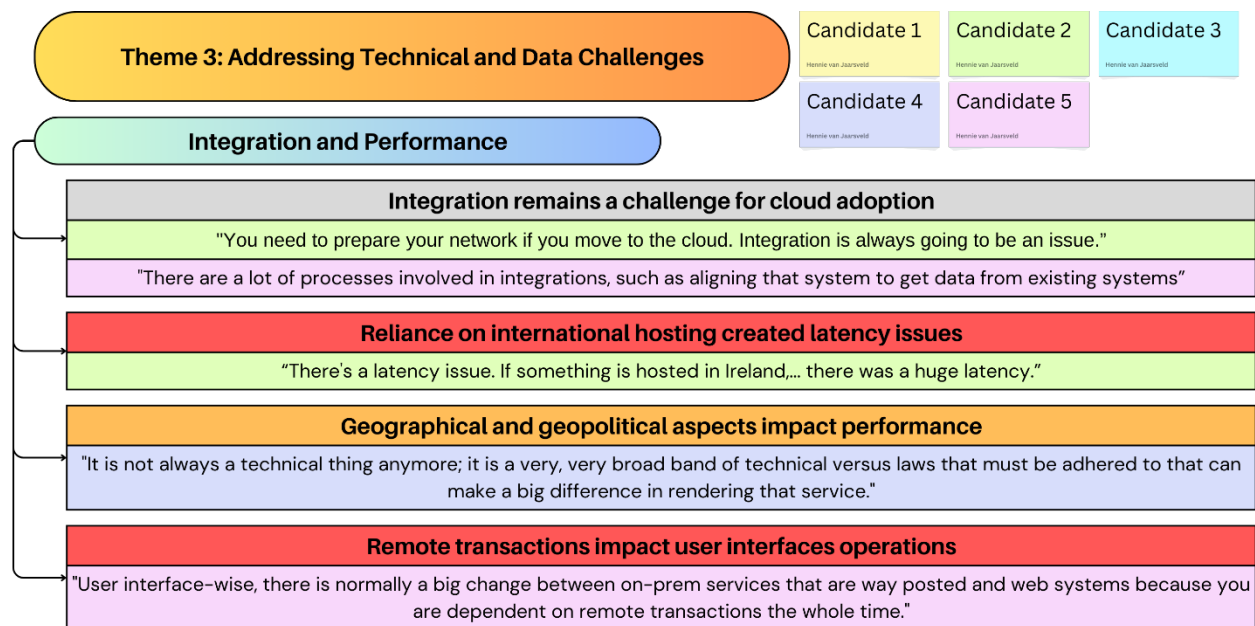


Figure 4-6: Theme 3 - Integration and Performance

Remote transactions also emerged as a notable concern. Participants commented that user interfaces dependent on cloud-based systems can feel less responsive than those on on-premises systems. This reliance on constant remote communication can hinder the user experience, emphasising the importance of optimising interface operations to balance functionality and responsiveness.

Participants pointed out that cloud performance is influenced not only by technical factors but also by geographical and geopolitical considerations. The statement that "there is a broad range of technical factors versus laws that must be adhered to" underscores how regional regulations and international data laws can significantly impact service delivery and cloud operations. This emphasises the need for institutions to navigate legal and geopolitical complexities when adopting global cloud services, especially when compliance with local laws is required.

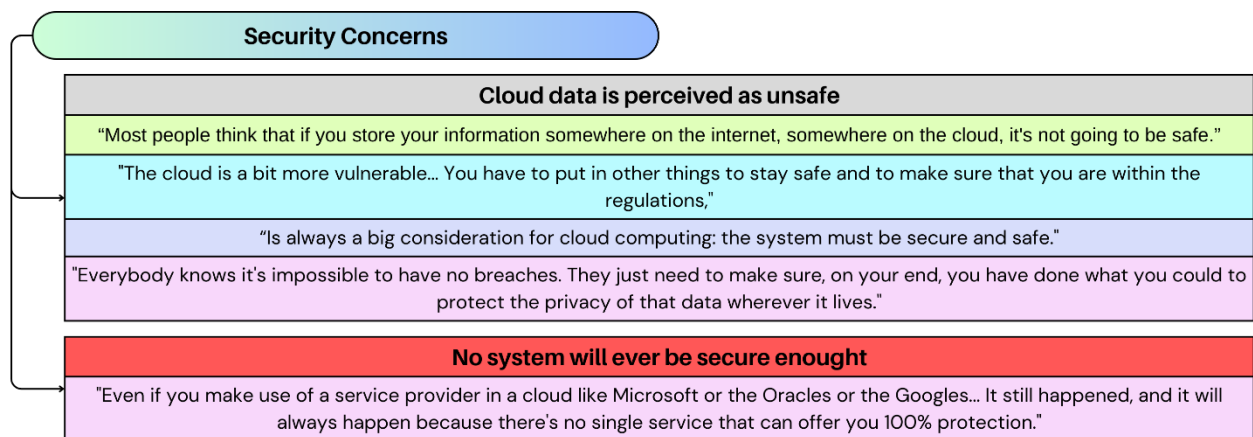


Figure 4-7: Theme 3 – Security Concerns

Security remains a critical challenge, with participants expressing the perception that “cloud data is a bit more vulnerable” compared to traditional systems. The inherent risks of storing information online necessitate robust safeguards to maintain compliance with regulations and protect sensitive data. Participants also acknowledged that “no system will ever be secure enough,” emphasising the inevitability of breaches and the importance of proactive measures to minimise risks. This perspective reinforces the need for continuous monitoring, encryption, and strict access controls to safeguard cloud data.

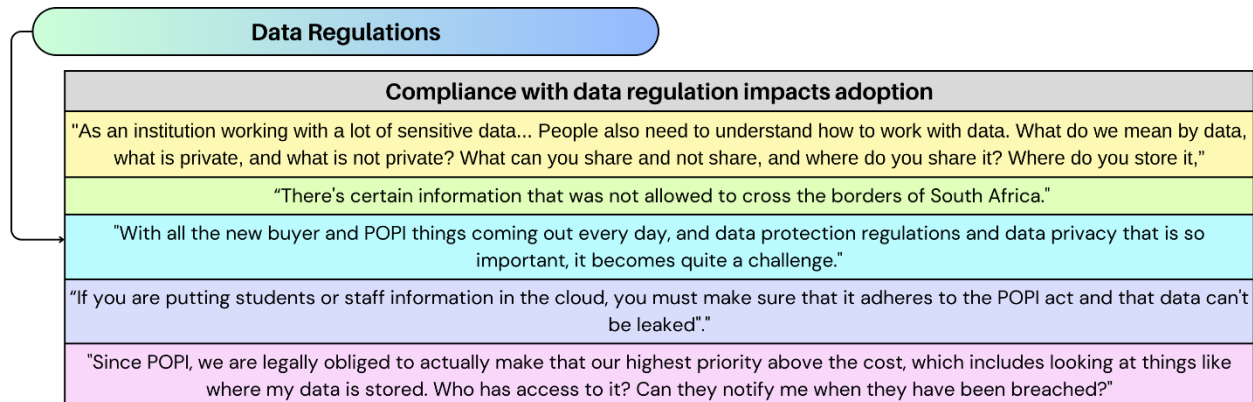


Figure 4-8: Theme 3 - Data Regulations

Compliance with data protection laws, such as the POPIA, was highlighted as a significant factor impacting cloud adoption. Institutions face challenges in managing cross-border data flows and ensuring adherence to privacy regulations. Comments like “we are legally obligated to make data protection our highest priority” demonstrate the crucial role of compliance in shaping cloud strategies. The complexity of navigating evolving regulations further complicates adoption, requiring institutions to remain agile in their data governance practices.

4.3.5 Theme 4: Human and Organisational Dynamics

The analysis of this theme emphasises the critical role that human and organisational factors play in the adoption of cloud computing. While technical challenges often dominate discussions, resistance to change, cultural shifts, awareness, and training emerge as significant dynamics influencing cloud adoption.

Resistance to change is a common barrier to cloud adoption. Participants pointed out that individuals frequently prefer traditional methods of working, as illustrated by statements like, “We want to do it like we used to; that’s the problem with migration.” This resistance often arises from a lack of understanding of the benefits of cloud computing or fear of disrupting established workflows. To overcome this inertia, institutions must foster trust in the process and highlight the value of transformation.

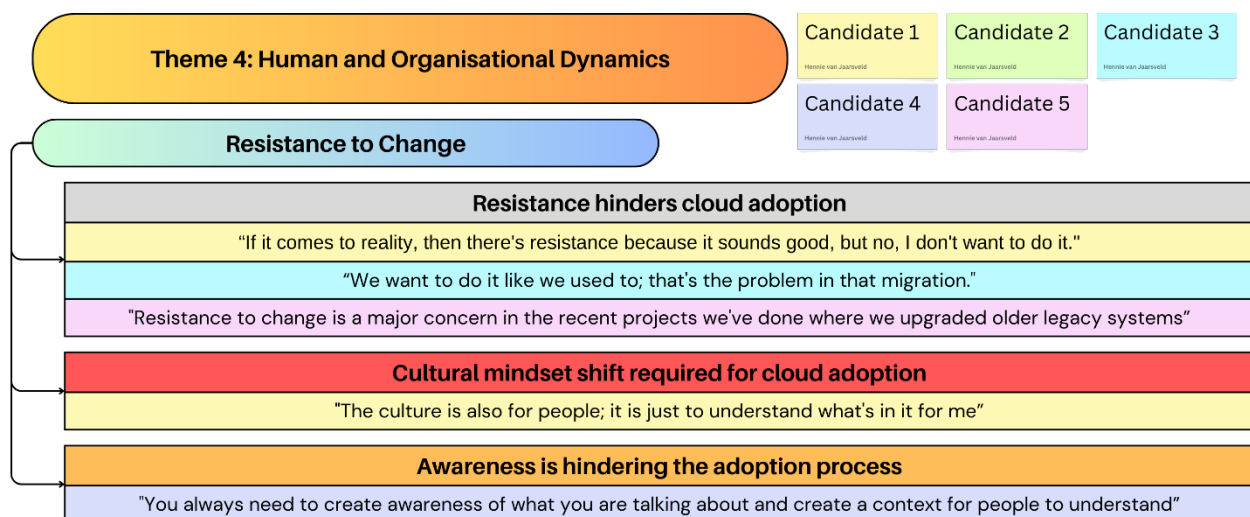


Figure 4-9: Theme 4 - Resistance to Change

A cultural mindset shift is essential for successful cloud adoption, though it can be challenging to achieve. The comment, “The culture is also for people; it is just to understand what’s in it for me,” underscores the need to align organisational culture with the goals of digital transformation. Additionally, strategies that actively encourage adaptation to new systems—such as providing demonstrations or involving employees in decision-making—can facilitate this shift. Encouraging input and collaboration reduces resistance and promotes a more adaptive organisational mindset.

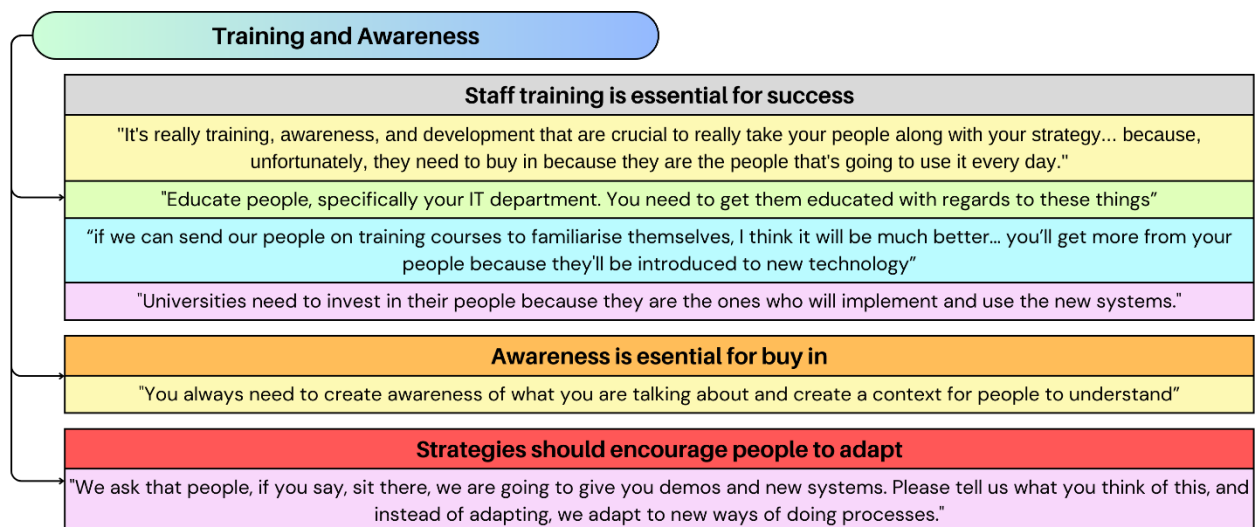


Figure 4-10: Theme 4 - Training and Awareness

Awareness plays a dual role in cloud adoption. On one hand, a lack of awareness can hinder progress, as participants noted the need to “create a context for people to understand.” This suggests that without clear communication about the purpose and benefits of cloud computing, stakeholders may remain sceptical or disengaged. Conversely, awareness is essential for securing buy-in; participants emphasised that educating teams and fostering visibility into the process can generate alignment and enthusiasm for change.

Participants consistently highlighted the importance of training and development in ensuring successful cloud adoption. Comments like, “educate people, specifically your IT department,” underline the need for targeted capacity building. Training sessions that introduce employees to new systems and demonstrate their practical benefits are critical for building confidence and competence. Investing in staff training ensures that the workforce is equipped to implement and sustain cloud initiatives effectively.

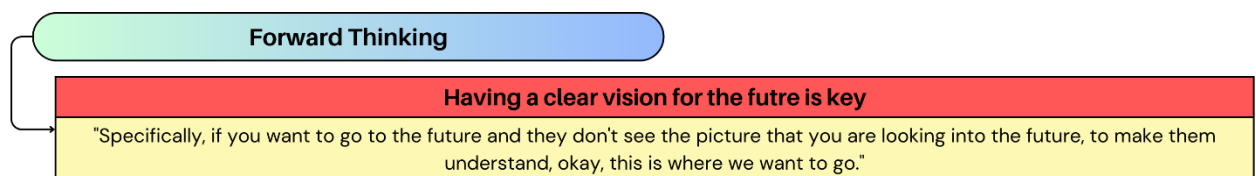


Figure 4-11: Theme 4 - Forward Thinking

Forward-thinking is another crucial aspect that influences human dynamics in cloud adoption. The statement, “If you want to go to the future and they don’t see the picture you are looking at, they won’t understand,” highlights the importance of having a clear and compelling vision. Leadership

must clearly communicate how cloud adoption aligns with the institution’s long-term goals to build confidence and alignment at all levels.

4.3.6 Theme 5: Strategic Opportunities

The analysis of this theme highlights the strategic opportunities that cloud computing offers to higher education, particularly in the areas of collaboration, customisation, and future-oriented teaching and learning models. These opportunities are considered crucial for addressing the specific needs of universities while utilising cloud technologies to enhance operations and educational outcomes.

Collaboration among universities is recognised as a key strategy for reducing duplication and optimising resources. As noted, “If universities in South Africa have more or less the same cloud solution, it will be much cheaper,” emphasising the potential cost savings and efficiencies that can be achieved through collective cloud adoption. By sharing administrative systems, institutions can streamline operations, concentrate on core activities like research, and avoid unnecessary redundancy.

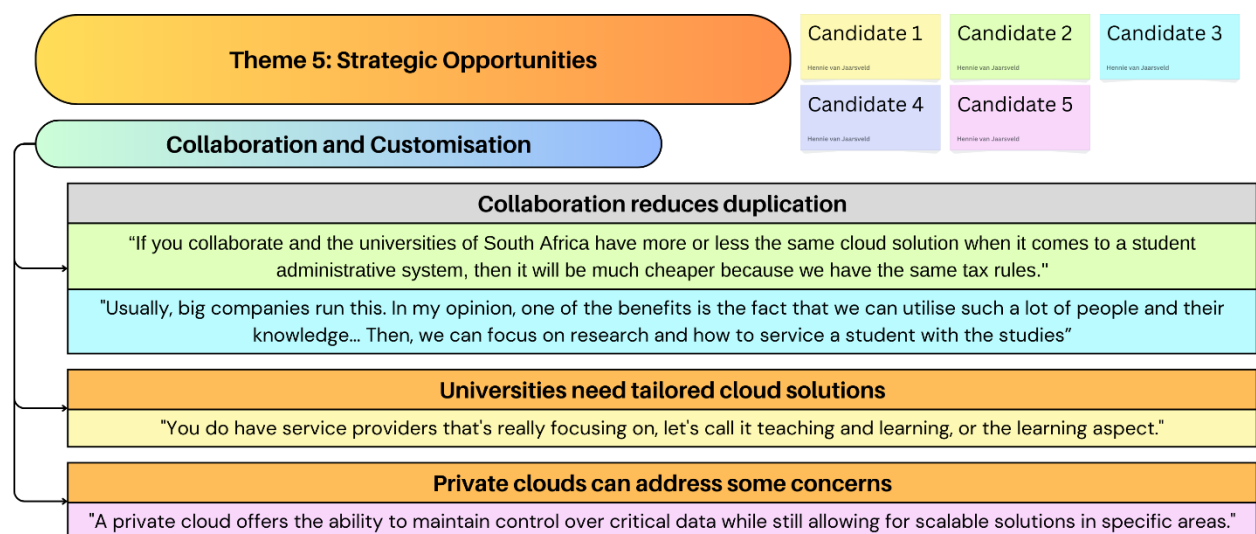


Figure 4-12: Theme 5 - Collaboration and Customisation

Universities require customised cloud solutions that cater to their distinctive teaching and learning needs. The statement, “You do have service providers that focus on teaching and learning,” reflects the demand for specialised services designed to support educational objectives. Tailored cloud solutions enable institutions to align their digital transformation efforts with academic priorities while addressing specific challenges in delivering education.

Private clouds also emerged as a significant aspect, offering a balance between scalability and control. The quote, “A private cloud offers the ability to maintain control over critical data,” highlights the importance of retaining ownership of sensitive information while benefiting from the flexibility of cloud services. This approach is particularly important for institutions with strict data privacy requirements or those seeking greater autonomy in managing their systems.

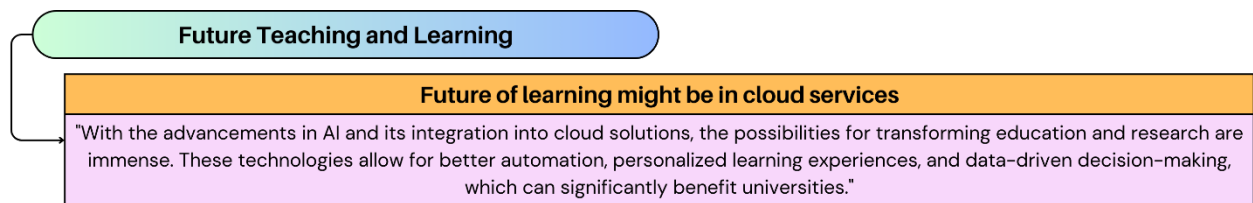


Figure 4-13: Theme 5 - Future Teaching and Learning

The future of learning in higher education is closely linked to advancements in cloud services. Technologies such as artificial intelligence and data-driven decision-making are viewed as transformative tools for personalised education and enhanced research capabilities. The observation, “The possibilities for transforming education and research are immense,” underscores the potential of cloud computing to enable automation, improve learning experiences, and foster innovation in academia.

4.4 SYNTHESIS OF FINDINGS

The analysis across the five themes reveals a multifaceted perspective on the opportunities and challenges associated with cloud computing in higher education. These themes highlight both the transformative potential of cloud solutions and the complexities involved in their adoption, underscoring the need for a balanced and strategic approach.

Cloud computing’s flexibility is a key driver for its adoption, offering scalable and adaptable IT infrastructures that align with the fluctuating needs of universities. The ability to streamline operations, reduce dependency on physical infrastructure, and provide scalable resources were consistent insights from the data. However, concerns about security and trust remain significant, emphasising the importance of implementing robust safeguards while maximising the flexibility that cloud solutions offer.

The financial implications of cloud adoption present a duality of challenges and benefits. While the initial investment and operational cost tracking can be significant barriers, participants emphasised the long-term cost optimisation benefits associated with a “pay-for-what-you-use” model. Smaller institutions were noted to benefit substantially, as cloud solutions eliminate the

need for extensive IT expertise and infrastructure. However, the unpredictability of costs poses a unique challenge, requiring meticulous financial planning and management strategies.

Technical and data-related challenges were prominent, particularly regarding integration with existing systems, international hosting latency, and regulatory compliance. The complexities of integration and latency issues underscore the need for localised and well-integrated cloud solutions. Security continues to be a pervasive concern, with participants acknowledging that no system can be entirely secure, highlighting the necessity of ongoing vigilance and proactive measures. Compliance with data regulations, especially in the South African context with POPIA, further complicates adoption, necessitating robust data governance frameworks.

Human and organisational factors play a crucial role in cloud adoption. Resistance to change, cultural shifts, and lack of awareness emerged as significant barriers to successful implementation. Participants highlighted the importance of training, awareness, and fostering a forward-thinking mindset to address these challenges. Awareness was identified as both a barrier and an enabler, emphasising the need for clear communication and engagement strategies to secure buy-in and align stakeholders with the institution's vision for digital transformation.

Cloud computing offers substantial strategic opportunities for higher education. Collaboration among institutions can reduce duplication and optimize resources, enabling a more cost-effective approach to digital transformation. Tailored cloud solutions and private clouds were highlighted as critical for addressing specific institutional needs while maintaining control over sensitive data. Looking ahead, the integration of advanced technologies, such as AI within cloud systems, positions cloud computing as a transformative tool for personalised learning and innovative research, paving the way for the future of education.

4.5 CHAPTER SUMMARY

This chapter explored the adoption of cloud computing in higher education through a thematic analysis from a bottom-up perspective. Using the Saunders Research Onion framework and Creswell's qualitative methods, it examined data gathered from semi-structured interviews with key stakeholders. Themes emerged from participants' experiences, highlighting challenges such as financial barriers, technical integration issues, and organisational resistance, alongside opportunities for collaboration, cost optimisation, and innovation.

The analysis emphasised the transformative potential of cloud computing in streamlining IT operations, enabling scalability, and enhancing both teaching and research capabilities. However,

it also stressed the importance of implementing robust security measures, ensuring regulatory compliance, and fostering cultural shifts within institutions.

Key findings indicated the flexibility and cost-efficiency of cloud solutions, the dual nature of financial implications, and the critical need for training and awareness to overcome resistance to change. Collaboration among universities and the development of tailored solutions for education were identified as essential strategies for maximising the benefits of cloud computing while maintaining control over sensitive data.

CHAPTER 5 DISCUSSION

5.1 CHAPTER OVERVIEW

This chapter analyses the interview data in relation to existing literature, highlighting both areas of agreement and disagreement. It examines the impact of cloud computing on universities, detailing benefits such as cost optimisation and scalability, along with challenges that include technical, financial, and organisational barriers.

Additionally, the discussion identifies strategies to address these challenges, including fostering collaboration, ensuring regulatory compliance, and developing tailored solutions. The aim is to provide insights and recommendations for effectively navigating cloud adoption while maximising its potential in higher education.

5.2 KEY FINDINGS

The interviews revealed several key findings related to the adoption of cloud computing in higher education. Flexibility emerged as a significant benefit, with a scalable IT infrastructure that enables universities to efficiently respond to varying demands. While benefits such as streamlined operations and reduced reliance on physical infrastructure were noted, concerns about security and trust highlighted the need for robust safeguards.

Financial implications showed a dual dynamic, where substantial initial investments contrast with long-term savings under “pay-for-what-you-use” models. Smaller institutions, in particular, benefit from affordable access to cloud services without needing extensive IT expertise; however, unpredictable costs require careful financial planning.

Technical challenges, such as system integration, latency, and compliance with data regulations, were also prominent, underscoring the importance of localised solutions and adherence to frameworks like the POPIA. Additionally, human dynamics, including resistance to change and shifts in organisational culture, reinforced the necessity for awareness campaigns and training to align stakeholders with cloud initiatives.

Finally, the strategic potential of cloud computing was evident in its ability to foster collaboration, reduce redundancy, and enable innovative, future-focused teaching and research models.

5.3 BENEFITS AND CHALLENGES IN CLOUD ADOPTION

Cloud computing presents significant benefits for universities and higher education institutions, offering a balance of cost-efficiency, scalability, and operational enhancements, alongside notable challenges related to data security, technical integration, and cultural acceptance.

One of the primary advantages of cloud computing is its cost-effectiveness. By moving from a capital-intensive model that relies on physical infrastructure to a pay-as-you-go operational model, institutions can allocate their resources more strategically. This is particularly beneficial for smaller universities that can take advantage of shared cloud services and economies of scale. Additionally, the scalability of cloud platforms facilitates dynamic resource allocation during peak demand periods, such as student registration or exams, while allowing for cost reductions during off-peak times. (Ali *et al.*, 2021)

Furthermore, enhanced accessibility and collaboration tools enable global academic exchanges, streamline administrative processes, and broaden access to advanced technologies like AI and analytics for research and learning. (Ali *et al.*, 2021)

However, these benefits come with significant challenges that universities must address. Data privacy and security concerns, especially in countries with strict regulations such as South Africa's POPIA, require rigorous compliance frameworks and thorough evaluation of cloud service providers. The integration of cloud solutions with existing legacy systems often poses technical challenges, compounded by potential latency issues when data centres are located far away. Additionally, cultural resistance to change within organisations highlights the need for effective change management, training, and stakeholder engagement. (Ali *et al.*, 2021; Scholtz & Atukwase, 2020)

Financial unpredictability, reliance on third-party service providers, and limitations in regional infrastructure add further complexity to the adoption process. To fully realise the transformative potential of cloud computing, universities must proactively tackle these challenges by cultivating a culture of acceptance, implementing strong governance policies, and leveraging customised solutions that align with their unique operational and educational needs. (Ali *et al.*, 2021)

5.4 INFLUENCING FACTORS IN ADOPTION DECISIONS

The decision-making processes surrounding cloud computing adoption in universities are influenced by a mix of internal and external factors, each presenting unique challenges and opportunities.

Internally, budget constraints play a significant role, especially for smaller institutions that struggle with limited financial resources. Although cloud computing has the potential to reduce costs through operational expenditure models, the substantial upfront investment needed to become “cloud-ready,” such as upgrading networks and training staff, poses considerable barriers. Additionally, many universities experience technological inertia due to their reliance on outdated systems and a lack of IT expertise, which complicates migration and integration efforts.

Institutional policies, including strict data governance frameworks, also shape cloud adoption strategies by imposing stringent controls over sensitive student and research data. Cultural resistance and a lack of strategic alignment within universities further complicate decision-making, highlighting the need for effective change management initiatives and clear communication of the benefits of cloud computing. (Ali *et al.*, 2021; Islam *et al.*, 2023)

Externally, market dynamics, regulatory constraints, and the actions of peer institutions also impact cloud adoption decisions. The competitive landscape of cloud service providers offers various options; however, universities must carefully navigate pricing structures, reliability, and security credentials to identify the best fit for their needs. Geopolitical factors, such as data sovereignty laws and fluctuations in exchange rates, add complexity, especially for institutions that depend on international cloud providers. On a positive note, advancements in technology and the successful transitions of peer institutions can serve as motivators for adoption, with shared cloud models emerging as a cost-effective and collaborative solution. (Islam *et al.*, 2023)

To balance these internal and external factors, universities must adopt a strategic, forward-looking approach that aligns their technological goals with financial realities, institutional policies, and stakeholder expectations, ultimately ensuring successful cloud integration.

5.5 STRATEGIES FOR OVERCOMING IMPLEMENTATION CHALLENGES

Navigating cloud adoption in higher education requires strategic approaches that effectively address financial, technological, cultural, and regulatory challenges. A clear, long-term strategy is essential for aligning cloud initiatives with the university’s mission in education, research, and community engagement. Implementing changes in phases offers a practical starting point, allowing institutions to adopt cloud services for non-critical systems first. This approach enables them to refine processes and build confidence before scaling up to more complex applications. Collaborative cloud models, where universities share platforms and training resources, are particularly effective in reducing costs and fostering collective innovation. (Ali *et al.*, 2021)

Financial planning plays a crucial role in overcoming budgetary constraints. Conducting detailed cost-benefit analyses—taking into account hidden costs such as training, compliance, and data transfer fees—helps universities make informed decisions. Collaborative strategies, like pooling resources for shared systems, empower institutions to negotiate better pricing and achieve economies of scale. These methods ensure that financial concerns do not hinder progress, even for smaller universities with limited budgets. (Ali *et al.*, 2021)

Technological readiness demands targeted investments in infrastructure and skills. Upgrading networks, firewalls, and integration tools is essential for ensuring seamless connectivity and system compatibility. Universities should also focus on enhancing the skills of their IT teams through certifications and training programs tailored to specific cloud platforms like AWS or Azure. Leveraging the expertise of cloud providers—such as built-in migration tools and security frameworks—can alleviate pressure on internal teams and ensure adherence to industry best practices. (Odeh *et al.*, 2017)

Cultural and organisational resistance to change can be mitigated through proactive strategies. Universities should implement change management programs that engage stakeholders early in the process, addressing concerns and building trust. Clear communication campaigns are vital to highlight the tangible benefits of cloud adoption, such as improved workflows and enhanced educational tools. Training and awareness programs for staff and faculty not only improve technical competence but also cultivate enthusiasm for the transition. (Ali *et al.*, 2021)

To address regulatory challenges, universities must establish robust data governance policies and partner with cloud providers that comply with relevant regulations. Negotiating detailed SLAs with providers ensures clarity on data ownership, security measures, and breach response protocols. Multi-layered security strategies, including encryption and access management systems, help safeguard sensitive data, while comprehensive backup and disaster recovery plans ensure resilience during disruptions. (Agbaglo & Bonsu, 2022)

5.6 ETHICAL AND PRIVACY CONSIDERATIONS IN CLOUD ADOPTION

Ethical considerations in cloud adoption are vital for universities, particularly regarding data protection and compliance with the POPIA. Institutions must safeguard sensitive data, including student records and research outputs, even when using third-party cloud providers. Stakeholders stress the need for measures like data encryption, access controls, and secure backups to prevent breaches and unauthorised access. (Staunton *et al.*, 2020; Wu & Plakhtii, 2021)

Transparency is crucial; universities must obtain explicit consent for data use and communicate clear policies to stakeholders. Ensuring data residency within South Africa further complicates ethics, requiring careful negotiations with cloud providers.

Responsible data handling also involves addressing potential misuse of data in research. Contracts with cloud providers should clearly define data ownership, storage, and usage. Human error poses ongoing risks, making it essential for universities to train staff and students on best practices. By establishing strong data governance frameworks and ethical guidelines, universities can balance the benefits of cloud computing with their duty to protect privacy and uphold ethical standards. (Snail ka Mtuze & Musoni, 2023; Staunton *et al.*, 2020)

5.7 DISCUSSION ON RESEARCH ALIGNMENTS

An analysis of literature studies and interviews reveals a notable alignment in key themes related to cloud adoption in universities, while also uncovering differences that enhance our understanding of the challenges and opportunities. Both sources emphasise the transformative potential of cloud computing, highlighting benefits such as cost efficiency, scalability, and enhanced collaboration. However, the interviews provide practical, on-the-ground perspectives that complement the theoretical focus of the literature.

Both the literature and the interviews agree on the critical role of training and awareness in successful cloud adoption. The literature emphasises the importance of equipping stakeholders with the necessary skills and knowledge to effectively utilise cloud platforms. Similarly, interview participants consistently stress the need for robust training programs to address resistance and skill gaps among staff and faculty. Both sources highlight that a lack of awareness and preparation can derail even the most well-intentioned initiatives, underscoring the need for targeted, institution-wide training strategies.

The importance of clear, phased strategies is a recurring theme in both sources. Literature studies advocate for structured frameworks and incremental implementation, such as beginning with pilot projects to test feasibility and refine processes. This is echoed in the interviews, where participants emphasise the necessity of long-term planning and the risks of rushing into large-scale solutions without adequate preparation. The shared focus on strategic alignment reinforces the need for measured, step-by-step approaches to cloud adoption.

Both sources recognise resistance to change as a significant barrier to cloud adoption. The literature addresses this issue broadly, highlighting the need for change management and organisational buy-in. Interviews provide additional context, pinpointing specific concerns such as

fears of job loss, discomfort with new technologies, and perceived loss of control. This alignment suggests that addressing resistance requires not only strategic communication but also hands-on engagement to demonstrate the tangible benefits of cloud computing.

Both the literature and the interviews highlight the cost-saving potential of cloud computing, particularly for smaller institutions with limited budgets. The scalability of cloud solutions is consistently mentioned as a key benefit, enabling universities to adjust resources to meet fluctuating demands. While the literature often focuses on theoretical savings, interview participants emphasise real-world experiences of financial constraints and the importance of careful financial planning to avoid unforeseen expenses.

While there is alignment in many areas, interviews offer a more detailed perspective that enriches the theoretical models presented in the literature. For instance, literature studies often assume a baseline level of technological readiness, while interviews reveal challenges related to legacy infrastructure and gaps in IT expertise. Similarly, while the literature emphasises broad compliance frameworks, interviews highlight specific regulatory hurdles, such as data sovereignty, and the practical challenges of negotiating contracts with cloud providers.

5.8 ALIGNMENT WITH THEORETICAL FRAMEWORK

The lack of explicit reference to theoretical frameworks during the interviews raises significant questions about the strategic approaches that universities employ in their cloud adoption processes. While the literature extensively discusses models such as the TAM, the UTAUT, and the DOI, their practical application appears to be underutilised or unrecognised. This disconnect does not necessarily imply that these frameworks are entirely absent from institutional processes; instead, it suggests that they may not be formally integrated or consciously utilised.

The absence of explicit mention of these frameworks in the interviews could indicate a reliance on ad-hoc implementation practices or widely accepted norms rather than on structured, theory-driven strategies. Frameworks like TAM and UTAUT highlight critical factors such as perceived usefulness, ease of use, and facilitating conditions, all essential for promoting user acceptance and engagement with cloud systems. Similarly, DOI Theory emphasises the importance of engaging early adopters and addressing barriers like complexity and compatibility. Without a clear strategy grounded in these models, universities may face challenges such as resistance, inefficiencies, and incomplete adoption.

This gap between literature and practice raises important questions about how universities approach cloud adoption. Are institutions relying on generic implementation practices without

customising them to meet their specific needs? What mechanisms are in place to foster user acceptance, reduce resistance, and align cloud solutions with institutional objectives? These considerations highlight the need for universities to critically assess their strategies and integrate established theoretical frameworks into their planning and execution. Doing so can provide a structured approach to navigate challenges, enhance user engagement, and ensure sustainable cloud adoption.

5.9 THE IMPACT OF CLOUD COMPUTING ADOPTION ON OPERATIONS

The transition to cloud-based systems has created skill gaps within IT departments, as many existing teams lack the necessary expertise to manage cloud technologies effectively. Implementing training initiatives is essential but often requires significant investments of time and money, creating challenges for many institutions. Participants noted that lean IT departments face capacity constraints as they strive to balance the demands of maintaining existing systems with the complexities of moving to cloud environments. Consequently, many universities turn to external consultants, which can raise costs and diminish internal ownership of crucial processes.

Cultural resistance complicates cloud adoption. Staff may feel threatened by job insecurity or perceive a loss of control over IT systems. This resistance not only delays implementation but also necessitates additional resources to address concerns and encourage organisational buy-in.

In terms of operations, cloud computing enhances efficiency by automating administrative tasks and reducing the reliance on physical infrastructure, such as servers and cooling systems. These efficiencies free up resources for strategic initiatives, like enhancing student services or expanding research capabilities. However, reliance on external vendors for maintenance and updates can create dependency, limiting the university's control over its operational processes and raising concerns about service reliability and accountability.

One of the most significant barriers to cloud adoption is the high upfront investment required. Universities must upgrade their network infrastructure, implement secure integration mechanisms such as firewalls and APIs, and train staff to manage cloud platforms. These initial expenses can be particularly challenging for smaller institutions with limited budgets, as participants highlighted misconceptions about the immediate cost savings of cloud computing.

Despite the initial financial challenges, cloud computing can provide considerable operational benefits over time. By transitioning from capital expenditures—such as purchasing hardware—to operational expenses like subscription fees, universities can gain greater budget flexibility. Pay-

as-you-go models align costs with actual usage, reducing waste and preventing the overprovisioning commonly associated with traditional IT systems. Shared cloud platforms allow multiple universities to pool resources, further minimising redundancy and lowering costs for shared services, such as student information systems.

However, financial risks persist. Variable costs, such as scaling during peak usage or unexpected data transfer fees, complicate financial planning. Poorly managed cloud resources, including failure to deactivate unused services, can lead to inflated costs. While long-term savings are attainable, they require careful financial planning to avoid short-term strain, particularly during the transition phase.

Collaboration among universities presents a promising strategy to alleviate financial challenges. By sharing infrastructure for research data storage or student management systems, institutions can significantly reduce costs. Joint negotiations with cloud providers and collaborative training programs can further enhance cost-efficiency and foster a sense of collective innovation within the higher education sector.

5.10 CHAPER SUMMARY

The findings offer valuable insights into the dynamics of cloud adoption in higher education in South Africa, highlighting both the opportunities and challenges that universities encounter. They emphasised the importance of scalability, cost efficiency, and collaboration as key drivers for adoption, while also pointing out significant barriers such as concerns about data privacy, resistance to change, and the lack of formal frameworks for adoption. By integrating theoretical perspectives, the research identifies gaps in strategy and implementation, particularly regarding user acceptance and readiness. These findings enhanced our understanding of the unique regulatory, cultural, and resource constraints within the South African context, providing actionable strategies for institutions to navigate cloud adoption effectively and sustainably.

CHAPTER 6 RECOMMENDATIONS

6.1 CHAPTER OVERVIEW

This chapter offers recommendations for successfully adopting cloud technology in higher education, addressing challenges such as financial constraints, technical obstacles, and resistance to change. Key strategies include implementing changes in phases, providing targeted training, and ensuring strict compliance with regulations. These guidelines provide a roadmap to streamline the adoption process, optimise resources, and leverage cloud technologies to create future-ready academic environments.

6.2 RECOMMENDATIONS FOR SUCCESSFUL CLOUD ADOPTION IN UNIVERSITIES

Based on findings to ensure effective and sustainable cloud adoption in higher education institutions, the following strategies are recommended, focusing on training, risk management, and stakeholder engagement:

Successful cloud adoption requires a knowledgeable and prepared workforce. Universities should prioritise cloud literacy workshops for staff and faculty, emphasising practical tools, workflows, and data security measures. Partnering with providers like AWS, Azure, or Google Cloud to offer certifications, such as AWS Certified Solutions Architect or Azure Fundamentals, can help build internal expertise and reduce reliance on external consultants. (Aruleba *et al.*, 2022; Scholtz & Atukwase, 2020)

Role-specific training tailored for administrative staff, researchers, and faculty can demonstrate how cloud solutions apply to their daily tasks, such as using LMS or data analysis tools. Additionally, continuous professional development and mentorship programs should ensure that IT personnel stay updated on emerging technologies. Incorporating cloud-related modules into academic curricula will also prepare students for technologically advanced workplaces, fostering a future-ready community. (Aruleba *et al.*, 2022; Scholtz & Atukwase, 2020)

Effective risk management is essential for cloud adoption. Universities must enforce multi-layered security protocols, including encryption for data both at rest and in transit, and implement Identity and Access Management (IAM) systems to control access. Adopting robust data governance policies that comply with local regulations, such as the POPIA, is crucial for protecting sensitive information.

Phased implementations should be employed to mitigate system integration risks, starting with non-critical systems to test compatibility before undertaking a full-scale migration. Institutions should also establish service-level agreements (SLAs) with cloud providers to guarantee uptime, disaster recovery, and prompt support response times. To prevent downtime issues, universities should maintain local backups for critical systems, ensuring continuity during outages or technical disruptions. (Aruleba *et al.*, 2022; Mosweu *et al.*, 2019b; Raga & Taylor, 2005)

Transparent communication and stakeholder involvement are vital for successful cloud adoption. Awareness campaigns using emails, webinars, and interactive sessions should clearly outline the reasons for transitioning to the cloud, its benefits, and anticipated challenges. Forming cross-functional committees that include IT staff, administration, faculty, and students ensures diverse input and buy-in during decision-making. (Ali *et al.*, 2021; Scholtz & Atukwase, 2020)

Demonstration projects showcasing successful implementations can build trust and illustrate tangible benefits, such as improved efficiency or enhanced research capabilities. Addressing resistance to change involves highlighting the personal and professional advantages of cloud adoption, such as streamlined workflows and enhanced collaboration. Providing on-demand support and recognising contributors will further cultivate a culture of cooperation and trust throughout the transition. (Aruleba *et al.*, 2022; Scholtz & Atukwase, 2020)

6.3 STRATEGIES FOR OVERCOMING COMMON CHALLENGES

Based on findings, the successful implementation of cloud adoption in universities requires a structured and strategic approach to address financial, technical, and cultural challenges. Below are key strategies designed to facilitate this process, emphasising both preparation and adaptability.

6.3.1 Adopt a Forward-Thinking Mindset

Universities should view cloud adoption as a transformative opportunity rather than merely a technological upgrade. By aligning cloud initiatives with institutional goals such as scalability, cost efficiency, and improved education delivery, institutions can build a strong foundation for their digital transformation journey. (Scholtz & Atukwase, 2020)

6.3.2 Set Clear Goals

Define measurable short-term and long-term objectives for cloud adoption. Short-term goals might focus on improving operational efficiency or reducing on-premises infrastructure costs,

while long-term goals could aim at enhancing research capabilities or expanding access to learning platforms.

6.3.3 Build Comprehensive Strategies

Develop robust strategies to guide the cloud adoption process. This should include phased implementation plans to mitigate risks, prioritising non-critical systems for initial migration, and integrating stakeholder input to ensure alignment with institutional priorities.

6.3.4 Conduct Diligent Research

Before selecting cloud solutions, universities should conduct thorough research on available providers. Important factors to consider include cost, data residency, compliance, and scalability. A detailed analysis of the total cost of ownership, including hidden fees such as data egress and scaling costs, is essential for informed decision-making. (Scholtz & Atukwase, 2020)

6.3.5 Communicate Goals and Vision to Users

Effective communication is crucial for building trust and understanding among stakeholders. Clearly articulate the reasons for cloud adoption, the expected benefits, and how it aligns with the institution's mission. Use webinars, newsletters, and meetings to engage users and gather feedback. (Shahzad *et al.*, 2012)

6.3.6 Select Tools Linked to Institutional Needs

Choose cloud tools that directly address the university's specific requirements. For example, SaaS solutions for administrative tasks or PaaS tools for research and development can streamline processes and provide targeted functionality.

6.3.7 Prepare a Skilled Transformation Team

Ensure that a team of IT staff and stakeholders is well-trained in cloud technologies, including system integration, security protocols, and data migration. Proper preparation minimises disruptions and builds internal expertise to manage the transition effectively. (Zhang, 2021)

6.3.8 Build a Steady Project Plan

Develop a detailed project plan that outlines timelines, milestones, and responsibilities for each phase of the implementation. A steady, incremental approach reduces risks and allows for adjustments based on feedback and unforeseen challenges.

6.3.9 Provide Training and Feedback Opportunities

Empower staff and faculty with targeted training programs to familiarise them with cloud tools and workflows. Establish feedback mechanisms, such as surveys and focus groups, to identify challenges and adapt strategies accordingly. (Shahzad *et al.*, 2012; Zhang, 2021)

6.3.10 Be Open to Process Changes

Rather than forcing cloud solutions to replicate outdated workflows, universities should embrace process changes that leverage the full potential of cloud technologies. This flexibility ensures better integration and increased efficiency.

6.3.11 Monitor Progress and Adapt

Regularly review the progress of cloud adoption against defined goals. Utilise performance metrics and user feedback to refine strategies and address emerging challenges. Continuous monitoring helps ensure that the project remains on track and delivers the expected outcomes.

6.3.12 Implement Frameworks for User Acceptance

Adopt frameworks like the TAM or the UTAUT to address user resistance and build confidence in cloud solutions. These frameworks can assist universities in designing strategies that align with stakeholder expectations and foster engagement. (Islam *et al.*, 2023)

6.3.13 Communicate Often and Clearly

Maintain regular and transparent communication throughout the cloud adoption process. Clear and precise updates keep stakeholders informed and aligned, reducing uncertainty and resistance. (Shahzad *et al.*, 2012)

6.3.14 Define Responsibilities Clearly

Assign specific roles and responsibilities to team members involved in the cloud adoption process. Clear accountability ensures that tasks are completed efficiently and mitigates confusion during implementation.

6.3.15 Start with Non-Essential Systems

Begin the migration with non-critical systems, such as administrative tools or basic collaboration platforms. This approach minimises risks and provides a testing ground for refining processes before scaling up to mission-critical applications.

6.3.16 Ensure Compliance with Regulations

Double-check compliance with regulations such as the POPIA and international data protection standards. Legal experts should review contracts and policies to ensure adherence to data residency and privacy laws. (Staunton *et al.*, 2020)

6.4 PROPOSED FRAMEWORK FOR CLOUD COMPUTING IMPLEMENTATION

The UTAUT is suggested as it offers significant advantages for universities by providing a structured framework to navigate the complexities of adopting cloud technology across diverse user groups. Higher education institutions comprise a variety of stakeholders, including students, faculty, administrative staff, and IT personnel, each with unique needs and expectations. UTAUT focuses on understanding user behaviour and addressing essential factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions, making it particularly suitable for universities. (Aytekin *et al.*, 2022)

One of UTAUT's strengths lies in its flexibility to accommodate varying levels of technical expertise within these institutions. Faculty and staff may require tailored training for cloud technologies, while more tech-savvy students may prioritise usability and accessibility. UTAUT enables institutions to create adoption strategies that take these diverse perspectives into account, ensuring that cloud solutions effectively meet the needs of all users. Additionally, the model allows for the incorporation of moderating factors such as age, experience, and the voluntariness of use, enabling universities to develop targeted interventions that address specific challenges faced by different demographic groups. (Aytekin *et al.*, 2022)

Furthermore, UTAUT promotes a feedback-driven approach to ensure continuous improvement, which is crucial in the dynamic environment of higher education. Universities can collect insights from users to refine cloud solutions, addressing usability concerns and aligning technology with evolving academic and administrative requirements. This iterative process encourages collaboration and enhances user engagement, facilitating a smoother transition to cloud systems. (Aytekin *et al.*, 2022)

Finally, UTAUT aligns well with the long-term strategic goals of universities by emphasising user acceptance and engagement. It serves as a roadmap for overcoming common barriers to cloud adoption, such as resistance to change, unclear benefits, and technical issues, which are often encountered in large-scale implementations. (Aytekin *et al.*, 2022)

6.5 SUGGESTIONS FOR FURTHER RESEARCH

The way universities define their goals for cloud adoption remains an underexplored area. Research could investigate how institutions prioritise objectives such as cost-efficiency, scalability, and enhanced learning environments, as well as whether these goals align with their long-term strategic visions. Furthermore, studies could examine the innovative constructs that universities employ to adapt to rapid technological changes and anticipate future needs.

The process by which universities identify the skills and resources needed for cloud adoption requires further investigation. Specifically, research could explore how institutions assess existing skill gaps, determine training priorities, and allocate resources for both technical and managerial roles. Insights into effective workforce planning—such as recruitment and upskilling of staff—would be valuable for building capacity in cloud technologies.

While strategies for cloud adoption are often documented, there is limited understanding of how universities tailor these strategies to their unique contexts. Future research could analyse specific approaches for addressing resistance, fostering stakeholder engagement, and ensuring compliance with data governance. Additionally, a critical question arises as to why universities frequently bypass theoretical frameworks like UTAUT or TAM, despite their established utility in guiding technology adoption. Studies could explore whether universities find these frameworks overly complex or irrelevant and identify other models that may better suit their needs.

Research on specific cloud service models—such as SaaS, PaaS, and IaaS—within the higher education sector is sparse. Future studies could evaluate the suitability of these models for different institutional needs, such as research-intensive universities versus teaching-focused colleges. Understanding how these models meet specific requirements, like data sovereignty, scalability, and cost management, could inform more targeted adoption strategies.

The fundamental necessities driving cloud adoption in universities, including infrastructure modernisation, administrative efficiency, and enhanced learning tools, warrant further examination. Future research could assess how these priorities differ across institutions and regions, providing a more nuanced understanding of their impact on cloud strategies.

Lastly, while UTAUT and TAM are widely recognised, alternative frameworks may offer unexplored potential for guiding cloud adoption in higher education. Studies could evaluate the relevance of models like the DOI theory or the Technology-Organisation-Environment (TOE) framework in addressing institutional challenges, such as legacy system integration and stakeholder alignment.

6.6 CHAPTER SUMMARY

This chapter presents a framework for successfully adopting cloud technology in higher education, tackling key challenges such as financial barriers, privacy concerns, technical complexities, and organisational resistance. It emphasises the importance of a phased approach, beginning with non-critical systems to mitigate risks, while cultivating a skilled transformation team to manage the transition effectively. Additionally, the chapter underscores the necessity for targeted training programs to enhance staff skills and ensure the smooth integration of cloud technologies.

Key recommendations include cultivating a forward-thinking mindset, establishing clear institutional goals, ensuring compliance with regulations, and maintaining consistent communication with stakeholders. The chapter advocates for leveraging frameworks such as UTAUT to improve user acceptance and engagement while promoting collaboration between institutions to optimize resources and reduce costs. Overall, these strategies aim to create a scalable, efficient, and future-ready cloud infrastructure that meets the evolving needs of higher education.

CHAPTER 7 CONCLUSION

7.1 REASON FOR STUDY

This study aimed to identify the significant challenges faced by a South African university in adopting cloud computing technologies, as highlighted in the problem statement. These challenges prevent institutions from utilising cloud-based solutions to gain a competitive advantage, underscoring the need for a thorough investigation into the benefits, obstacles, and strategies related to cloud adoption. The primary objective of the study was to explore the impact of cloud-based systems on university operations. Additionally, it sought to achieve secondary objectives, including understanding the key drivers and barriers to adoption, evaluating current strategies, and identifying actionable solutions to mitigate risks.

7.2 SUMMARY OF KEY FINDINGS

The key findings of this study emphasise the diverse opportunities and challenges associated with cloud adoption in universities. Cloud computing provides significant advantages, including scalability, cost efficiency, enhanced collaboration, and improved access to advanced technologies such as AI and data analytics. These benefits align well with universities' goals of modernisation and operational efficiency.

However, the findings also highlight ongoing challenges, such as concerns about data privacy, difficulties with technical integration, and resistance to change. Addressing these issues requires strategic planning and strong engagement with stakeholders.

The study also points out a gap in the use of theoretical frameworks to guide the cloud adoption process. This indicates a need for structured approaches to overcome these challenges. By incorporating user-focused strategies, promoting a forward-thinking mindset, and utilising suitable adoption frameworks, universities can unlock the full potential of cloud technologies.

This balance between benefits and challenges provides a roadmap for institutions to effectively navigate digital transformation, ensuring alignment with their academic, administrative, and strategic goals.

CONTRIBUTION TO KNOWLEDGE

This study provides valuable insights into the preparation and strategic guidance needed for universities to successfully adopt cloud computing solutions. It identifies key challenges, including integration with legacy systems, data privacy concerns, and resistance to change, highlighting the importance of thorough preparation and understanding before initiating cloud transitions.

The findings underscore the necessity for universities to formulate clear strategies, which should include robust training programs, stakeholder engagement plans, and comprehensive risk management frameworks. These elements are essential for effectively navigating the complexities of cloud adoption.

Additionally, the study emphasises the importance of knowledge in guiding universities through the adoption process. It offers detailed insights into scalable implementation, compliance with data protection laws, and the alignment of cloud technologies with institutional goals, forming a solid foundation for informed decision-making.

Practical strategies such as phased implementation, resource pooling, and collaboration with cloud providers are presented as key tools for mitigating risks and ensuring successful transformation. Ultimately, this research equips universities with a roadmap to develop the technical, organisational, and cultural readiness necessary for embracing cloud technologies, facilitating smoother transitions and promoting long-term sustainability.

7.3 LIMITATIONS OF THE STUDY

While this study offers valuable insights into cloud computing adoption at South African universities, it is important to acknowledge its limitations. Focusing on a single university significantly narrows the generalisability of the findings, as the unique characteristics and circumstances of that institution may not fully represent the broader landscape of higher education. Additionally, the small sample size of five participants, all from the IT domain, limited the range of perspectives. Including individuals from broader management and administrative roles could have provided a more comprehensive view of the institutional dynamics influencing cloud adoption.

Time constraints and delays in the research approval process further restricted the study's scope and depth. The availability of candidates also posed challenges, affecting the ability to gather a more diverse set of insights. These limitations highlight opportunities for future research to expand the sample size, include a wider range of institutional roles, and explore multiple universities. Such efforts would provide a more thorough and representative analysis of cloud adoption strategies and challenges in South African higher education.

Another limitation of this study is the misalignment between the research objectives and the structure of the interviews conducted to gather data. A more clearly defined interview guide could have led to deeper and more targeted insights, thereby enhancing the robustness of the findings.

7.4 CONCLUDING REMARKS

Cloud computing represents a significant shift in technological advancement, providing universities with the tools they need to transform their operations, enhance educational delivery, and stay competitive in an increasingly digital world. As the future of academic and administrative processes, adopting cloud technology offers unparalleled opportunities for scalability, collaboration, and innovation. However, this transformation comes with challenges. The risks associated with cloud computing—such as financial unpredictability and data privacy concerns—are significant but manageable. With strategic planning, thorough training, and the implementation of customised frameworks, these risks can be effectively reduced, allowing universities to fully leverage the benefits of cloud technologies.

While the operational impacts of cloud adoption, including reliance on external vendors and initial financial investments, must be carefully managed, the long-term advantages far exceed these costs. Cloud computing streamlines administrative processes, facilitates global research collaborations, and supports innovative teaching models, enabling universities to adapt to the evolving demands of higher education. As institutions encounter increasing competition and rapidly changing technological landscapes, adopting cloud solutions becomes essential for future success. By embracing this change, universities can position themselves as leaders in education, research, and innovation, ensuring both resilience and relevance in a digitally driven era.

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ANNEXURES A: RESEARCH CONCENT FORM

Informed Consent Form for Research Participants

Dear Participant,

You are invited to take part in the research on Investigating the impact of cloud-based systems as solutions for business operations at a selected university of South Africa. The focus of the study is to determine the factors that have an impact on the implementation of cloud-based solutions for universities. No detailed IT knowledge is required since the study determines the impact from a business perspective, not a technical one.

This study forms part of a dissertation being submitted for a Master's in Business Administration (MBA) at the North-West University (NWU).

To adhere to ethical standards, your consent is required as a prerequisite for participation. Participation in this study is voluntary and you may withdraw from it. All the data gathered will be kept confidential and will only be used to conduct research to obtain information for the study.

As a participant, we would like your consent to:

- Conduct a semi-structured (open-ended and structured questions) interview with you. This can be done via face-to-face sit down or teams/zoom conference call. The duration of the interview would be approximately 30 min of your time.
- Your responses to the questions will be voice-recorded during the interview along with interviewer notes. These responses will be transcribed and used for data analysis. Extracts from the recording might be included in the final dissertation document. If any sensitive data is revealed during the interview, it will be omitted from the recording to protect your interests and those of your employer.
- Transcripts of your answers will be made and stored. These responses will be used to answer the objectives of the research. These transcripts will be anonymised and will form part of the final dissertation. No personal or sensitive information will be transcribed or documented.

Note that all the data in regard to your interview will be made available to you. If at any time during the interview, you are uncomfortable or unsure, you may request to stop participating. This is

voluntary and you should not feel pressured or coerced to participate. There will be no repercussions for withdrawing participation.

All data containing personal information is protected under the Protection of Personal Information (POPI) Act. It will not be shared or used for research purposes. Only data relevant to the study will be documented.

Thank you for your consent and participation.



Researcher: Hennie van Jaarsveld

Email: hennie.vanjaarsveld@nwu.ac.za

Number: 0834415315



Supervisor: Dr. Kaizer Ndlovu

Email: 35181680@nwu.ac.za

Number: 0184994023

Participant:

ANNEXURES B: RESEARCH INTERVIEW GUIDE

Interview Guide

Introduction

- Start by introducing yourself and the purpose of the interview.
- Reiterate that participation is voluntary, and participants can withdraw at any time.
- Mention that the interview will be recorded for accuracy but assure confidentiality.

Basic participant information

- Position/Role at the university (if they agree to disclose)
- Years of experience in the field (if they agree to disclose)

Question 1 - Understanding Cloud Computing

Can you provide an overview of your understanding of cloud computing and its potential benefits in the context of higher education?

Question 2 - Obstacles to Cloud Computing Adoption

From your perspective, what are the most significant obstacles or challenges that South African universities face in adopting cloud computing solutions?

Probes:

- Can you share specific technical challenges or concerns related to data security or privacy that you've encountered?
- How have financial constraints or budgetary considerations influenced the adoption of cloud-based solutions in universities?
- In your experience, can you discuss any cultural or organisational resistance to cloud computing adoption within universities?

Question 3 - Benefits and Opportunities

What potential benefits or opportunities do you believe cloud computing offers to South African universities, particularly in terms of academic and administrative processes?

Probes:

- Have you observed any universities successfully implementing cloud solutions and reaping notable benefits? If so, could you share examples and describe the outcomes?
- How do you see cloud computing contributing to the competitiveness and innovation of universities in the digital age?

Question 4 - Strategies and Best Practices

In your opinion, what strategies or best practices can help overcome the obstacles identified and accelerate cloud computing adoption in universities?

Probes:

- Can you provide examples of universities or institutions that have effectively addressed these obstacles? What lessons can be learned from their experiences?
- How important is staff training and development in ensuring successful cloud computing adoption, and what steps can universities take in this regard?

Question 5 - Legal, Ethical, and Data Privacy Concerns

Are there any legal or ethical considerations, such as data protection regulations, that universities need to be particularly mindful of when adopting cloud-based solutions?

Probe: How can universities navigate potential legal and ethical challenges related to data management and privacy in the cloud?

Closing

- Ask if the participant has any additional insights or comments they'd like to share.
- Thank the participant for their time and valuable contributions.

ANNEXURES C: APPROVAL LETTER



NWU Business School
North-West University
Private Bag x6001
Potchefstroom, 2520

<https://www.nwu.ac.za/business-school>
<http://commerce.nwu.ac.za/business-school>

Authorization for Participation in MBA Research on Cloud Computing Implementation

To whom it may concern,

I hope this letter finds you well. I am writing to inform you that Hennie van Jaarsveld, a dedicated student enrolled in the Master's in Business Administration (MBA) program, has sought and obtained approval to conduct research on the impact of cloud computing within our Information Technology (IT) department. The research aims to explore the business implications and challenges associated with cloud computing implementations.

Hennie has my full support and authorization to approach employees within the IT department, including yourself, to conduct confidential interviews as part of this research project. Your participation is entirely voluntary, and any information shared will be kept confidential and used solely for academic research purposes.

The insights gained from your experiences and perspectives will be instrumental in contributing to the depth and richness of the research findings. The goal is to generate knowledge that can enhance our current practices and contribute to the optimization of cloud computing resources within our organization.

Hennie will be reaching out to schedule a convenient time for the interview. Your cooperation and openness during the interview process are highly appreciated. If you have any concerns or questions, please feel free to reach out to Hennie directly or contact me.

Thank you for your support and participation in this valuable research endeavor.

Sincerely

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ANNEXURES D: ETHICS CLEARANCE



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Web: <http://www.nwu.ac.za>

Senate Committee for Research Ethics
Tel: 018 299-484
Feziwe.Mseleni@nwu.ac.za

23 February 2024

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **Economic and Management Sciences Research Ethics Committee (EMS-REC)** on, 23/02/2024 the Economic and Management Sciences Research Ethics Committee hereby **approves** your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-REC) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Investigating the impact of cloud-based systems as solutions for business operations at a selected university

Study Leader/Supervisor (Principal Investigator)/Researcher): Dr K Ndlovu

Student: H van Jaarsveld (24138525)

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Institution Study Number Year Status
Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application Type:

Commencement date: 23/02/2024

Risk:

Minimal

Expiry date: 23/02/2025

Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.

Special in process conditions of the research for approval (if applicable):

- None.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the EMS-REC:
 - annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and
 - without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.
- The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the EMS-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.
- Annually a number of studies may be randomly selected for an external audit.
- The date of approval indicates the first date that the study may be started.
In the interest of ethical responsibility, the NWU-SCRE and EMS-REC reserves the right to:

- request access to any information or data at any time during the course or after completion of the study;
- to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;
- withdraw or postpone approval if:
 - any unethical principles or practices of the study are revealed or suspected;
 - it becomes apparent that any relevant information was withheld from the EMS-REC or that information has been false or misrepresented;
 - submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or
 - new institutional rules, national legislation or international conventions deem it necessary.

The EMS-REC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the EMS-REC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,



Prof Diana Viljoen-Bezuidenhout
Chairperson: NWU Economic and Management Sciences Research Ethics Committee

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Investigating the impact of cloud-based systems as solutions for business operations at a selected university of South Africa

Match Overview

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ANNEXURES F: LANGUAGE EDITING CERTIFICATE

This document has been edited by Grammarly Tools to improve sentence structures and wording of discussions. Thereafter, it was send for language editing as indicated by the certificate below.

