

**Investigating perceptions of reliability, efficiency and feasibility of data storage technology: A case study of cloud storage adoption at UCT Faculty of Science**

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**COMPULSORY DECLARATION**

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## DEDICATIONS

Dedicated to my mother, *Margaret Netshiongolwe*, and my grandmother, *Masindi Maliga*.

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## **ABSTRACT**

Within an increasing number of organisations cloud storage is becoming more common as large amounts of data from people and projects are being produced, exchanged and stored (Chang & Wills, 2016: 56). In fact, “technology has evolved and has allowed increasingly large and efficient data storage, which in turn has allowed increasingly sophisticated ways to use it (Staff, 2016: n.p.).

Thus, the aim of this study is to investigate the perceptions of reliability, efficiency and feasibility of data storage technology. The investigation is done by addressing claims and perceptions of data storage technology within the Faculty of Science at UCT. This study intends to determine if cloud storage is the future of storing, managing and preservation of digital data. The study used a qualitative research method grounded by Management Fashion Theory. Data was collected from three case studies from the Faculty of Science, and also from a desktop internet search on the marketing of cloud storage. Data collection from the case studies was facilitated through semi-structured interviews and from three researchers and academics who are working on cloud storage projects. Main themes that guided the dialogue during data collection originated from reviewed literature. The study concludes that cloud storage is the way forward for storing, sharing and managing research data. Academic researchers find storing data on cloud beneficial; however, it comes with challenges such as costs, security, access, privacy, control and ethics.

## Table of Contents

DEDICATIONS.....	ii
ACKNOWLEDGEMENTS .....	iii
ABSTRACT .....	iv
LIST OF TABLES.....	viii
LIST OF FIGURES.....	viii
LIST OF ACRONYMS & ABBREVIATIONS .....	ix
CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY .....	1
1.1 Introduction .....	1
1.2 Background to the study.....	2
1.3 Statement of the research problem .....	5
1.4 Objective of the study.....	7
1.5 Research questions.....	8
1.6 Significance of the study .....	8
1.7 Definitions of relevant terms .....	9
1.7.1 Big Data .....	9
1.7.2 Cloud Storage.....	10
1.7.3 Digital Data .....	10
1.7.4 Technology.....	10
1.7.5 The Internet .....	10
1.8 Overview of the Methodology Used .....	11
1.9 Limitations and Delimitations of the study.....	13
1.9.1 Limitations of the study.....	13
1.9.2 Delimitations of the Study.....	14
1.10 Structure of the dissertation .....	14
1.11 Summary .....	15
CHAPTER 2: LITERATURE REVIEW .....	16
2.1 Introduction .....	16
2.2 Theoretical Framework .....	16
2.3 Emerging Themes.....	19
2.3.1 Overview of Cloud Storage Adoption.....	19

2.3.2 Factors influencing adoption of cloud storage .....	22
2.3.3 Cloud storage challenges and issues .....	23
2.3.4 Reliability of the Cloud .....	26
2.3.5 Cloud Storage Trends in Public Organisations .....	27
2.3.6 The Rise and Challenges of Cloud in Africa.....	29
2.3.7 Ethical Issues Concerning Cloud Storage Technology .....	30
2.4 Related Studies .....	31
2.5 Summary.....	32
CHAPTER 3: THEORETICAL FRAMEWORK AND METHODOLOGY .....	33
3.1 Introduction .....	33
3.2 Research Design and Method .....	37
3.3 Case Study Research.....	38
3.4 Population and Sample .....	38
3.5 Data Collection .....	40
3.5.1 Interview Guide and Design.....	41
3.6 Data Analysis.....	42
3.7 Reliability and Validity .....	43
3.8 Ethical Considerations .....	44
3.9 Summary.....	45
CHAPTER 4: PRESENTATION OF FINDINGS .....	46
4.1 Introduction .....	46
4.2 Data Collection and Validity.....	47
4.3 Presentation of Findings.....	47
4.3.1 Current state of discourse surrounding the innovation.....	48
4.4 Presentation of findings: Actual adoption.....	58
4.4.1 Square Kilometre Array (SKA) and African Research Cloud (ARC) .....	58
4.4.2 Computational and Biology Group (CBIO).....	62
4.5 Cross-case analysis .....	64
4.6 Observations.....	65
4.7 Summary.....	66

CHAPTER FIVE: DISCUSSIONS OF MAIN FINDINGS, CONCLUSIONS AND RECOMMENDATIONS .....	68
5.1 Introduction .....	68
5.2 Discussion of findings .....	68
5.2.1 Claims made for cloud storage .....	69
5.2.2 Perceptions held regarding cloud storage.....	70
5.2.3 Adoption of cloud by SKA, ARC and CBIO projects .....	71
5.3 Researcher’s validation and invalidation of claims made on cloud storage.....	71
5.4 Recommendations emerging from the study .....	72
5.5 Conclusions.....	73
REFERENCES.....	75
APPENDICES.....	83
Appendix A: Research Interview Guide and Questions.....	85
Appendix B: Interview Consent Form.....	86
Appendix C: Invitation Letter .....	87
Appendix D: Department Ethical Clearance Letter .....	88

## LIST OF TABLES

Table 4.1 Table of sources .....	55
Table 4.2 Marketing of cloud word count .....	57
Table 4.3 SKA and ARC interview word count .....	60
Table 4.4 CBIO interview word count .....	62

## LIST OF FIGURES

Figure 2.1 External data storage media .....	19
Figure 3.1 Population strata for semi-structured interviews .....	38
Figure 3.2 Data analysis guide .....	41
Figure 4.1 Forrester (2018) .....	48
Figure 4.2 Gartner (2018) .....	49
Figure 4.3 Google Cloud For Higher Education (2018) .....	49
Figure 4.4 Microsoft Education (2018) .....	49
Figure 4.5 Cloudwards.net (2007-2017) .....	50

## **LIST OF ACRONYMS & ABBREVIATIONS**

API- Application Programming Interface

ARC- African Research Cloud

BGP- Border Gateway Protocol

CBIO- Computational and Biology Group

CIO- Chief Information Officer

HPC- High Performance Computing

IaaS- Infrastructure as a Service

ICTs- Information and Communication Technology

ICTS- [University of Cape Town] Information and Communication Technology Services

IDIA- Inter-University Institute for Data Intensive Astronomy

IP- Internet Protocol

IS – Information Systems

IT – Information Technology

LIS- Library and Information Studies

NWU- North West University

PaaS- Platform as a Service

SaaS- Software as a Service

SKA- Square Kilometre Array

SMEs- Small and Medium Enterprises

UCT- University of Cape Town

UPS- Uninterrupted Power Supply

US- United States

# CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY

## *1.1 Introduction*

Lately, cloud computing has become a popular technology (Rahimli, 2013:141). However, a review of the literature reveals that cloud storage is a technology that users and organisations do not have sufficient information about, but still adopt and use because of factors such as perceived cost and security effectiveness, and reliability (Nicholas, 2013: n.p.). Yu et al. stated that “cloud storage services allow data owners to migrate their data from local storage systems to the cloud, and relieve the burden of storage infrastructure management and maintenance” (2014:307). Moreover, cloud storage offers “scalable, pay-on-demand, location-independent storage service for users” (Yu et al., 2014:307).

The “information generated by users daily is increasing exponentially, resulting in more challenge for information management” (Wang & Lin-Lin, 2016: n.p.). According to Gorton and Gracio, (2013:1) “we have entered the sphere of data intensive computing also known as big data and through the development of new software, algorithms, and hardware, data-intensive applications are able to provide timely and meaningful analytical results.” Large amounts of data from people and projects (experiments, simulations, images and documents) are being produced, exchanged and stored in cloud storage services (Chang & Wills, 2016:56). This research intended to ascertain if cloud storage is the best storage medium for ensuring the optimal preservation of digital data, for efficient long-term storage and archiving of digital data. This was established by looking at the perceptions of and trends in cloud data storage in an academic environment, with regard to the criteria defined by Zhang et al. (2018:2), specifically: the **feasibility, efficiency**, reliability and security of the storage platform.

The researcher chose to focus on perceptions of cloud storage to allow for the emergence of new ideas or reveal unrealistic assumptions that may impact on the management of big data for academic institutions. Through this qualitative analysis,

the researcher was able to answer the research question and explore the data storage efficiency and data access functions of cloud storage platforms as well as the security and reliability of the data stored in these platforms. This dissertation focused on cloud storage adoption at the Faculty of Science at the University of Cape Town (UCT) where high-performance cloud storage and big data processing is taking place.

## ***1.2 Background to the study***

To give context on the background of UCT data storage services, short summary of UCT's data storage strategy and policies follows. UCT is a large institution, and with the amount of research data being generated, researchers often require large amounts of secure storage space to save their information. UCT-Information and Communication Technology Services (ICTS) has set aside dedicated storage space on UCT's centralised storage that departments and research groups can use to store their large datasets. This static storage space is available at a cost per 1TB per month with a minimum period of 12 months (University of Cape Town, 2019). It is important to note that the information saved in these solutions is owned by the university. All data is secure and private, but is not backed up. Each application has its own security measures in place to ensure that the data remains safe. The university provides these terms and conditions to its users and they recommend that users must continue to save their data in a secure location on the UCT network (such as the F: and G: drives) as this information is regularly backed up and can be restored if accidentally deleted. UCT does not back up the information on either Google or Microsoft storage solutions. Should a file be deleted it will be saved in the Deleted items folder for 25 days before being permanently purged (University of Cape Town, 2019).

It is difficult to determine which cloud storage service is suitable for an organisation; if important factors which influence adoption decisions are not considered carefully, the results might be costly. "There is an absence of standardised terminology across cloud service contracts to refer to confidential privacy and security" (Bushey, Demoulin & McLelland, 2015:130), hence the specific issues that need to be addressed in a cloud provider contracts checklist, such as:

- a) data ownership,
- b) availability, retrieval and use
- c) data retention and disposition,
- d) data storage and preservation,
- e) security, confidentiality and privacy, and finally
- f) data location and cross-border data flows (Bushey, Demoulin & McLelland, 2015:130).

While quick and easy to use, external hard drives should not be used as the only backup medium for important university data as they are susceptible to the same risks of fire, damage and theft (University of Cape Town, 2019). This has influenced the researcher to investigate the reliability, efficiency and feasibility of cloud storage, so as to address the perceptions and security challenges of cloud storage and also to validate or invalidate the claims that have been made regarding the cloud storage medium. Addressing perceptions and security challenges of cloud storage will enable service providers and application programmers to implement their service efficiently (Al-Fuqaha et al., 2015: 2362). For instance, security and privacy play a significant role in all markets globally due to the sensitivity of consumers' privacy.

Reliability of cloud storage refers to the proper working of the system based on its specification and aims to increase success rate of the implementation of systems (Al-Fuqaha et al., 2015: 2362). Reliability, efficiency and feasibility of platforms need to be effectively measured both qualitatively and quantitatively as investment in new storage technologies is rational for organisations seeking market competitiveness. Research on Information Technology (IT) artefacts and data storage capabilities is important, in order to seek better understanding of the emerging computing risks, with a view to identifying ways for risk mitigation.

Wang et al. (2010:19) argued that cloud storage has become the next generation architecture of the digital library and Information Technology enterprise, due to its applications and service advantages, such as on-demand self-service, ever-present network, rapid resource elasticity and transference of risk. Cloud storage allows users to access their files in the comfort of their homes and without requiring the installation of any special application other than a web browser (Sosa-Sosa & Ramirez, 2012:35).

According to Sosa-Sosa and Ramirez (2012:35), “services deployment in a cloud storage environment can be implemented in three types: private, public and hybrid cloud.” In private cloud, the infrastructure is operated solely for a single institution and made accessible to members of the institution (Sosa-Sosa & Ramirez, 2012:35). The public cloud is the traditional version of cloud computing, in which the infrastructure is open to the wider public, where costs are a function of the resources used, and these costs include administration (Sosa-Sosa & Ramirez, 2012:36). The hybrid or heterogeneous cloud is a mixture of private and public cloud, where the environment is mainly supported by technologies such as virtualisation and service-oriented architecture (Sosa-Sosa & Ramirez, 2012:37).

Choo (2010:3) argues that “cloud storage offers significant computing capabilities but it also has its own failures and security risks that need to be researched and addressed at this critical stage in its development.” There are risk areas in cloud storage services, particularly those that apply in an online environment, which clients of cloud service providers should be aware of. According to Marinescu (2013:16), some of the dangers and common complaints by cloud storage users are:

- a) What happens when one does not have access to Wi-Fi?
- b) The fear of surrendering one’s rights to privacy of your data;
- c) Fear that these organisations are corrupt and can sell-out one’s details that data could be hacked;
- d) What happens when these organisations [cloud providers] go out of business?
- e) What about the integrity of data?

These are all real issues, and although cloud service providers have standard service agreements, there are potential dangers, and the researcher recognised a gap in knowledge and the need to address these concerns. McKinnon (2015:23) has argued that cloud storage is one of many storage media carrying low security risks. Chang and Wills (2016:57) also maintain that cloud storage is much better at managing larger files compared to non-cloud systems. However, Choo (2010:4) argues in contrast with other scholars that, just like many other virtual storage systems, cloud storage has computing risks in its underlying infrastructure. In light of these remarks by different authors, there is no doubt that cloud storage is convenient and it offers more flexibility and tangible benefit to data owners. This dissertation argues that although cloud

storage appears to be the most fashionable digital storage trend currently, most people do not really understand what cloud storage is: it is much more complicated and it has high computing risks and dangers that need to be addressed. For example, “unauthorised access, data corruption, infrastructure failure and service unavailability are some of the risks related to the control of cloud storage services” (Marinescu, 2013:16). There are gaps in the existing cloud provider service and that is why the researcher made an effort to research this area, as adding to knowledge in this regard is certainly necessary. The value of information services for the individual and for society is an important part of this study; the researcher believes that access to information services can “positively influence skills, attitudes and behaviour of cloud users into becoming increasingly independent in their information seeking even when information seem to be freely available on the web” (Jackson et al, 2007:05). As a Library and Information Studies (LIS) student, the researcher believes in the need for preservation of long term research data, and also in the need for virtual storage infrastructures that digital libraries can access, organise and manage efficiently and economically. This research study places under test, storage of digital data and cloud computing storage, investigating its perceptions of reliability, efficiency and feasibility in the modern data storage technology. The researcher aims to find out if cloud storage system is the best virtual storage medium in ensuring the optimal preservation of digital data, for efficient long-term storage and archiving capabilities of digital data.

### ***1.3 Statement of the research problem***

For some computer owners, finding enough storage space to store large amounts of data is challenge. Users are resorting to a range of solutions to this data storage challenge. According to Wu et al. (2010:381), “most people invest in larger and more expensive storage, whereas others prefer external storage devices like thumb drives and compact discs. Those who are desperate enough might even delete entire folders of old files in their computers in order to create space for the new data” (Wu et al., 2010:381).

The Information Technology revolution has led to the digitisation of different kinds of information, and this has put pressure on organisations to manage large amounts of digital data (Khan et al, 2014:34). According to the MarketsandMarkets Research (2018) the cloud market is expected to pass \$500 billion by 2020 and 72% of businesses had at least one application in the cloud in 2015, which is a 15% increase from 2012. As Wu et al. (2010:381) would argue, there is an essential need for storage infrastructures that digital libraries can access, organise and manage efficiently and economically. Wu et al. (2010:382) also argue that although cloud storage gives significant benefits to its users, there is a lack of awareness of policy along with risks of cloud storage that users are not aware of. It is important that the risks are recognised before choosing to store data in the cloud. In other words, the challenges of preserving and sharing data stored on digital media such as cloud storage are many, compared to the traditional storage for print materials, according to Khan et al. (2014: 34).

This dissertation intends to investigate the claims and perceptions of cloud storage technology, particularly its quality of being reliable, degree of convenience, state of being efficient to its users and its security. There are different kinds of cloud storage services for backup, for example: DropBox, SugarSync, Google Drive, SpiderOak, Apple iCloud. “Some have a specific focus such as storing web e-mail messages or digital pictures, whereas some services include small operations that keep customer data in a single room, while others fill warehouses with storage equipment” (Buyya et al, 2013:7).

Private cloud is a private storage infrastructure that operates for the exclusive use of an organisation (Suciu et al, 2012: n.p.). This particular cloud storage architecture may be managed by the organisation that adopted it or by a third party and it can be on or off-premises (Suciu et al, 2012: n.p.). Private cloud is recognised to be of benefit for small and medium sized enterprises (SMEs) because it is based on a model where the management of the cloud is done within the organisation itself (Suciu et al, 2012: n.p.). Public cloud, on the other hand, is suitable for small and midsized business (SMBs) because these organisations often do not have much capital and risk losing information from theft or security breaches (Suciu et al, 2012: n.p.). Since “user requirements for cloud services differ, service providers such as Amazon, Google, IBM and Microsoft have to ensure flexibility in their service delivery, while keeping the users

isolated from the underlying infrastructure” (Wu et al, 2010:385). The current discourse in the market place focuses on teaching consumers to choose cloud storage in the interest of productivity and competitive advantage without full awareness (Nicholas, 2013: n.p.). Abrahamson’s (1991: n.p.) Management Fashion theory, contributes to our understanding of the forces underlying the rise and fall in popularity of new management techniques through analysing current dominant discourse that influences adoption of these techniques. In other words, these norms and discourses are characterised by fashion waves, as well as pressures such as competition, economic factors and the need for technology change (Abrahamson,1991: n.p.). This dissertation focuses on private and public cloud storage adoption by three identified cloud storage projects in the University of Cape Town (UCT) Faculty of Science. Two representatives from each group were selected, exclusively those with experience of cloud storage at UCT and those who are storing their data in the cloud.

These projects are:

- a) The Square Kilometre Array project
- b) The African Research Cloud project
- c) The Computational and Biology Group (CBIO).

#### ***1.4 Objective of the study***

This dissertation aims to investigate the claims and perceptions made regarding cloud storage. This research is based on a set of derived criteria for evaluating the effectiveness of cloud storage for long-term preservation of data. The researcher focused on cloud storage reliability, feasibility, efficiency and security. Based on the findings of this study, the author validated and invalidated the claims made on cloud storage in the particular context of research data within a university faculty. The research objective is to find out if the cloud storage is the best storage medium for ensuring the optimal preservation of digital data, its efficient long-term storage and archiving capabilities.

The main objective of the study is unpacked into sub-objectives to further clarify what the study intended to achieve. The sub-objectives of the study are:

- a) To investigate the claims made for the cloud storage medium.

- b) To investigate perceptions held regarding cloud storage.
- c) To investigate the adoption of cloud storage at UCT Faculty of Science, how they operate the services and how they overcome and/or address the challenges that come with cloud storage adoption.

### ***1.5 Research questions***

In order to address the study's objective, the following research questions were developed:

- a) What claims are made in the industry for the benefits of cloud storage?
- b) How do researchers' perceptions of the cloud storage at UCT Faculty of Science relate to the claims and actual use of cloud storage?
- c) How is cloud storage at UCT used for research data in the Science Faculty: what kind of research data do they store, where, and from which researchers?

### ***1.6 Significance of the study***

This research intends to point out important elements of cloud storage that users are supposed to know. Furthermore, it considers whether cloud storage is the best storage medium for ensuring the optimal preservation of data. Findings are based on analysis of the current state of discourse surrounding cloud storage innovation, and on the actual adoption of cloud storage by users. In conclusion, the researcher reveals claims made about cloud storage, validates and invalidates them, based on the data collected. The findings of this study could contribute to the existing knowledge by investigating the perceptions and practice of cloud storage adoption in academic institutions, thus reflecting how universities are moving towards digital technologies and expanding into areas of technological innovation. This opportunity will present insight into how data scientists and universities archive their data in Africa, the role and responsibilities of the data librarians and everyday data management processes and procedures. "A number of library organisations from various countries have published reports about the need for academic libraries to get involved with data supports to secure their future relevance to the scholarly record and science" (Rise &

Southhall, 2016:83). Judith Mavodza (2013:132) discussed issues involved in navigating the modern information environment where relevance of cloud computing is unavoidable. Mavodza's study explains the impact of cloud computing on the future of academic library practices and services (2013:132). Her study also indicates a shift in libraries from hardware and software demands of storing and organising data, to information access concerns (Mavodza, 2013:132).

The literature findings reveal that "currently libraries are using the cloud for putting together user resources." For example, "using Software as a Service (SaaS), such as in library catalogues, WorldCat, Googledocs, and the aggregated subject gateways like SUMMON, and others. The web Platform as a Service (PaaS) as in the use of GoogleApp Engine, or Infrastructure as a Service (IaaS) as in the use of D-space, FED, ORA, and others" (Mavodza, 2013:132). In summary, Mavodza's study (2013:132) confirmed cloud as a "facilitator in storing and accessing information in addition to providing a unified web presence with reduced legal storage capacity challenge." Hence, the value of this study will remind librarians of the shift in academic library practices influenced by the impact of cloud computing. This shift in practice is leaning towards new cloud-based services for academic institutions such as multiplatform search tools and open access data on the move. Emerging technological innovations such as laptops and smartphones provide library personnel with storage affordances that are better when compared to traditional storage methods.

### ***1.7 Definitions of relevant terms***

This research involves key concepts around which the study is built. Definitions of these terms follow:

#### ***1.7.1 Big Data***

According to an Oracle Enterprise Architecture White Paper (2016), "big data describes a holistic information management strategy that includes and integrates many new types of data and data management alongside traditional data." Big data also refers to "those structured or unstructured digital datasets that are so colossal (often hundreds of terabytes or more) that they present unusual contemporary

challenges with regard to everything from basic storage to read, write, search, analysis and visualization” (Bevan, 2015: n.p.).

### *1.7.2 Cloud Storage*

Wu et al. (2010:382), describe cloud storage as a development of the new-hosted storage technologies that comprises sophisticated application programming interfaces (APIs), namespaces, file or data location virtualisation, and management tools. Cloud storage offers “a novel service model, in which data is maintained, managed and backed up remotely and accessed by cloud users over the network at any time and from anywhere” (Yu et al., 2014:7789).

### *1.7.3 Digital Data*

Digital data is information that is digitised or born digital, and able to be reused, combined and analysed to show patterns and trends for informing educational decisions. The Black Law Dictionary (2018) defines digital data as discrete and discontinuous binary digits. It is a different type of data than analogue data. When we say data is 'digitised' we mean it is turned into 1s and 0s for storage (BBC, 2018).

### *1.7.4 Technology*

Technology is defined as “the information necessary to achieve a certain production outcome from a particular means of combining or processing selected inputs which include production process, intra-firm organizational structures, management techniques, and means of finance, marketing methods or any of its combination” (Wahab et al., 2012:62). This term is often used in the current digital age as the term ‘technology’ is a “body of knowledge devoted to creating tools, processing actions and extracting of materials” (Karehka, 2013: n.p).

### *1.7.5 The Internet*

The Internet “is a global computer network providing a variety of information and communication facilities, consisting of interconnected networks using standardised communication protocols” (Beal, 2016: n.p.). “It is a collection of separate and distinct networks, each one operating under a common framework consisting of globally

unique Internet Protocol (IP) addressing and using IP routing and global border gateway routing (BGP) protocols” (Marinescu, 2013:204).

### ***1.8 Overview of the Methodology Used***

This dissertation adopts a qualitative methodology in order to explore claims and individuals’ perceptions of cloud storage. This approach is suitable for this kind of research study as the researcher could generate data from the participants by investigating their perceptions, attitudes and opinions when collecting necessary data. This approach was also chosen because this dissertation focuses on a small sample, and the qualitative approach is a better fit for the research needs and questions. The focus is on introducing open-ended questions, to allow opportunity for in-depth responses from interviewees’ experiences, perceptions, opinions, feelings and their knowledge of cloud storage in the UCT Faculty of Science. The qualitative approach in this study is supported by the constructivist paradigm, which suggests that “all knowledge is constructed in and out of interaction between human beings and their world” (Golafshani, 2003: n.p.). Constructivism values multiple realities that people have in their minds, their knowledge, perceptions, experiences, background, and opinions as they engage in social, cultural, and historical context (Golafshani, 2003: n.p.). Thus, in order for the researcher to make sense of the aims and perceptions of cloud storage at the UCT Faculty of Science, she had to engage with deeper understanding rather than examining surface features, and the constructivist paradigm facilitated that aim.

Cloud storage is becoming integral to business transformation; it has reshaped how businesses engage with customers. The researcher believes that knowledge of the cloud is socially constructed, developed and transmitted within various social contexts, in such a way that cloud users have put trust in the service provider as they do not have control over the service. This study attempts to capture the claims and perceptions of cloud storage, particularly its reliability, efficiency and feasibility, in order to gain understanding of cloud storage from the user’s data management behaviours.

This dissertation adopts Management Fashion Theory to inform the research questions, and to interpret participants' perceptions of cloud storage. Theory in this qualitative study is used as a broad explanation for certain attitudes, behaviour and perceptions; hence, it informs how data is collected and analysed (Creswell, 2013:85).

The researcher used inductive reasoning to build from the data, a broad explanation about claims and perception of the cloud storage. Management Fashion Theory was designed by Eric Abrahamson and his colleagues in 1991 to build on the earlier theories of aesthetic fashion, and on other theories such as neo-institution and the production of culture theory (Lee & Collar, 2002: n.p.). Through a number of studies, Eric Abrahamson provided explanations of why technically inefficient innovations diffuse while technically efficient innovations get rejected (Lee & Collar, 2002: n.p.).

According to the theory, "management fashion is largely shaped by particular norms of rationality, for example, sets of behaviours that are believed to be rational by a particular organisation group, and expectations of progress" (Abrahamson, 1991:709).

Cloud storage is claimed to have both financial and security advantages in the 21st century (Wu et al, 2010:382). It is claimed to be cost effective and secure, it is also argued that it is one of the most popular and well-known off-site backup storage services, and for those with sensitive files this storage service may be a worthwhile feature to consider, as argued by Carter (2013:101). However, is this really true? Cloud storage services are expected to meet certain requirements for preserving and archiving users' data, such as high availability, privacy control and data consistency, but is it possible that these services can achieve all that? The researcher believes cloud storage has its own faults as any other storage medium, and this research aims to consider these unspecified attributes because no single system can manage all basic operating and software applications (databases access, privacy control) while simultaneously experiencing no faults. This study shares McKinnon's (2015: 23) view that, "regardless of the optimism about the ongoing technology developments in this information age, there is still a huge gap in applying preservation policies to digital content storage, and this puts a question mark on the future retrieval and preservation of data."

The participants in the study were UCT Faculty of Science researchers and/or academics and staff members. The participants were selected based on their involvement in cloud storage projects in the UCT Faculty of Science. Their participation was voluntary and was not based on any reward. The data collection instrument for the study was interviews (formal) developed by the researcher.

The semi-structured interview questions for the experiment were presented face-to-face and each interview took about 90 minutes. The purpose of this methodology was to obtain as much detailed information as possible in order to uncover research questions laid out in this dissertation.

### ***1.9 Limitations and Delimitations of the study***

Limitations refer to “potential weakness” in a study; as opposed to delimitations, limitations are beyond the researcher’s control (Simon, 2011:2). The most common limitation of case studies is that they provide little basis for scientific generalisation as their aim is to generalise theories (Yin, 2014:4). According to Simon (2012:2) delimitations of the study are characteristics, in the researcher’s control, which delineate the boundaries of the study.

#### ***1.9.1 Limitations of the study***

The researcher was not able to collect as much or as detailed data as intended because of the amount of time available to collect data and the relatively small size of the population. This statistical limitation stemmed from the choice of the study design and as a result it produced a more serious limitation in terms of interpreting the findings. This research does not pursue deep technical knowledge of Information Technology and computer science; the main focus of this dissertation is to examine the perceptions of the cloud virtual storage, concerning its reliability, efficiency and feasibility. This study is concerned with the growth of digital data that is being produced, and the storage of this digital data. Hence, this study is interested in the storage and management of such large volumes of research data, and only at the UCT Faculty of Science. The researcher put effort into keeping the study free of bias by

paying attention to the research language and construction of IT terminology, computing, business and technical knowledge.

### *1.9.2 Delimitations of the Study*

The intention of this study is to focus on private and public cloud storage services and not other types of cloud (hybrid or heterogeneous cloud) because the researcher aims to examine the cloud storage system adopted in the UCT Faculty of Science, where large volumes of research data from different African research projects are stored and made publicly available for researchers all over the world. Delimitations were influenced by the focus of this study and the choice of the sample population, specifically UCT researchers and academic support staff with Information and Communication Technology (ICT) knowledge. This was necessarily a small population, as this type of knowledge is highly specialised. The researcher chose the University of Cape Town (UCT) Faculty of Science as the case study of the research in order to investigate the perceptions, performance, challenges and use of cloud storage within the Science Faculty. The UCT Science Faculty is equipped with a vast range of infrastructure and state of the art equipment linked to ongoing research projects. The faculty gives students and academic researchers the opportunity to explore different areas of research specialisations, with well-developed international researchers across the world (University of Cape Town Website, 2017).

### **1.10 Structure of the dissertation**

This dissertation is divided into five chapters.

Chapter 1 functions as general introduction of the study and outlines the correlation between Chapter 2 and Chapter 3.

Chapter 2 comprises the literature review and provides a theoretical background to the research topic. This chapter consists of organised reviews, theories and empirical studies of related and relevant research by other researchers, indicating how their study fits into this body of research and how it may contribute to it.

Chapter 3 addresses the research question. It gives a comprehensive description of the methodological approach, methods and procedures used to collect data, including ethical considerations and the data analysis process.

Chapter 4 represents the findings of the study based on the analysis of data collected. Finally, Chapter 5 provides the conclusion drawn from Chapters 2, 3 and 4. It contains recommendations and concludes with a summary of the research as a whole.

### **1.11 Summary**

According to Staff, (2016: n.p.), technology has evolved and has allowed increasingly large and efficient data storage, which in turn has allowed increasingly sophisticated ways to use it. Academic institutions are becoming attracted to cloud storage technologies because of the benefits such as costs, security, access, privacy, control and ethics. This chapter covers the fundamental aspects of this report as it provides a background to the study as well as UCT Faculty of Science as the study research site. It articulates the research problem of the evolving trend of cloud storage services and its claimed benefits, such as scalability, reliability and efficiency. The main justification of this study, which is to build upon the existing body of knowledge on cloud storage adoption, may help improve efforts to build privacy protection into technology from the start and the use of better security mechanisms. The research objectives are clearly clarified and case study projects for the study are also set out in this chapter. The following chapter presents a literature review related to the study, also the theory and framework that informs the study.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 *Introduction***

A literature review is “the process of familiarising the researcher with the existing knowledge relevant to the topic in order to sharpen and deepen the theoretical framework of the research” (Bless, Higson-Smith & Sithole, 2013:49). “This also creates an opportunity for the researcher to identify gaps of knowledge in the field of research, thus making way for comparison of new findings with existing knowledge” (Neuman, 2012:73). This chapter is divided into three sections. The first part discusses the theory that informed the study and the second part is made up of themes emerging from literature, the third and final part includes related studies. In order to set some context for the themes, this chapter also discusses factors influencing adoption and innovation of cloud storage.

### **2.2 *Theoretical Framework***

This study was informed by Management Fashion Theory developed by Eric Abrahamson in 1991, aimed at the belief that “as new technological innovations emerge the use of a particular management fashion will eventually decline and the new fashion will emerge” (Abrahamson & Fairchild, 1999:708). According to Baskerville and Myers (2009: 647), management fashion is “a relatively transitory belief that a certain management technique leads rational management progress.” Research in the field of management has suggested that management research and practice is characterised by fashion (Baskerville & Myers, 2009: 647). “At first sight, management fashion appears to be new and innovative”; however, “[t]hese fashions have a relatively short shelf life and disappear almost as quickly as they arrive” (Baskerville & Myers, 2009: 647). Hence, management fashions have been criticised for tending to offer persuasive and unworkable solutions to a complex international business network (Currie, 1999: n.p.).

Abrahamson's (1996:261) theory sees management fashion mostly as a cultural phenomenon, shaped by norms of rationality and progress. These norms of management progress create an expectation of ever-improved techniques for managing organisations and individuals (Baskerville & Myers, 2009: 647). The theory of management fashion builds upon neo-institutional theory and theories of innovation and diffusion. Neo-institutional theory states that "norms of both rationality and management progress influence managers to adopt management techniques perceived as progressive" (Baskerville & Myers, 2009:647). As argued by Abrahamson (1996:263), "there is a management fashion setting community that shapes transitory collective belief among management fashion followers, that certain techniques are rational and at the forefront of management progress."

Management fashions have been criticised for tending to offer superficial and unworkable solutions to a complex international business environment (Baskerville & Myers, 2009: 647). In a study by Bergquist et al. (2013: n.p.), the theory of management fashion is adopted to analyse how a management discourse in social media unfolds and enacts social media as both the next big thing in IT and a disruptive force that calls for management action and corporate strategies. Bergquist et al. (2013: n.p.) argue that social media platforms and services have rapidly grown into an important societal phenomenon, also with increased impact on business. Thanks to this phenomenon, the lack of well-grounded best practice and scarcity of research results in organisational decision-makers having to rely on vendor descriptions and trade press articles to make sense of social media. That is, social media exposes the company to forces outside the organisational boundaries in a way that appears different from previous fashions; hence, it opens up the company for societal change, entailing a much higher complexity than previous fashions (Bergquist et al., 2013: n.p.).

Perkman and Spicer's (2008: n.p.) study found that discourses associated with management fashion move in a recognisable cycle. This means "the life of management fashions typically follows a bell-shaped curve with early adoption followed by widespread uptake and an eventual downturn" (Abrahamson & Fairchild, 1999:708). "We often assume that managers are hard-nosed rationalists who adopt new management ideas to achieve important goals or improve existing practice.

However, managers' decisions to embrace new ideas are often informed by collective beliefs about rational or progressive managerial practice" (Perkmann & Spicer, 2008:812).

Abrahamson's Management Fashion Theory was selected for in this study to describe some of the fashion waves leading to adoption and innovation of cloud storage in academic institutions. As argued by Erkoç and Kert (2015: n.p.), educational institutions are constantly experiencing external pressures to change and adopt the latest innovations for storing and securing their data. In the context of this study, management fashions in academic institutions are largely influenced by a cultural phenomenon, shaped by norms, organisational pressure and competition, so cloud storage platforms are adopted to solve digital storage challenges and this adoption shows a definite trend (Khan et al., 2014: 34). The theory selected is also used in the discussion as a tool to analyse various factors that influence the adoption and use of cloud storage.

In business and academic contexts "we often assume that managers are rationalists who adopt new management ideas to achieve important goals or improve existing practice, however, managers' decisions to embrace new ideas are often informed by collective beliefs about rational or managerial practice" (Perkmann & Spicer, 2008:811). Abrahamson's theory (1996) indicates that management fashions are influenced by external pressures for organisational change, such as competition, economic factors and new technology. This means the life of management fashions is not simply spontaneous, but is shaped by norms of rationality and progress.

Cloud storage is a fashionable trend that is replacing software applications that were traditionally installed on computers located within university campuses. These traditionally-installed software applications are now replaced with applications delivered via the internet, while reducing universities' IT complexity and costs, as argued by Erkoç and Kert, (2015: n.p.). It therefore seems as if, as the networked society continues to develop, the need for industrialised cloud infrastructure continues to increase. Perhaps cloud storage is not a way forward but a passing technological phase that will eventually fade out of fashion.

## **2.3 Emerging Themes**

There are several factors that emerge from the literature leading to cloud storage adoption and innovation by academic and business institutions. The list of factors discussed in this chapter is by no means exhaustive, but it provides a general overview of cloud storage adoption and the reason why it is replacing the traditional ways of managing and storing data. To provide some context to the themes outlined below, an overview of cloud storage adoption and innovation is included.

### *2.3.1 Overview of Cloud Storage Adoption*

It is undeniable that “one of the most dynamic aspects of information technology today is cloud storage” (Goldsborough, 2015:59). “Cloud-based services are increasingly becoming a key part of how organisations worldwide conduct business activities” (Bushey, Demoulin & McLelland, 2015:128). “The ease with which large amounts of information can be affordably stored and accessed from anywhere with an internet connection has made these services an attractive option for organisations of various types” (Bushey, Demoulin & McLelland, 2015:128). Also, as a result of its low cost, “organisations are increasingly moving their records into cloud storage and delegating to cloud storage providers the responsibility for their security, accessibility, disposition, and preservation” (Borglund, 2015:115). According to Erkoç and Kert (2015: n.p.), the rise of modern storage technologies has resulted in rapid changes in higher education institutions. As with this change, storage technology such as the cloud provides educators and researchers with new and different ways to collect, store and produce data, while reducing the traditional ways of managing and storing data. Cloud storage is replacing software traditionally installed on campus computers with new applications delivered through the internet, with the aim of reducing university IT complexities and costs (Erkoç & Kert, 2015: n.p.). For example: client/server applications are being replaced with web-based software. The UCT ICT team is responsible for “customercentric services, which are tailor-made for university-wide end user profiles and needs. These services present desktop, mobility and collaborative technologies and processes in a manner which may be used on demand and in self-service manner” (University of Cape Town, 2018).

Cloud storage is a development of new hosted storage technologies, and it comprises sophisticated application program interfaces (APIs), data virtualisation and system management tools (Wu et al., 2010:381); it enables “opportunities for enhanced collaboration, integration, and analysis on a shared common platform, and it is convenient and offers more flexibility” (Goldsborough, 2015:59) than traditional software, such as in the case of client/server applications where one might need to buy

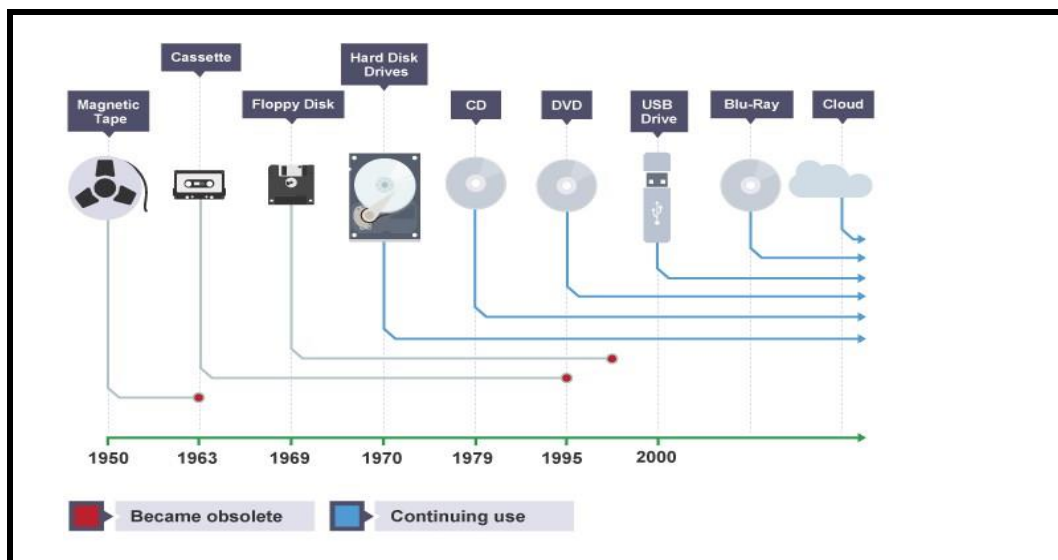
- a) application software licences
- b) servers on which to install and run the applications and
- c) third-party software such as an operating system and a database server to store the data (Neosoft, n.d.).

Cloud storage has transformed our understanding of producing, storing, accessing, and sharing information (Wu et al., 2010:381), by hosting and delivering services over the internet. Although cloud storage has many advantages, “it also carries risks that are largely unrecognised and not well understood, which often result in consumers using services that do not meet the best practices and legislation governing the management and storage of information and business records” (Bushey, Demoulin & McLelland, 2015:129). All this raises a question of entrusting cloud storage providers with an organisation’s data.

According to Stancic, Rajh and Brzica, (2015:214), the idea of an archival cloud service is very appealing due to the fact that creators of records are usually nonarchival institutions that may lack infrastructure, technical capabilities and staff knowledge adequate for long-term preservation of data. Yet, very little research has been undertaken to assess the impact of cloud storage from an archival science perspective (Borglund, 2015:115). According to Bushey, Demoulin and McLelland (2015:130), there are gaps in the existing cloud provider contracts, such as: the availability of metadata assigned to data, the ability to audit data, uncertainty about where the data is stored, difficulties in destroying and migrating data, and lastly, difficulties in establishing the authenticity of the data stored within these services. These are only a few of the problems encountered by organisations using the cloud, yet the number of those who choose to use the cloud for storage purposes is growing exponentially by the day (Borglund, 2015:116). Looking at the image of external backup storage media

provided in Figure 2.1, we see that magnetic tape, cassette and floppy disks were the predominant storage media for digital data between 1950 and 1970, but many computers no longer support these types of devices. In recent times, the most popular new storage technology is cloud (Rahimli, 2013:141).

Figure 2.1 External data storage media



Sourced from BBC, 2017

According to Borglund (2015:120), it is almost impossible to talk about online storage resources without mentioning the cloud, which implicitly also makes cloud storage a topic of interest in most organisations. As a result, MarketsandMarkets Research (2018) revealed that “the cloud storage market is expected to grow from USD 30.70 billion in 2017 to USD 88.91 billion by 2022, at a Compound Annual Growth Rate (CAGR) of 23.7% during the forecast period (2017–2022).” These statistics clearly indicate that cloud markets have grown in recent years, just as the growth of data volumes of all types. Rahimli (2013:141) argues that some of the factors that influence organisations to adopt cloud storage include cost effectiveness, security effectiveness and reliability. Moreover, scholars such as Stancic, Rajh and Brzica, (2015:214) have outlined that the increasing momentum of cloud storage might downgrade over time because of significant risks it carries such as security, privacy, integrity, authenticity, accessibility and digital continuity of data and records in the cloud.

### *2.3.2 Factors influencing adoption of cloud storage*

It is assumed that “adopters make independent rational choices guided by goals of technical efficiency and never decide to adopt an inefficient administrative technology or to reject an efficient one” (Abrahamson, 1991). Adoption decisions have many social influences inside and outside organisations, “while for some innovations such as cloud storage to be considered for adoption, they must offer advantages to users and be efficient with current technology” (Rahimli, 2013:143). Cloud storage has several advantages over traditional data storage (Erkoç & Kert, 2015: n.p.). For instance, “when data is available in cloud storage, it is more easily accessed in all places and at much lower cost” (Wu et al., 2010: n.p.). Moreover, when faced with the ability to do a job quicker, easily, and with lower cost and faster, one can find cloud adoption attractive (Rahimli, 2013:143). Some of the factors that influence cloud storage adoption from management decision making are outlined below:

#### *a) Ease of management*

Wu et al. (2010:383) argue that one of many advantages of cloud storage is that, instead of storing data to a personal computer’s hard drive or any other local storage device, the user may store their data on cloud remote database which is convenient and flexible. In an academic institution context, the benefits of cloud storage include: accessing file storage, e-mails, educational resources, databases and research publications (for faculty, administrators, staff and students) (Erkoç & Kert, 2015: n.p.).

Hence, the researcher shares the sentiments of Sookhak et al. that “cloud storage satisfies the educational needs of researchers” (2015:2). Not only does cloud satisfy educational needs, it can also provide opportunities for university academics and researchers to use applications in their own time and own space, without worrying about implementation and maintenance of hardware (Sookhak et al., 2015:2). Overall, “the efficiency of cloud storage enables educational institutions to teach students in new different ways and help them manage research projects efficiently” (Erkoç & Kert, 2015: n.p.).

### *b) Simplified planning and online data backup*

“Cloud storage is a service that enables individuals and enterprises to outsource the storage of data backups to remote cloud providers at a low cost” (Rahumed, 2011:160). “The online backup model assists individuals and enterprises to remotely archive their data and avoid any information loss in case there are any hardware or software failure or unforeseen disasters” (Rahumed, 2011:160). “Instead of pursuing the needed storage media to keep data backup, cloud users can simply outsource their data backup services to the cloud service providers, which provide the necessary storage resource to host data backups” (Rahumed, 2011:160). One of the many attractive functionalities of cloud storage is the ability to gather, store and exchange data much more easily and at a lower cost (McKinnon, 2015:19), and this results in institutions becoming attracted to cloud storage technologies because of the benefits they offer.

### *c) Cost effectiveness*

Authors such McKinnon (2015:24) have claimed that “cloud storage has both financial and security advantages.” Many organisations and users are moving from traditional data storage, outsourcing their data to the cloud in order to avoid storage maintenance costs and management complexities (Erkoç & Kert, 2015: n.p.). Large and mediumsized institutions such as Monash University (2018) argue that cloud storage can be cheaper to rent. For instance, a user may choose to rent server space for a few hours at a time, rather than maintaining proprietary servers. Moreover, it is important to understand that opportunities and benefits of cloud storage realised by an institution depend on many unique factors and may vary significantly with the needs of the user or institutions (Monash University, 2018). Cloud storage “offers significant computing capability and economy of scale that might not be affordable to businesses, especially small and medium enterprises (SMEs) who may not have the financial and human resources to invest in IT infrastructure” (Choo, 2010:3).

### *2.3.3 Cloud storage challenges and issues*

Although cloud storage is attractive, it also has its own challenges, just like any other data storage medium. Cloud storage carries issues related to security guarantees for

outsourced data, general problems related to the management of data and the fact that the storage location of data is unknown (Bushey, Demoulin & McLelland, 2015:128). In his study, Choo (2010:4) stresses the lack of privacy protection in the digital landscape compared with traditional storage. Data stored in the cloud may contain highly sensitive information. Once private information gets misused, the probability of privacy breaches increases, thereby reducing users' trust in the cloud providers (Dhsarathan, Thirumal & Ponnurangam, 2016:7). The question then remains whether cloud storage is reliable, efficient and feasible for the archival and preservation of data, considering the privacy risks of data, security issues, and technical matters that may affect users. Three cloud storage issues and challenges that inform this study are presented below:

*a) Data Outsourcing Risk*

There are gaps in the existing cloud provider contracts, such as the availability of metadata assigned to data, the ability to audit data, uncertainty about where the data are stored, difficulties in destroying and migrating data, and difficulties in establishing the authenticity of the data stored within these services (Bushey, Demoulin & McLelland, 2015:128). Wang et al. (2010:19) assert that "the biggest challenge with cloud storage is that while data outsourcing relieves data owners of the burden of local storage and maintenance, clients lose their physical control of storage dependability and security." As stated by Shahzad (2014:358) "there is a degree of location independence in that the customer has no control or knowledge over the exact location of the provided resources." Cloud storage makes its "advantages more appealing than ever, and it also brings new and challenging security threats towards users' outsourced data" (Srinivas, 2011:2691). "Data outsourcing is actually surrendering users' ultimate control over the fate of their data and as a result, the correctness of the data in the cloud is being put at risk" (Srinivas, 2011:2691). Challenges of preserving and sharing data stored on virtual media (such as cloud storage) are very important and risky, hence Srinivas' (2011:2963) proposal for a privacy-preserving public auditing system in the cloud, "which not only eliminates the burden of cloud users from the tedious and possibly expensive auditing task, but also alleviates the users fear of their outsourced data security."

### *b) Bandwidth and Internet Access*

“When storing data in the cloud, the cloud user sees a virtual server that appears as if the data is stored in a particular place with a specific name”; however, that place doesn’t [sic.] truly exist in reality (Wu et al., 2010:382). “Cloud storage provides omnipresence and facilitates deployment of file-storage services” (Wu et al., 2010:382), and at the most basic level cloud storage works when the data server is connected to the internet. In this fashion, “it sends copies of files over the internet to the data server which then records the information” (Zwick & Dholakia, 1999:2). This means that when the user wishes to retrieve information from cloud storage, he/she will need to access the data server through a web interface.

“A major risk to business continuity in the cloud storage environment is loss of internet connectivity as businesses are dependent on the internet to access their corporate information” (Choo, 2010:3). The internet plays a fundamental role in cloud storage; “it represents the medium of the platform through which many cloud services are delivered and made accessible” (Sosa-Sosa et al., 2012:41). This means that if a cloud-based storage backup is used as primary storage by a cloud user or client, then high-bandwidth access becomes essential wherever they go. This is another gap that is investigated in this study. The researcher was interested in discovering what happens if and when cloud users do not have access to high-speed connections: How do they access their data? How does internet access affect them and how do they overcome the challenge?

### *c) Security and Privacy*

Security and privacy challenges bring the burden of local data storage and maintenance (Srinivas, 2011:2691). “Security is one of the most important frames for a cloud provider as it will utilise data storage and transmission encryption, user authentication, and authorisation” (Dhsarathan, Thirumal & Ponnurangam, 2016:1). Many security concerns about cloud storage are associated with “virtualisation, control and data associated data integrity and shuffling of data; with data integrity concerns at remote places” (Rahimli, 2013:144). A definition by Rouse (2018: n.p.) explains “data virtualisation as a method of data integration or data management that allows an application to retrieve and manipulate data without requiring technical details about

the data, such as how it is formatted or where it is physically located.” Data integrity, on the other hand, refers to “the accuracy and consistency of stored data, indicated by an absence of any alteration in data between two updates of a data record” (Business Dictionary, 2018). For success as a cloud-computing provider, it is mandatory that the provider have effective security protection for users’ files and data (Rahimli, 2013:144). Cloud storage is one new technology that users and organisations do not have enough information about (Rahimli, 2013:144), and often customers may not be aware of the detailed security incidents, vulnerabilities, risks and agreements they are getting themselves into with cloud service providers (Choo, 2010:3). In the area of security, innovative methods are required, to ensure that the correct security and privacy system is in place for the protection of users (Rahimli, 2013:144). It is also important for users to acquire enough knowledge regarding cloud storage before selecting the storage repository in order to avoid unwanted outcomes in their data storage.

#### *2.3.4 Reliability of the Cloud*

Reliability is the quality of being dependable or reliable. Reliability is very important to cloud storage success (Rahimli, 2013:144), and cloud users should be able to trust the cloud storage without worrying about the need to verify its integrity (Wang et al., 2013). Reliable access to data is a prerequisite for most data storage and applications (Sivathanu, Wright & Zadok, 2005:26). “The current move towards open data, reuse of public sector information and virtual storage increases the importance of understanding how trustworthy and reliable data can be ensured, specifically every time data move in a new-networked environment” (Borglund, 2015:118). According to Sivathanu, Wright and Zadok (2005:26) there are several factors that cause unexpected or unauthorised modification to stored data. Firstly, data can be corrupted due to hardware or software malfunctions. Secondly, disk errors are common today and storage software that exists is typically not designed to handle a large class of these errors. Thirdly, a minor integrity violation when not detected by the software on time could cause further loss of data.

For example: “a file system inconsistency can cause data corruption and files might become inaccessible due to inconsistency between the meta-data and data caused by

a system crash” (Sivathanu, Wright & Zadok, 2005:26). Therefore, prompt detection of integrity violations is vital for the reliability and safety of the stored data (Sivathanu, Wright & Zadok, 2005:26). The problem with making digital records trustworthy is that in cloud services an external partner manages the records; hence the challenge of guaranteeing that the record fulfils the quality criteria of authenticity, integrity, completeness and usability (Borglund, 2015:119). As suggested by Borglund (2015:124), IT departments must set up a new cloud audit service to guarantee that organisational information assets in cloud storage are kept according to organisational requirements. This can be attractive to users and organisations that depend on cloud storage and to guarantee that data is reliable and authentic, and according to preservation standards.

### *2.3.5 Cloud Storage Trends in Public Organisations*

Societal changes and technological innovations do not stop, and the modern online culture and the adoption of available technologies have invaded public institutions (Borglund, 2015:119). Cloud storage has emerged as a new paradigm for storing, hosting and delivering services over the internet (Erkoç & Kert, 2015: n.p.). This technological trend “is attractive to business owners as it eliminates the requirement for users to plan ahead for provisioning, and allows enterprises to start from the small and increase resources only when there is a rise in service demand” (Zhang et al, 2010:7). Cloud storage makes it easy for users to organise, manage, describe, identify and retrieve data efficiently (Erkoç & Kert, 2015: n.p.).

There is a trend in public organisations to be more service oriented, and trends such as cloud storage make public organisations more eager to test and use cloud-based services (Borglund, 2015:119). According to Borglund, (2015:119) many citizens are used to accessing services they use themselves, such as DropBox, iCloud and Google Drive, from any device, and this is another reason why public authorities are going for cloud solutions. Citizens request easy access and this motivates cloud usage, which makes it easier to access and to reach data, information, or records that are stored in such services (Borglund, 2015:119). Staff within public organisations also use cloud solutions privately and this use creates an organisational-bounded desire for such services (Borglund, 2015:119).

In a study by Matthew Goldner (2010) he discussed how cloud computing solutions could be beneficial to libraries in three basic areas of technology, data and community. According to Goldner (2010:272) “the library community can apply the concept of cloud computing to amplify the power of cooperation and to build a significant, unified presence in the web.” The following are three basic areas of cloud that could be beneficial to libraries: technology, data and community.

*a. Technology improvements*

According to Goldner (2010:273) “cloud computing solutions are built on current technology and should be architected to allow technology shifts.” This means that librarians need to anticipate a shift in core library services due to emerging technological solutions introduced by cloud environment such as “the possibility of open service-oriented architecture.” Goldner argues that “many cloud solutions offer this type of openness with published application program interfaces (APIs) (2010:273). This means if a new service or technology emerges, libraries will not always be dependent on a vendor or other third party to start taking advantage of these services and technologies” (Goldner, 2010:273).

*b. Data efficiencies*

When data is stored in the cloud it offers several advantages. Firstly, common data can now be easily shared among services and users. Secondly, the need for local storage, maintenance and back-ups is removed. Thirdly, Agreements can be forged to share data that normally would be considered private to a single business or organisation and finally, libraries can achieve web scale when they massively aggregate data and users, something a cloud environment makes possible (Goldner, 2010:273).

*c. Community power*

In summary, Goldner argues that libraries have a unique opportunity with cloud computing, and that is to create an online information community network (2010:275). He further mentions in his study that such a community is divided into two communities: first, the internal community of libraries collaborating within a single institution and across institutions, and second, the external community of libraries and

information seekers (Goldner, 2010:273). Therefore, cloud provides “the cooperative effects of libraries, which create scale savings and efficiencies, bring wider recognition for libraries, and provide the platform of which libraries can innovate” (Goldner, 2010:273).

As a result, according to the literature, libraries have the opportunity to improve their services and relevance in today’s information society (Goldner, 2010:273). The findings indicate that “cloud computing is one avenue for this move into the future as it brings several benefits for libraries and give them a different future” (Goldner, 2010:273). Hence, it has become necessary for librarians who make use of commercial cloud services to be conversant with the implications on institutional data, in order to avoid the dangers and risks involving cyber-security (Mavodza, 2013:144). It is also important for institutions to keep policies, procedures, fiscal, and personnel data in private clouds that have carefully crafted access permissions (Mavodza, 2013:144). “Being aware of these implications enables thoughtful, adoptive planning strategies for the future library practice and service” (Mavodza, 2013:144).

### *2.3.6 The Rise and Challenges of Cloud in Africa*

According to Speckman (2014: n.p.), the use of cloud storage technology by business institutions and individuals in South Africa is increasing. This storage technology has also been increasingly adopted by major organisations in the United States and the United Kingdom (MarketsandMarkets Research, 2018). The cloud market is expected to pass USD500 billion by 2020 and 72% of business had at least one application in the cloud in 2015: a 15% increase from 2012 (MarketsandMarkets Research, 2018), yet, in most African countries cloud storage technology is still emerging (Speckman, 2014: n.p.).

Mujingam and Chipangura (2011: n.p.) argued in their study ‘Cloud storage concerns in developing economies’ that cloud storage technology can present a massive opportunity for Africa and for organisations that adopt cloud storage. For instance, cloud storage can reduce the infrastructure investment and offer more convenience and accessibility at a lower cost. This means that when small and medium-sized companies adopt cloud storage, Africans can enjoy the cost benefits offered by the cloud storage (Speckman, 2014: n.p.).

According to Noury (2011: n.p.), cloud storage has the potential to benefit Africa; however, due to lack of infrastructure resources and financial support, cloud storage adoption remains the biggest challenge in African universities. A large proportion of the continent is still not connected to cloud storage because of the capital expenditure that cloud storage requires and lack of infrastructure to support its use (Noury, 2011: n.p.). Furthermore, it seems that the possibilities that cloud storage offers are out of reach to many ordinary Africans (Noury, 2011: n.p.). Based on the literature, three main challenges that may affect cloud storage adoption in government institutions in Africa are:

*a. Lack of Infrastructure*

Most rural communities in Africa lack basic infrastructure such as roads, telecommunications and electricity. On top of that, not every researcher or student owns a personal computer at African universities; often many rely on institution-owned devices or internet cafés to access electronic information. Mujingam and Chipangura (2011:n.p.) argue that this lack of infrastructure does not help in combating the digital divide in Africa: the absence of such infrastructure results in unavailability of internet connectivity and the escalating cost of devices for internet access also poses limitations because of limited funding (Mujingam & Chipangura, 2011:n.p.).

*b. Lack of Resources*

According to Mujingam and Chipangura (2011:n.p.) many government institutions in Africa experience the challenge to invest in cloud storage infrastructure particularly because of lack of financial support. Although scholars such as Sosa-Sosa et al. (2012:40) argue that cloud storage model is cost effective, numerous academic institutions in Africa experience financial crises and cannot afford to invest in data storage infrastructure of any significant size, whether cloud-based or local. Therefore, one may suggest that cloud storage expansion should focus on price reductions, as well as providing affordable bandwidth for government institutions.

### *2.3.7 Ethical Issues Concerning Cloud Storage Technology*

There are many security concerns raised in the literature concerning cloud storage. The following ethical issues are an important factor in the storage life of digital data

and therefore need to be addressed. Firstly, reliability of cloud storage technology: to many cloud storage users, “cloud storage is in actual fact neither secure nor reliable” (Erkoç & Kert, 2015: n.p.), and this adds new challenges to the confidentiality, integrity and availability of data stored in the cloud storage medium. Therefore, it is important to have the cloud server provide evidence or report that the data in the storage is safe and it is not being tampered with (Erkoç & Kert, 2015: n.p.). Secondly, multiple services running across the network: “There are issues relating to replication of data and lack of transparency in cloud services that impact record keeping and archiving” (Stancic, Rajh & Brzica, 2015:214). It is important that digital records that are stored on cloud solutions be made safe in terms of long-term preservation with relevant standards compliance (Stancic, Rajh & Brzica, 2015:214). There are four important aspects that should be considered when the user decides to store data in the cloud, specifically: holding portability, digital continuity, environment sustainability and warranty of compliance with corresponding legal context. Overall, these ethical concerns need to be addressed, for the benefit of the users and the security of the data that is stored in the cloud.

## **2.4 Related Studies**

Although cloud storage is not entirely a new concept, “it has become ubiquitous due to the proliferation of internet, broadband, mobile devices, better bandwidth and mobility requirements for end-users; be it consumers, small and medium businesses (SMEs) or entrepreneurs” (Gupta, Seetharaman & Raj, 2013:861). A study by McKinnon, (2015:19) revealed that data backup, data archiving, portability, continuity and sustainability are some of the preconditions for long term preservation of data in the cloud. The study also revealed that cloud storage makes it possible to gather, store and exchange data much more easily and freely (McKinnon, 2015:19).

Erkoç and Kert’s (2015: n.p.) paper argues that research and educational needs of universities have changed with the development of cloud storage technology. According to them, universities have started using storage technology infrastructures for research application and data archiving. The storage infrastructure makes it easy for universities to organise, manage, describe, identify and retrieve data efficiently

(Erkoç & Kert, 2015: n.p.). Choo's study revealed that "cloud storage adoption provides a scalable online environment which facilitates the ability to handle an increased volume of work without impacting on the performance of the system" (2010: n.p.). For instance, Figshare at Monash University is a repository in which researchers can store, share and manage their research outputs, and it hosts large amounts of data online with no impact on the storage infrastructure (Monash University, 2016). Lakshminarayanan, Kumar and Raju's (2013: n.p.) revealed that functionality available through cloud storage services is sufficient for the needs of most users, and the replication techniques of storing digital data benefit educational institutions by freeing IT staff from maintenance, updates, and all but minimal software support. Gupta, Seetharaman and Raj (2013:861) focus on the perceived inclination of small and medium businesses (SMEs) toward cloud computing and the benefits reaped by them. Their study presents five factors such as: (i) ease of use and convenience, (ii) security and privacy, (iii) cost reduction, (iv) reliability (v) sharing and collaboration influencing the cloud adoption and usage by this business community, whose needs and business requirements are very different from those of large enterprises. The results revealed that the first factor, which is ease of use and convenience, is the biggest favourable factor, followed by security and privacy and then third factor cost reduction. The fourth factor is reliability and they identified that reliability is ignored as SMEs do not consider cloud to be reliable. Lastly, SMEs do not want to use cloud storage for sharing and collaboration and prefer their old conventional methods for sharing and collaboration with their stakeholders (Gupta, Seetharaman & Raj, 2013:861).

## **2.5 Summary**

This chapter outlined the theoretical framework that the study employs and also explored some of the prominent themes relating to innovation and adoption of cloud storage as well as related studies. It reviewed literature on factors influencing cloud storage, and challenges and ethical issues concerning cloud storage were outlined. It also addressed the rise and challenges of cloud storage in Africa and the reliability of cloud storage. The following chapter looks at the research design and methods employed by this study.

## CHAPTER 3: THEORETICAL FRAMEWORK AND METHODOLOGY

### *3.1 Introduction*

To assist the researcher in drawing findings into a coherent structure as well as summarising accumulated knowledge of this study, this chapter discusses the theoretical framework to support the theory of the research study and the methodology that was applied. Theoretical framework is described by Swanson (2013: n.p.) as the structure that supports a theory of the research study. The theoretical framework introduces and describes the theory by informing the reader why the research problem under study exists. This study adopts Management Fashion Theory as proposed and described by Eric Abrahamson (1991: n.p.). Management Fashion Theory is an Information Systems (IS) theory that can be described by alternative names such as “management fads and fashions” and deals with adoption of management innovations. In Abrahamson’s (1991: n.p.) description, “Management Fashion Theory’s main dependent factor is the level of adoption of management innovations, and the status of fashion setters’ sources of discourse (i.e. mass media, business press/trade magazines, academic journals), as well as external pressures for organisational change (i.e. competition, economic factors, new technology).” That is to say, this theory discusses management fashions with the belief that certain management techniques are at the forefront of management progress.

This study’s framework discusses the influence of technology in higher education institutions. The researcher believes Information Technology (IT) has made users very trusting of new storage technologies such as Microsoft, Apple, Yahoo, and Google. In fact, it may be asserted that higher education institutions are on the brink of a revolution. Technology has affected how many institutions run, making them move towards a different kind of economy, and modified traditional ways of doing things as ‘business as usual’. As argued by Hooker (1997: n.p.) we are in the midst of changing from an energy-based to a knowledge-based economy which will alter the rules of international economic competition, thrusting universities into roles they have not traditionally played. As a result, users have become accustomed to thinking and talking

about the technological changes with regards to the future of education. According to Hooker (1997: n.p.), two of the greatest challenges our institutions face are those of harnessing the power of digital technology and responding to the information revolution. For this reason, the opportunities and challenges technology presents are far greater than at any previous time in higher education's 750-year history. Looking at institutions that offer cloud storage services for instance, one may argue that these cloud services products (Microsoft Cloud Services, IBM cloud, SaaS, PaaS and IaaS) are great examples of fashion trendsetter sources. These institutions do not force clients to use their storage applications; however, cloud storage is marketed as the most attractive option for digital data. Abrahamson sees management fashions as shaped by norms of rationality and progress, and these norms of management progress create an expectation of ever-improved techniques for managing organisations and individuals (Abrahamson & Fairchild, 1999: n.p.). The reality of this is, cutting edge technology is very complex, and educational institutions are constantly experiencing external pressures to change and to adopt the latest innovations for storing and securing data. Hence, applications and platforms that generate and hold data continue to change. Chang and Wills (2016:56), argue that “new and modern storage technologies are needed to deal with the increasing demand of digital data, from data processing, data management and big data analytics.” Therefore, because of these constant technology innovations, one may predict that eventually cloud storage might also fall behind, for another leading management fashion to take its place.

In Management Fashion Theory, the practice of social constructivism is evident, supported by an interpretive approach where management fashion setters transmit their views and beliefs to a social context with the aim of promoting their discourse and practices. Social constructivism is shaped by how people think, feel and act. Boghossian (2001, n.p.), says that “to say something is socially constructed is to emphasise its dependence on the contingent aspects of our social selves.” Social constructivism could not have existed had people not built it; it is the knowledge constructed through interaction with others in social settings. This theory assists the researcher in understanding the construction of cloud storage knowledge, cloud

storage perceptions and to interpret this knowledge from various perspectives of participants.

In this chapter the researcher explains a theoretical lens through which perceptions of cloud storage were approached, the strategies used to collect and analyse data and the understandings of what constitutes important data in answering the research questions. There are many information systems (IS) theories, and Management Fashion Theory was chosen because it supports this research study, with cloud unequivocally constituting a leading trend in IT management, as has been shown in Chapters 1 and 2. This theory allows the researcher to understand the evolution of IT innovations and fashion, as well as providing insights into the nature of information system research and practice (Baskerville & Myers, 2009:660)

Management Fashion Theory has made a significant contribution to the business community. Lee and Collar (2002: n.p.) argue that “this theory influences decisions and strategies in the business community and leads to better understanding of management discourse and how such discourse patterns are motivated.” One can add that Management Fashion Theory explains the production and consumption of temporary information technology trends that replace the old technology fashions over time. Management fashions are largely shaped by norms of rationality, that is to say socially constructed beliefs and behaviours that organisations and stakeholders believe are “rational”. This provides further clarity as to why institutions adopt the current trend of computing ostensibly to improve their management process and to compete in the market as new technological innovations become available. Accordingly, IT trends (cloud, World Wide Web and mobile computing) have managed to shape and influence our organisational behaviours and expectations.

Nevertheless, although these technology fashions rise, fall and influence the decision making of many business organisations, we have become dependent on them to an extent that these technology fashions have shaped practices in higher education institutions. Nowadays, cloud computing service models such as SaaS, PaaS and IaaS are often used in businesses to change the way businesses work, from planning a private cloud project to finding a cloud provider. Infrastructure as a Service (IaaS) “is

the foundation of the cloud services; it provides clients with access to server hardware, storage, bandwidth, and other fundamental computing resources” (Choo & Raymond, 2010: n.p.). IaaS also “allows consumers to deploy virtual machines with preconfigured operating systems. With this service, networking and storage are easily achieved, without the need to interact with a network administrator” (Finn et al, 2012:8). Platform as a Service (PaaS) on the other hand, “builds upon IaaS and it provides clients with access to the basic operating software and optional services to develop and use software applications without the need to buy and manage the underlying computing infrastructure” (Choo & Raymond, 2010: n.p.). “PaaS is a service-provider–managed environment that allows software developers to host and execute their software without the complications of specifying, deploying, or configuring servers” (Finn et al, 2012:8). Lastly, the Software as a Service (SaaS) model builds upon the underlying IaaS and PaaS. “It provides clients with integrated access to software applications” (Choo & Raymond, 2010: n.p.). “The strength of SaaS is that any user can subscribe to a service as soon as they pay for it. The experience is not that different from purchasing an app for a Smartphone: you find something that meets your needs, you pay for it, and you start using it” (Finn et al, 2012:7).

Business and academic institutions are increasing their familiarity with cloud computing technology so as to follow the industry’s newest developments. Erkoç and Kert, (2015: n.p.) argued that “the use of cloud computing in universities continues to grow and Information Technology (IT) companies continue to encourage the adoption of cloud computing as the next step in evolution of on-demand information technology services and products.”

Management Fashion Theory has been applied in two ways in this study:

- a) analysis of the current state of the discourse surrounding the innovation, and
- b) analysis of the degree to which the innovation is actually adopted for continued use.

The researcher looked at the current discourse of the type that is most likely to be persuading individuals and institutions adopt cloud storage. This was achieved by analysing cloud storage marketing such as magazines, articles, analyst reports and published columns on technology innovations, and commercials in the advertising

industries. In this fashion, the researcher was able to collect data from the internet, referred to as cloud marketing data, and research interview data from the sampled participants.

The researcher used NVivo software to support the qualitative research method applied in this study. NVivo is known as “the software that supports qualitative and mixed method research approach; it is designed to help individuals organise, analyse and find insights in unstructured or qualitative data such as: interviews, open-ended survey responses, articles, social media and web content” (QSR International, 2017). NVivo gives individuals a place to organise and manage research material so as to find insights on data collected. In addition, it provides tools that allow questions to be asked of data in a more efficient way (QSR International, 2017). To accomplish the above, the researcher grouped the data by themes. The internet search on marketing of the cloud assisted the researcher in discovering what marketing says about cloud storage. On the other hand, the research interviews studied the perceptions and actual use of cloud storage from the study participants who are directly involved with the storage of research data in the Science Faculty at UCT.

### ***3.2 Research Design and Method***

The second area in which to build a sound argument for the research report is its design. The researcher is able to show that the design is the result of a series of decisions she has made based on the knowledge gained from the methodological literature and previous work (as recommended by Marshall and Rossman, 2006:13). This research study adopts the qualitative research approach, because the researcher is concerned with understanding individual’s perceptions of cloud storage. As Bell and Waters (2014: 9) explain, “researchers adopting a qualitative perspective doubt whether social facts exist and question whether a scientific approach can be used when dealing with human beings.” The researcher therefore studied the current discourse on marketing of the cloud, as well as the perceptions of cloud storage technology by individual researchers, academics and staff within the UCT Faculty of Science. The participants involved in this study have insights on cloud storage at UCT Faculty of Science and are currently using cloud storage to store valuable data for

innovative science projects. This means insights were drawn from the users themselves.

### ***3.3 Case Study Research***

The case study method “allows investigators to retain the holistic and meaningful characteristics of real life events, such as: individual life cycles, organisational and managerial processes, neighbourhood change, international relations and the maturation of industries” (Yin, 2003:3). Case study approaches are “the preferred strategy when ‘how’ or ‘why’ questions are being posed in the research study but also when the researcher has little control over events and when the focus is on a contemporary phenomenon within some real-life context” (Yin, 2003:3). The goal of employing a case study research approach in this study was to provide the researcher with an opportunity for one aspect of a problem to be studied in some depth, thus ensuring a clear and logical rationale for this research to build a case at UCT Faculty of Science to collect, analyse and present data fairly while focusing on a specific group of individuals.

### ***3.4 Population and Sample***

“Choosing the appropriate research setting, site, population, or phenomenon of interest is fundamental to the design of the study and serves as a guide for the researcher” (Marshall & Rossman, 2006:61). In this study the researcher studied the current discourse on marketing of the cloud, as well as the perceptions of cloud storage technology by individual researchers and academic support staff within Faculty of Science.

The researcher focused on Faculty of Science out of the six academic faculties at UCT. The researcher specifically chose the Faculty of Science rather than another faculty at UCT because the Faculty is a major contributor to the University’s high international ranking through sustained high-impact research output, and the largest user of cloud storage services at the University. The Faculty of Science offers various opportunities for postgraduate research; the faculty has A-rated academics and researchers, it is

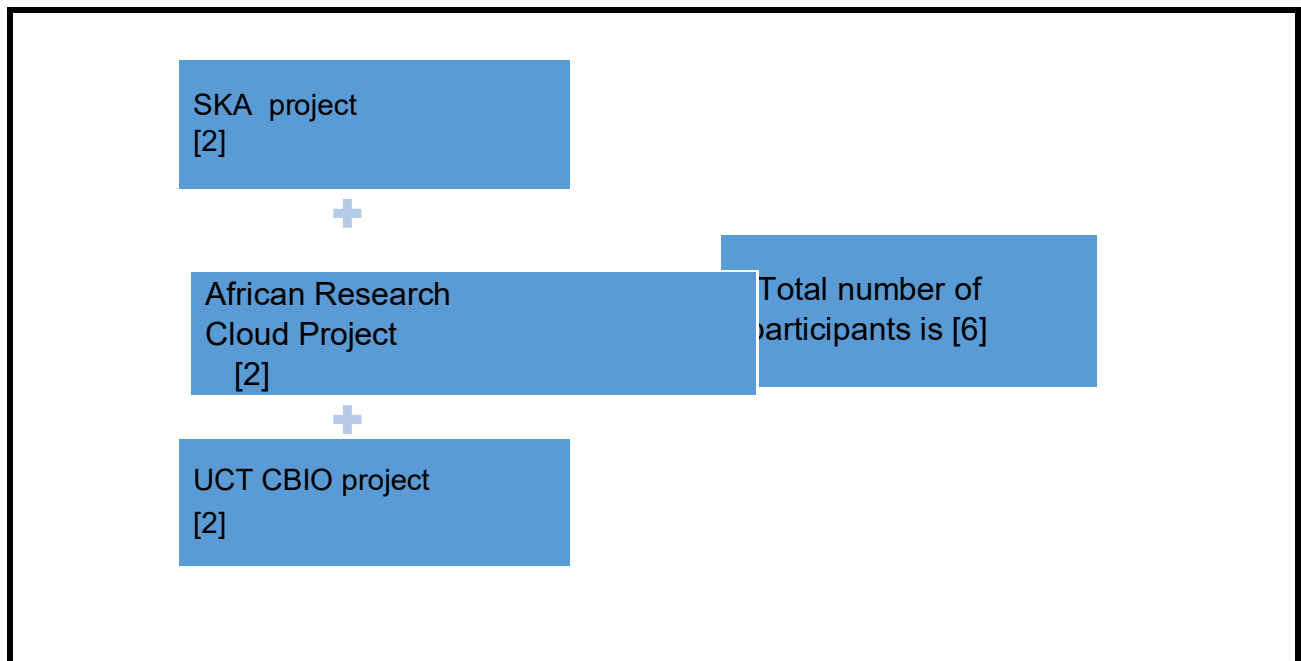
known for producing leading global research (University of Cape Town, 2016). There is a high probability that a rich mix of the processes, people, programs, interactions, and structures of interest are present. This presents a possibility for the researcher to build trusted relationships with participants in the study, which may help to assure data quality and credibility of the study.

The population for this study is UCT Faculty of Science researchers and academic support staff who are using or considering adopting cloud storage. The cloud storage projects identified below are where the researcher focused her data collection.

- a) The SKA project for UCT/UWC,
- b) African Research Cloud project at UCT,
- c) UCT Computational Biology Group (CBIO) project

This study made use of the purposive sampling technique. “Purposive sampling is selecting a sample on the basis of your own knowledge of the population, its elements, and nature of your research aims” (Babbie, 1990:97). This means that the “individual characteristics are selected to answer necessary questions about a certain matter or product” (MacNealy, 1999:157). The researcher selected participants of the study from the Faculty of Science population purposefully, so as to gather necessary data to answer research questions of this study. Moreover, all selected participants have understanding and knowledge of the cloud storage at UCT Faculty of Science; this was an opportunity for the researcher to explore unique aspects of the case in detail. Table 3.1 describes the population strata for semi-structured interviews. However, of the six participants identified as the sample, only three were available at the time of data collection between July and August 2017. All participants were purposively selected for semi-structured interviews. The researcher reached the sample size of six individuals instead of a larger size due to the availability of participants during the period of data collection. However, the researcher determined that a smaller group would still be able to contribute meaningful information especially as the available participants are specialists in their field.

Figure 3.1 Population strata for semi-structured interviews



### **3.5 Data Collection**

The research instruments selected for gathering information determine the quality of data the researcher produces. This study collected data using semi-structured interviews. Using semi-structured interviews in the constructivist paradigm “is a method of inquiry that combines a pre-determined set of open questions with the opportunity to allow participants to discuss and raise issues that the researcher may not have considered when answering research questions.” The participants of the study were alerted about the use of recording device such as voice recorders and interviews commenced on 17 July 2017 and ended on 3 August 2017.

Data collection provided logical judgements and a range of examples on arguments proposed in this study. The researcher obtained permission from all participants involved to conduct the research during working hours in the interests of achieving a positive response rate. The researcher’s target population was six (6) participants, all of whom are researchers and/or academics storing their data using cloud storage. The participants are users working on cloud storage technology research projects at UCT in the Faculty of Science. All participants were selected to participate in the semi structured interview. The researcher sought permission from all participants before

interviews were conducted and each interview took more or less than half an hour (30 minutes).

### *3.5.1 Interview Guide and Design*

De Jager and Nassimbeni (2006:86) state that “interviews provide important and richer information and are better technique to use where complex situations and phenomena are being investigated in detail.” Interviews have particular strengths and are a useful way to get large amounts of data quickly (Marshall & Rossman, 1995:80). Interviews have strength and values in this study; they allow for information to be obtained in greater detail. The advantage of individual and group interviews is that the researcher has greater control and freedom to adapt the proceedings to fit the needs of the specific situation. This allowed for in-depth interviews that provided ideal information and the researcher was able to obtain data that truly reflect the respondent’s feelings and opinions about the topic.

The research interviews for this study were conducted on one- on -one basis, as well as in pairs of two individual teams on the 17<sup>th</sup> August 2017. One of the limitations of this study was to get hold of participants since they are full-time professionals. Therefore, time management was of critical importance in this study. To avoid time management and schedule constraints, the researcher considered conducting group interview of two researchers and academic support staff as it provided an opportunity to save enough time for both parties. This arrangement was fruitful in terms of good data collection during group interviews because one participant’s input triggered ideas for others. The other participant was interviewed alone as he was the only one available to participate to the study.

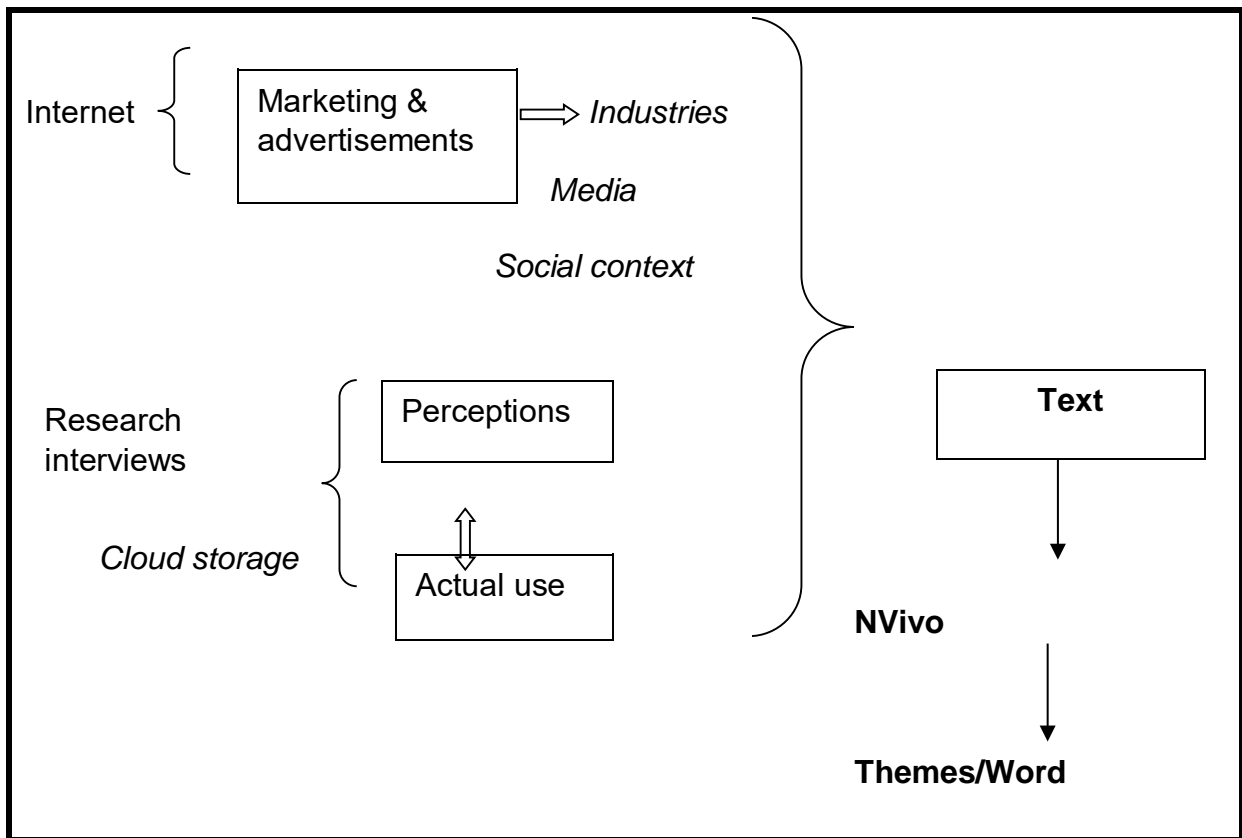
The interview guide (refer to Appendix A) was designed to address research questions and the theory informing the study - Management Fashion Theory - guided the questions. The consent form and Invitation emails were sent out to the identified sample of UCT Faculty of Science researchers and support staff (refer to the consent form in Appendix B and invitation letter in Appendix C). The researcher found out more in terms of claims and perceptions of cloud storage technology because the respondents in these interviews were Faculty of Science researchers and academic support staff members who are currently heading research projects involving cloud

storage projects. The respondents include researchers and academic support staff who are storing their data in the public cloud storage at UCT.

### **3.6 Data Analysis**

Data analysis relates to the type of research strategy that the researcher has chosen for the procedures of analysing data (Cresswell, 2009:218). Data analysis in this study helped direct the researcher's strategy and minimised uncertainty. Data analysis in qualitative study simplifies the language of analysis for the reader to understand how the findings evolved out of the data that was collected (Thorne, 2000:69). This study relied on an inductive reasoning process to interpret and structure the meanings derived from data. The inductive reasoning approach "moves from specific observation to broader generalisations and theories", while deductive reasoning "works from the more general to the more specific" (Trochim, 2007: n.p.). The researcher depended on inductive reasoning because it is more open-ended and exploratory than other reasoning processes, in line with the objectives of the study. The researcher interpreted the data set using explanatory analysis, transformed raw data into a new and coherent depiction of the subject being studied. The researcher also made use of constant comparative analysis strategy by taking one piece of data (one interview, one statement, one theme) and comparing it with all others that may be similar or different, to develop conceptualisations of possible relations between various pieces of data. The idea of comparing the interview responses of two different people who had a similar experience or background, the researcher was able to construct analytical questions. For instance, 'why is this different from that?', 'how are these two related?' and so forth. Constant comparison analysis strategy is suited for this study because the design was used to study human behaviour and experiences, which is the main interest of this study. This study aims to investigate the current discourse on marketing of the cloud (See Table 3.2), as well as the perceptions of cloud storage technology by individual researchers, academics and staff within Faculty of Science.

Figure 3.2 Data analysis guide



### 3.7 Reliability and Validity

Reliability is defined by Phelan and Wren (2007: n.p.) as the degree to which an assessment tool produces stable and consistent results, whereas validity refers to how well a test measures what it is purported to measure. Reliability alone is not sufficient; for a test to be reliable, it needs to be valid (Phelan & Wren, 2007: n.p.). The researcher approached reliability from a social sciences perspective: this was achieved by firstly admitting that reliability in social sciences is dependent on context and cannot be measured or assured. Accordingly, the researcher used the knowledge gained from the methodological literature to administer different instruments of measuring data, and made sure interview questions matched the research questions and objectives. In achieving this, the researcher identified a group of individuals or experts who formed the population of the study. This included researchers and academics who are managing cloud storage projects at UCT Faculty of Science, this group of individuals or experts represented parallel forms of reliability, meaning that the researcher created

a large set of questions and divide them into two sets, in order to address the same construct, knowledge and skills of the participants.

The researcher also used sampling validity in ensuring that the instruments cover the broad range of areas within the concept under the study. In reality, not everything could be covered, and methodology instruments and population therefore had to be sampled. The researcher then approached validity by ensuring that the interview questions related directly and specifically to the research questions. In this manner, the researcher was able to get good data from group interviews because one participant's input triggered ideas for others. Therefore, in ensuring reliability and validity, the researcher depended on the trustworthiness of the participants and the research instruments. The researcher improved validity of results by making sure research goals and objectives were clearly defined to sampled participants. She also had the interview questions reviewed by the faculty ethics committee and supervisors. The researcher was interested in uncovering users' perceptions about cloud storage technology, rather than making judgments on whether those opinions and views were valid.

### ***3.8 Ethical Considerations***

During the process of planning and designing a qualitative study, researchers need to consider what ethical issues might surface during the study and to plan how these issues need to be addressed (Cresswell & Poth, 2018: n.p.). Ethical behaviour is critical in research as in other fields that involve human activity (Sarantakos, 2013: n.p.). This research study involves human subjects and there are therefore certain requirements the researcher had to meet in ensuring that no harm of any kind comes to the subject of the research, either directly or indirectly. The researcher sought official approval from the University of Cape Town, to obtain necessary clearance declaring that the research was ethically sound. The research methodology and instruments were reviewed and approved by the Departmental Research Ethics Committee on behalf of the Humanities Faculty of the University of Cape Town. The researcher's ethics was granted on the 30<sup>th</sup> June 2017 (refer to Appendix D).

Honesty and openness were maintained throughout the entire research process. Details of the research, including the aims, motivations and expected outcomes, were carefully explained to the participants prior to the interviews. In addition, the researcher took the necessary steps in informing the participants concerning their right not to participate in any part of the research. Most importantly, the researcher preserved each participant's confidentiality and anonymity throughout the period of the research. The challenge was the level of trust that could be established in maintaining confidentiality, anonymity and accurate reporting.

### **3.9 Summary**

The aim of this chapter was not to present an exhaustive discussion of the various methodological aspects involved in data collection, but to discuss theoretical framework and the methods approach employed by this study. This chapter discussed the methodological approach employed by this study. The discussion included reasons why a qualitative research approach and research design grounded in Management Fashion Theory were regarded as useful to inform the study.

Data collection via face to face semi- structured interviews with UCT Faculty of Science researchers and academic support staff conducted to validate research instruments, data analysis, reliability and validity, ethical consideration as well as evaluation of methodology used in the study, were discussed in the latter part of this study. Furthermore, this study made use of the purposive sampling technique to collect qualitative data. The following chapter presents the research findings based on the analysis of the data collected.

## CHAPTER 4: PRESENTATION OF FINDINGS

### 4.1 *Introduction*

The previous chapter discussed the research design and the method of data collection as well as instruments for collecting data. This chapter presents the findings of the data collected through internet search on marketing of the cloud and from interviews. Data collected from interviewees, selected UCT Faculty of Science academics, and internet search data was analysed using NVivo. The main objective of the study was to investigate the perceptions of reliability, feasibility and efficiency of modern data storage technology. The researcher wanted to determine if cloud storage is the way forward for storing, managing and preservation of digital data. Below are the specific research questions of the study:

- a. What claims are made in the industry for the benefits of cloud storage?
- b. How do researchers' perceptions of the cloud storage at UCT Faculty of Science relate to the claims and actual use of cloud storage?
- c. How is cloud storage at UCT used for research data in the Science Faculty:  
what kind of research data do they store, where, and from which researchers?

The literature review revealed that Information Technology (IT) industries constantly encourage the adoption of cloud storage by persuading researchers and IT professionals to pursue cloud storage initiatives. According to the literature, cloud marketing strategy is aimed at teaching consumers to choose cloud storage instead of other storage media, in the interests of productivity and competitive advantage (McKinnon, 2015:22). The literature also claims that cloud storage is considered secure compared to other storage media (Wu et al, 2010:381). McKinnon further goes to say that cloud storage has the potential to shape how online data is stored and its value (2015:22). Above all, the literature addressed the benefits, disadvantages and challenges of cloud storage, as well as the ethics surrounding the cloud storage.

## **4.2 Data Collection and Validity**

The projected return rates for interviews is indicated in Chapter 3: Figure 3.1 indicating the population of the research participants for the semi-structured interviews. The study dealt with low response rate due to unavailability of some selected participants and because the projected total number of participants was only six academics. Although the population was small, the data collected was rich and sufficient to answer the research questions. The study also collected internet data to answer the analysis of current state of cloud storage discourse. The researcher selected data sources from analyst reports and cloud providers in order to review marketing strategies used by providers to promote cloud storage adoption.

This study approached validity from the Social Sciences perspective in order to ensure the quality of data collected (refer to section 3.7). This was done by ensuring that the interview questions relate directly and specifically to the research questions. The researcher also selected research participants who are experts in their fields and have a good understanding of cloud storage adoption at UCT Faculty of Science. One interviewee represented both Square Kilometre Array and African Research Cloud case studies. For this reason, the researcher believes she could have collected more data if she had interviewed more than one person on each case study.

## **4.3 Presentation of Findings**

In the previous chapter, the researcher explained that only internet data and interview data would be used to answer the research questions. In addition, the data collected was analysed by applying Management Fashion Theory in two ways in this study:

- a. Analysis of the current state of the discourse surrounding the innovation, and
- b. The degree to which the innovation is actually adopted for continued use.

#### *4.3.1 Current state of discourse surrounding the innovation*

This section will discuss and evaluate the type of language that marketing and advertising industries use to market cloud storage and the impact that they might have on decision-making by customers. With the help of a librarian, the researcher selected data sources from analyst reports and cloud providers in order to review marketing strategies used by providers to promote cloud storage adoption. Gartner Inc. (2018) is the world's leading research and advisory company and a member of the S&P 500, (Standard & Poor's 500 Index), an index of 500 large companies that represent the leading industries in the United States economy (Investopedia. 2018). 'They equip business leaders with indispensable insights, advice and tools to achieve their mission-critical priorities and build the successful organizations of tomorrow' (Gartner Inc, 2018). Forrester is one of the most influential research and advisory firms in the world, and they claim to work with business and technology leaders to develop customer-obsessed strategies that drive growth.

Gartner and Forrester research marks new trends in the IT industry. One may argue that these firms' role is to direct the narrative of how customers should think and react on the adoption of new technological innovations. Their research insights share their predictions about trends in the IT industry and sometimes they may point out the major players in the market, which make them key fashion setters in the areas of digital transformation, business architecture, process management and technology innovation.

Research analysts have considerable influence in today's marketplace. Analysts' recommendations or reports can influence the price of a company's stock, especially when the recommendations are widely disseminated through television appearances or through other electronic and print media (U.S Security and Exchange Commission, 2010). In Management Fashion Theory context, analyst reports and cloud providers are typically trendsetters who have an interest in generating demand for the fashion. They create a market for discourses, disseminating rational and progressive management knowledge to society.

Management fashion theories are shaped by norms of rationality and progress (Abrahamson, 1991:588). This is in contrast to the “efficient choice perspective which assumes that rational adopters make independent and technically efficient choices” (Abrahamson, 1991:587). As quoted in Rogers (1962:1983), the “efficient choice perspective perpetuates pro-innovation biases because it provides limited help in addressing the questions of when and by what processes technically inefficient innovations are diffused or efficient innovations rejected,” whereas Management Fashion Theory suggests that “organisations imitate each other’s’ adoption of inefficient administrative technology, and that they are influenced by outside fashion setters that lead the diffusion of inefficient innovations or the rejection of efficient innovations” (Abrahamson, 1996:261).

The above provides a foundation for Wang’s (2010: n.p.) conclusion that the core source of IT management fashions are vendors, consultants, market analysts who are producing the discourse, constituting the next big thing and the image of what it means to be at the forefront, while executives and IT-managers are on the lookout for the next big thing in IT that will improve their organisation ability to perform and compete. If one may argue the reason why people are willing to pay for cloud storage services, it is because of the perceived service quality and conformity of the cloud. The claims positively affect the perceived value and then increase the user’s willingness to adopt and to pay for the service. Some examples of the industry marketing strategies are listed in Figures 4.1 – 4.5, and discussed later in themes

Figure 4.1 Forrester (2018)



Figure 4.2 Gartner (2018)

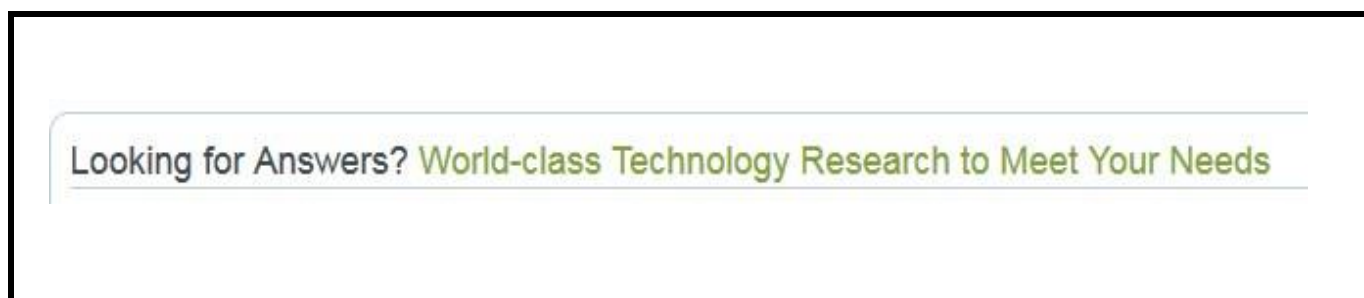


Figure 4.3 Google Cloud For Higher Education (2018)

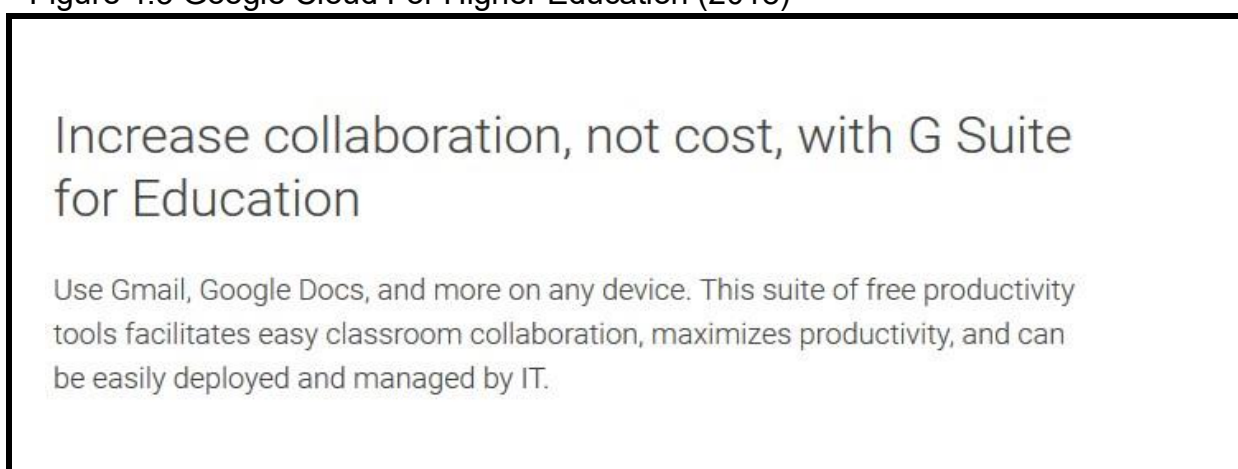


Figure 4.4 Microsoft Education (2018)

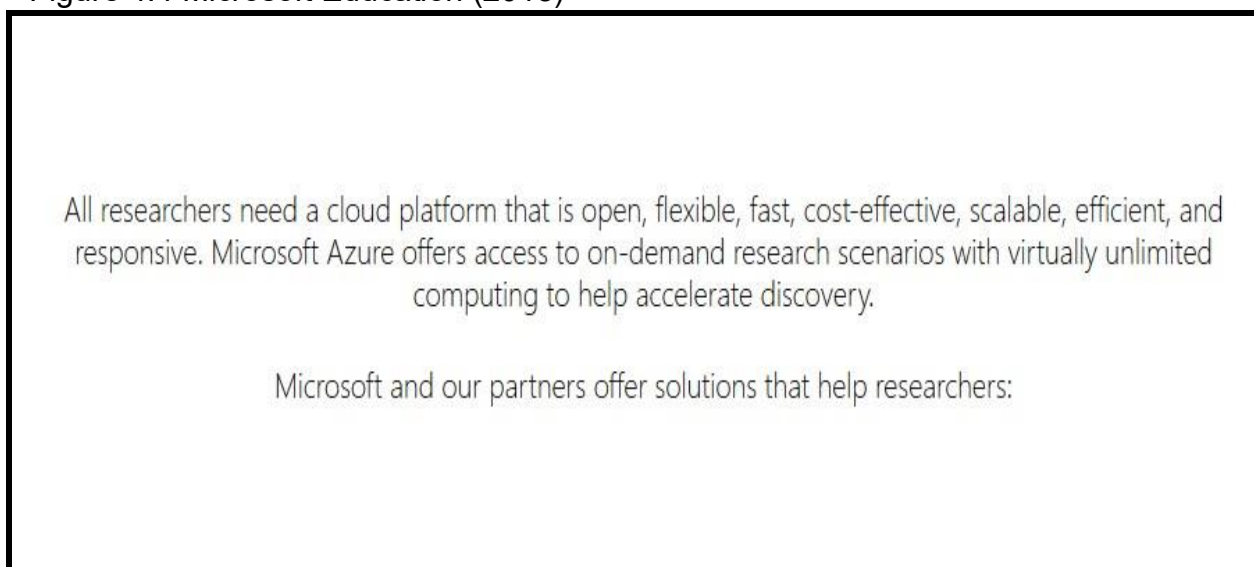
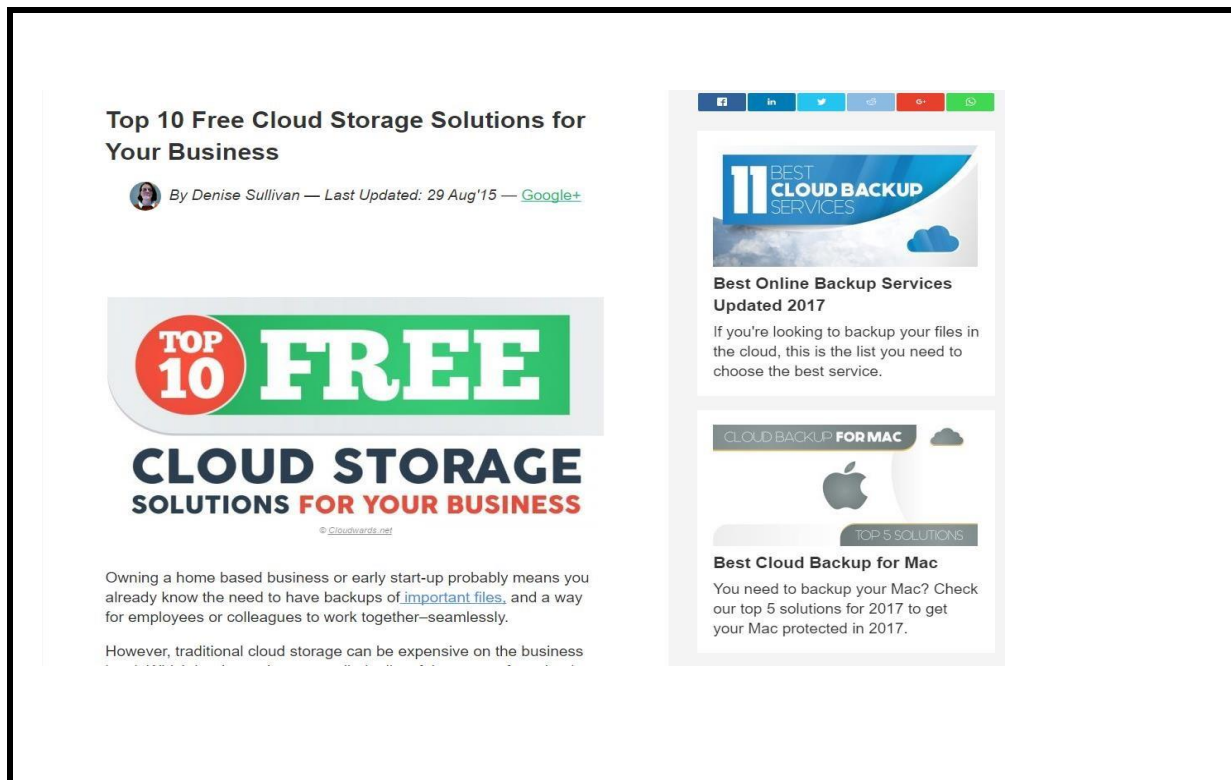


Figure 4.5 Cloudwards.net (2007-2017)



The researcher did not include analysis of what analyst reports are actually saying about cloud storage in academic institution, as she could not get hold of the reports themselves. However, she included analysis on cloud adoption and its benefits for higher education. The researcher discussed industry-marketing strategies in themes as follows:

a. Analyst reports

Major analyst firms that sell research subscriptions have analysts who write the research. 'Research analysts study publicly traded companies and make recommendations on the securities of those companies' (U.S Security and Exchange Commission, 2010). The research in itself is very useful; however, we must remember that every company has different needs which analyst's research might not really cover. Advertising and marketing firms will do everything to reach their sales goals. As a result, they may sell fear and confusion to customers, whereas some sell trust and relationships. Big analyst firms sell their reports and their primary audience are usually the chief information officers (CIO) and IT organisations.

As demonstrated in Figure 4.1 sourced from Forrester, statements such as “Top emerging technologies for marketers” are used to market their research reports. Gartner is using a questioning technique with a closed question “Looking for answers? World class technology research to meet your needs” which can determine if customers are ready to make a decision or to end a discussion. Aside from their different marketing strategies, Gartner and Forrester are more or less in the same business. They are seen as leaders in their industry and customers make the mistake of narrowing choices down to just these two institutions. As a result, customers may miss other reports that discusses similar technology areas and that may have shed additional light on the vendors. Alternatively, customers may miss out on reports that discuss transitions in marketing, sales and technology that should alter their decision process and final decision.

While analysts provide an important source of information in today’s market, investors and consumers should understand the potential conflicts of interest analysts might face. For example: some analysts work for firms that analysts cover, and sometimes they may own stocks in the companies they cover-either directly or indirectly (U.S Security and Exchange Commission, 2010). Hence, investors and customers should not rely solely on some analyst recommendations when deciding whether to buy, hold, or sell a stock. Instead, they should also do their own research to confirm whether a particular investment is appropriate for them in light of their individual financial circumstances (U.S Security and Exchange Commission, 2010).

#### b. Cloud providers

According to IBM Global Business Services White Paper (2009), ‘the cloud market is appealing to new entrants not only because of its size and growth, but also due to the business potential it brings to a company.’ ‘Cloud providers benefit by accessing new customers and markets, improving their deployment times, potentially lower their costs and achieving new revenue streams’ (IBM Global Business Services, 2009). Provider’s strategy is to differentiate themselves and become a leader in cloud service delivery. For this reason, trying to figure out which cloud-based platform is right has become a difficult choice for consumers. As a result, cloud providers use marketing strategies focused on teaching consumers to choose their cloud services, such as:

“increase collaboration, not cost, and with G Suite for education”, or “Microsoft and our partners offers solutions that help researchers”- as shown in the examples from Google Cloud For Higher Education and Microsoft Education (Figures 4.3 and 4.4, respectively). Deciding between the two primary education platforms (Google Apps for Education or Microsoft for Higher education) may be a difficult choice, depending on your previous technology investments, consumer needs and relationships with both companies. Hence, ‘service provider strategies need to address pricing models, goto-market approaches, business intent and value propositions, in addition to defining services and customers’ (IBM Global Business Services, 2009).

### c. Push advertising

Push advertising “is any content sent by or on behalf of advertisers and marketers to a wireless mobile device at a time other than when the subscriber requests it” (Uni & Harmon, 2007:30). The cloud providers driving the marketing of cloud storage use push advertising to push the cloud storage product towards customers. They do this by sending advertising messages to consumers’ cell phones even when consumers did not subscribe to receive updates for the product. Push advertising also uses large advertisements like internet banners and attention-grabbing claims to establish the existence of the product in the minds of customers. Looking at figure 4.5 above by @Cloudwards.net for instance, persuasive phrases such as “top10” “free” and “best” are used on the advertisement. This is to build customers’ interest and to create curiosity, which also facilitates consumer and supplier interaction.

As argued by Nicholas (2013: n.p.), advertisements are increasingly interacting with customers. For instance, a television spot can prompt a Google search that leads to a click-through on a display advertisement that ends in a sale (Nicholas, 2013: n.p.). The marketing and advertising industries’ strategy is to capture and manipulate attention subliminally by using eye-catching and sophisticated advertisements to catch attention (Nicholas, 2013: n.p.). An example is demonstrated in the cloud storage advertisement by @Cloudwards.net in Figure 4.5. The cloud marketers use tempting phrases such as “Top 10 free cloud storage solutions for your business.” These words are in bold, colour and capitalised, which readily catches a user’s attention when they are scrolling through a web page. From a marketing strategy perspective, these words are used to

actively inspire consumer desire for a product, to make them recognise the brand and to be familiar with the product.

d. Organisational pressure

Cowen, Johnson and Vuke (2016: n.p.) maintain that organisations are currently being reshaped by cloud storage adoption. In other words, organisations are being taught about why they should choose and adopt cloud storage over competing products (Cowen et al, 2016: n.p.).

“Abrahamson’s theory of management fashion postulates both exogenous and endogenous forces shape management fashions” (Abrahamson 1996; Abrahamson et al. 2000). “Exogenous forces originate from outside the management-knowledge market and are assumed to create or destroy management fashion niches or trigger demand for new types of techniques within an existing niche”. Whereas, “endogenous forces, on the other hand, refers to influences that shape management fashions independent of exogenous forces, such as the tendency for an organization to seek newer techniques whether out of a desire to differentiate itself from the others or simply in search of novelty” (Lee & Collar, 2002: 3). According to Abrahamson (1996: n.p.), “management fashion has an influence on existing knowledge by its constructs and generalisation on a discourse”. For instance, institutions such as businesses and universities are constantly pursuing newer technologies to differentiate themselves from others and simply because of the popularity of an emerging technology. These common factors influence management changes and innovations in organisations, by enabling transformation and production of new technologies and standards, while in turn distracting people from the old ways of producing, storing, accessing and sharing information Erkoç & Kert, 2015: n.p.).

e. Cloud storage trend

Cloud storage has become a driving force in the information technology arena, even when people do not fully understand what cloud really means (Nicholas, 2013: n.p.). Alternatively, consumers are more focused on the service than the technology itself (Nicholas, 2013: n.p.). Consumers are exposed to an expanding, fragmented array of cloud marketing touch points across all communication channels (cell phones, television, web, radio, and many other media platforms), and many people are left with

'confusion of what the term cloud really means' (Nicholas, 2013: n.d). For example, in the educational space it seems that institutions are no less immune to the popularity of cloud storage. In the global higher education market, aggressive marketing of cloud storage has led to a widespread adoption by universities, as institutions adopting new technologies are perceived to be ahead of those who do not (Nicholas, 2013: n.d).

Table 4.1 contains internet sources that the researcher used to gather data for analysis. The objective of analysing these sources is to answer the study's first research question, which is to investigate the claims made in the industry for the benefits of cloud storage. The data found revealed that the strategy used for marketing cloud solutions is to challenge consumers to grasp the concept of cloud storage. In other words, 'the techniques used connect with customers so that even when people are unaware of exactly what the cloud storage does, they recognise its benefits' (Nicholas, 2013: n.p.). Furthermore, the data collected from the internet search on the marketing of the cloud storage indicates that popularity of cloud storage has increased (Nicholas, 2013: n.p.). This could also be because cloud storage solutions are becoming more available and cheaper over time. Nicholas, (2013: n.p.) also argues that some users do not have a thorough understanding of cloud storage, which led the researcher to believe that consumers do not engage in research before selecting a cloud storage provider. Hence, cloud storage adoption fashion is not stopping, and it seems to be the other reason for the exponential growth of cloud storage.



The data collected from the internet search was analysed using NVivo in order to organise, manage and to find deeper insights. A query was performed to identify word frequency in the marketing of cloud storage. The objective of performing this query was to analyse the reasons why more and more businesses of all sizes are storing some or all of their data in the cloud. The amount of digital data (e.g. documents, images, emails, video) organisations produce is overwhelming. Storing all your data in the cloud storage can be costly, that is why the researcher is interested to find out reasons cloud storage has become increasingly popular.

Table 4.2. shows a relatively high frequency of terms such as “**analyst**” at 0.36%, “**providers**” at 0.36%, “**reports**” at 0.26%, “**influence**” at 0.15%. Management Fashion Theory maintains that analysts, consultants and IT industries are the champions of management fashions (Abrahamson, 1991). Nicholas also argues that, in most instances, consumers tend to base their response to cloud storage based on what they have “heard” or what other organisations are doing without proper understanding (2013: n.p.). In the same way, the data from marketing of the cloud revealed that research reports and cloud providers aim to connect and influence decision making among customers. Hence, consumers are currently implementing cloud storage as a solution despite knowledge, confusion over what cloud storage technology is, and what it does (Nicholas, 2013: n.p.).

Based on the data on Table 4.2, frequency in words such as “**competition**” is at 0.16%, “**pressures**” at 0.14%, and “**trend**” at 0.05%, indicating that cloud adoption is influenced by pressures for organisational change as well as competition for technological trends. Similarly, Management Fashion Theory informs us that most organisations seek to adopt new trends and newer techniques, whether out of desire to differentiate their organisation, or simply in search of innovations. As seen in this data, cloud storage users adopt their management fashion based on advertisements and marketing of cloud storage across media platforms.

Table 4.2 Marketing of cloud word count

Word	Count	Weighted Percentage (%)
Cloud	358	0.74
Analyst	172	0.36
Providers	176	0.36
Reports	126	0.26
Competition	75	0.16
Media	74	0.16
Influence	72	0.15
Pressures	68	0.14
Industry	65	0.13
Trend	12	0.05

#### **4.4 Presentation of findings: Actual adoption**

The findings of the research presented here are according to the sequence of research questions guiding this study. The research instrument used served to answer all research questions and the data is collected from team of experts working with cloud storage at UCT Faculty of Science.

##### *4.4.1 Square Kilometre Array (SKA) and African Research Cloud (ARC)*

One participant of the Square Kilometre Array (SKA) and African Research Cloud (ARC) project, who has been involved in the SKA for about 10 years in variety of ways, was interviewed.

#### a. Cloud storage at UCT Faculty of Science

The SKA project is using private cloud as the primary storage, and the storage is strictly reserved for scientific data. SKA chose private cloud storage because it is secure and private. According to the SKA & ARC researcher, using private cloud storage matches their needs in many ways to the extent that the benefits of cloud storage outweigh the cost. The types of data they store in the cloud include radio data from several telescopes. The SKA researcher estimated that in the next three to five years SKA will be generating 100 gigabytes of data a day. The project has a data management plan and the SKA team control access to data by keeping the user groups as small as possible. That way the SKA team are able to maintain transfers, storage, and access to make things convenient and simple. The SKA team also have architecture and specification standards for the type of data they save. The research participant emphasised that as storage demand increases, the team might have to buy a tape storage library, as another option for archiving data. A definition by Rouse (2018: n.p) explains tape library in data storage as a collection of magnetic tape cartridges and tape drives.

The African Research Cloud (ARC) is a partnership with University of Cape Town (UCT) and North West University (NWU) for general research in South Africa. The driver of the ARC is the SKA (Square Kilometre Array telescope) and it therefore focuses on Astronomy. The ARC cloud operating system comprises hardware at UCT and North West University. ARC consists of small projects and uses a cloud system called BeeGFS to manage data and metadata. BeeGFS is a high-performance parallel file system that provides the scalability and flexibility that is required to run today most demanding High Performance Computing (HPC) application (BeeGFS, 2017).

#### b. Users' perceptions of cloud storage

The interviewed SKA & ARC researcher/academic argued that he used to be very sceptical about cloud storage but now he personally uses cloud storage almost daily. He uses Dropbox and Google drive for storing, sharing and collaborating with other international researchers and academics. The SKA & ARC researcher said he has a positive experience with cloud storage, both professionally and personally. He is even considering migrating backups to the cloud. According to the SKA & ARC researcher,

“migrating to cloud is cheaper than buying your own hardware because with cloud you can also share information between devices and other people as well”. However, he also stressed that there is a constant concern with the security of the cloud.

Furthermore, he maintained that storing data in the cloud is feasible and he believes that as time goes on feasibility will improve. He argued that accessing data in the cloud is not a problem, at home, at work, at the mall or any other location, since internet access is provided at his workplace and other public areas such as the shopping malls by the City of Cape Town government. He further indicated that, “there are more benefits in using cloud storage compared to the traditional ways of storing data”.

### c. Challenges of cloud storage

The SKA & ARC researcher is not ready to accept the loss of control over his data. In fact, he does not like the barrier that exists between the data in the cloud and the user. In his perspective, the data belongs to the owner of the research and because the owner paid for storage, he/she should have control of and access to the data. According to him, the whole point of using the cloud is to ensure user control of the data. Internet availability is not a huge problem with the SKA project since they have institutional access and have an Uninterruptible Power Supply (UPS) system that sustains them in case of electricity shutdown or any infrastructure damage. The UPS is an uninterrupted power supply that, in case of blackouts, short power outages or electricity disturbances, utilises stored energy of 12V/7A batteries by providing power primarily to storage machines/servers. The UPS ensures that no data loss takes place due to voltage spikes that can occur when utility power is restored. However, the SKA researcher believes that the team needs to put a strategy in place concerning security of the cloud storage.

The data collected from SKA and ARC representative was analysed using NVivo to identify similarities and differences amongst the two cloud storage projects. Thereafter a query was performed to identify word frequency in the interview. The result is presented in Table 4.3, with the words “cloud” and “SKA” as controls.

Table 4.3 SKA and ARC interview word count

Word	Count	Weighed Percentage (%)
Cloud	71	5.45
Data	53	4.07
Storage	44	3.38
Researcher	13	1.00
Technology	11	0.84
Access	9	0.69
Management	8	0.61
Big	6	0.46
Private	6	0.46

The SKA and ARC participant used words frequency such as “**cloud**” at 5.45%, “**storage**” at 3.38%, and “**data**” at 4.07% because cloud storage is specifically used for storing and management of data in this project. In addition, words relating to “**access**” at 0.69%, and “**technology**” at 0.84% also appear frequently because SKA and ARC believes data that is stored in the cloud is more easily accessible in all places and one does not need to carry around a physical storage device to retrieve the data. The SKA and ARC team is confident that cloud storage is designed to eliminate operational complexity and maintenance. However, they do acknowledge that it still carries with it complex issues. These two institutions are saving their research data primarily on cloud storage and are ready to rise to the challenges of the global data revolution in the era of data-intensive research. That is to say, the SKA and ARC researcher believes that cloud storage growth would have a positive effect on South African institutions because it offers more benefits than traditional ways of storage.

#### 4.4.2 Computational and Biology Group (CBIO)

Two researchers of the Computational and Biology Group (CBIO) were interviewed, a Network Manager of the H3ABioNet Computational Biology Division and a Senior Bioinformatics Specialist in the Division of Computational Biology Group. 'H3ABioNet is a Pan African Bioinformatics network comprising 32 Bioinformatics research groups distributed amongst 15 African countries and 2 partner Institutions based in the USA which will support H3Africa researchers and their projects while developing Bioinformatics capacity within Africa' (H3ABioNet.org, 2014).

##### a. Cloud storage at the UCT Faculty of Science

The CBIO team is using Microsoft Azure Windows Share and UCT Information and Communication Technology Services (ICTS) for offsite replication. The CBIO team works with raw data, sequence data, population genetics data and genotypes. The team has an internal data management plan that they refer to for their ethical data procedures. They upload research documents on Google cloud and use cloud more for processing data than for data storage (cloud computing, rather than cloud storage).

##### b. Users' perceptions of cloud storage

According to the CBIO team, cloud storage is still unclear to them and they are still trying to figure it out. The CBIO team always have their data encrypted, most data is stored locally on their machines, and not much is stored on Google Drive. Many users of the cloud are storing genotype datasets and non-human data. The CBIO team thinks cloud is "oversold", but they plan to investigate more about cloud storage before using it for datasets. According to the CBIO team, cloud storage is very feasible; the only challenge is that accessing cloud is expensive. One of the researchers argued that accessing cloud storage requires internet connection and there seem to be financial constraints around that. Both researchers argued that the benefits of cloud are more likely to be perceived for computing than for storage, and that cloud storage is the future for international branches, but in Africa, "we still have a long way to go." Moreover, the team support that cloud storage is convenient for research purposes, user friendly, and it has a good user interface, provides a good collaborative space and is pleasant to work with.

### c. Challenges of cloud storage

The CBIO team argues that one of the challenges of cloud storage is access to the data stored in the cloud, as internet bandwidth is very expensive in South Africa. One of the researchers even argued further “most of our data is stored outside South Africa’s borders, which means we are not responsible for all our research data.” The researchers argued that security of the data will always remain a big issue as a quote from the interview reveals: “as users we always question whether our data is protected on secure servers. Where is data located? How is access to data controlled? Are data protections appropriate for the data use?” The CBIO team believes that there is not enough ethics around security of the cloud.

A query was performed on NVivo of the data collected from CBIO interview in order to identify word frequency in the interview and is presented in Table 4.4. The relative frequency of words such as “**security**” at 0.38% and “**high**” at 0.38% clearly indicate that cloud storage security is still under question for CBIO. Furthermore, this institution is watchful of the limited access and financial commitment associated with using cloud services, in contrasting with SKA and ARC. The CBIO team agrees that cloud storage is a useful resource; however, they consider the cost of access to be high as stated in the interview. The CBIO team believes there are greater opportunities that cloud storage could present and provide to its users, but the problem is high costs, i.e. paying vendors, services and subscription models.

Table 4.4 CBIO interview word count

<b>Word</b>	<b>Count</b>	<b>Weighed Percentage (%)</b>
Security	5	0.38
Technology	5	0.38
High	5	0.38
Infrastructure	4	0.31
Innovations	4	0.31

Processing	4	0.31
Storing	4	0.31

#### **4.5 Cross-case analysis**

From the data presented above, it is clear that the needs of each institution are different due to their needs of cloud storage for their projects. The SKA and ARC cloud storage needs differ from those of the CBIO. For instance, the SKA and ARC team believe cloud storage is desirable, cheap, secure and easy to access. On the other hand, the CBIO team argue cloud storage is expensive and is difficult to access. These institutions' priorities for cloud usage are different because they utilise the same technology for different needs. In most instances such as in these case studies, we find that institutions adopting cloud storage have business strategies in place, which they consider when implementing Information Technology (IT) investments to ensure maximum rewards, and improved performance. Institutions such as these tend to choose the storage strategy that best fits their project needs, and this was supported by observations in this study. All of these three case study representatives for SKA, ARC and CBIO agree that cloud storage is the future when it comes to providing a platform for collaboration, storage and exchanging data. However, they have different views when it comes to access to research data in the cloud, as internet is a major player in cloud storage infrastructure. The CBIO team argues that limited access to the internet is a challenge to cloud storage users and that this gap needs to be addressed, whereas the SKA and ARC team find cloud storage consumer friendly and internet connectivity capacity is not a big issue.

The CBIO team expressed that internet coverage in developing countries such as South Africa is still a challenge due to lack of infrastructure. According to the CBIO team, the absence of infrastructure in Africa leads to unavailability of internet and escalating cost of cloud services. The SKA and ARC project on the contrary enjoy the cost benefits associated with cloud storage services and have invested in ICT infrastructure to eliminate operational complexities such as costs of installing, maintaining and upgrading complex IT systems in the user's own environment.

Institutions such as SKA and ARC prefer to control the quality of the data in the cloud storage, with the right systems in place, regulatory compliance, security, and IT governance maintained by a service provider. The CBIO on the other hand finds offsite public cloud storage attractive to institutions that do not want or cannot afford to build their own data storage. Briefly, all these researchers working in different cloud projects prefer private cloud storage, where they are able to design cloud storage to be exactly what they need.

#### **4.6 Observations**

Davids and Van Belle (2017:286) contend that “organisations are faced with business environments that rapidly change and are fiercely competitive.” Management Fashion Theory states that organisations imitate innovation models promoted by fashion setting, either out of organisational pressure, competitiveness, and technological growth or just to be ahead with management innovations. My observation from crosscase analysis revealed that Information Technology (IT) innovations are assisting the SKA, ARC and CBIO to achieve their business value, and this is because IT is an enabler. The adoption of cloud storage by SKA, ARC and CBIO research projects is important for their project and to manage big research data as well as for other solutions such as data sharing and data storage. The SKA, ARC, and CBIO teams believe cloud storage has provided an opportunity to develop their disciplines and to collaborate with other universities. The researchers in the Faculty of Science at UCT who participated in this study are recognising that IT is playing an important role in changing the research environment into one that is service driven, information based and knowledge intensive. However, the study revealed some conflicting data from the case studies, especially on the issue of access to the data stored in the cloud. One group of projects, the SKA and ARC, believes the data stored in the cloud is easy to access in all places, whereas the other group, CBIO, argues that lack of internet access puts cloud users in a disadvantaged position as they have limited access to data. The findings from internet search data specify that current organisations and people had begun adopting or transitioning to cloud storage because of marketing strategies used by cloud industries and because of organisational competitiveness.

The internet data indicate that individuals are adopting cloud storage even when they do not have proper understanding of what cloud storage does (Nicholas, 2013: n.p.). The literature also argues that “awareness” of the regulatory compliance, data location, security and privacy of data stored in the cloud is crucial (Davids & Van Belle, 2017:286). Hence, organisations must understand the role IT plays within an organisation, especially when considering IT investment to ensure greater rewards and performance. In other words, while management fashion innovations are largely shaped by norms and discourse surrounding the innovation, institutions adopting cloud storage must go through proper planning so as to experience viable growth that IT infrastructure can bring within an organisation. The UCT Faculty of Science researchers in this study have different views when it comes to claims and actual use of cloud storage; however, they all agree in one common argument: cloud storage provides researchers with omnipresence of broadband networks, which allows collaboration to achieve new heights. Overall, researchers are recognising the strategic contribution of IT innovation in their research projects, into one that shapes, produces, enables and augments organisational success.

#### **4.7 Summary**

The advantages of adopting cloud storage can go beyond cost savings as cloud allows clients to avoid the expensive and time-consuming task of installing and maintaining hardware infrastructure and software applications. However, organisations need to consider various factors when deciding on cloud storage solutions. This chapter presented the sources used to collect research data about the marketing of the cloud, which demonstrated that the current state of discourse surrounding cloud storage innovation is one that highlights the desirability of cloud solutions. Afterward, the factors that actually led UCT Faculty of Science researchers to adopt cloud storage were analysed, as well as their perceptions on the reliability, efficiency and feasibility of the cloud storage technology. This chapter also contained a cross case analysis of the case studies, which revealed that SKA, ARC & CBIO representatives believe cloud storage is the future when it comes to providing a platform for collaboration, storage and exchanging data. Lastly, observations were made that highlighted important

points from the data, such as the importance of IT innovations in assisting SKA, ARC and CBIO to achieve their business value and this is because IT is an enabler. Moreover, SKA, ARC, and CBIO representatives believe cloud storage has provided an opportunity to develop their disciplines and to collaborate with other universities.

## **CHAPTER FIVE: DISCUSSIONS OF MAIN FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 *Introduction***

The previous chapter presented findings from the analysis of data collected using internet search data and interviews. These findings were presented in the sequence of the research questions in order to address the objective of the study. This chapter discusses the main findings in terms of the objectives of the study, the research questions, the theory informing the study, as well as the issues that arose in analysis of the data. Based on this discussion, conclusions will be drawn and recommendations will be made.

Data collection was a challenging process as arranging appointment dates with senior researchers was problematic due to their busy schedules. This limitation was unforeseen and it resulted in the size of the population being smaller than expected. The objective of this study was to investigate the perceptions of reliability, feasibility and efficiency of cloud storage technology and to validate or invalidate the claims that have been made regarding the cloud storage medium. This objective is unpacked by the following sub-objectives:

- i. To investigate the claims made for the cloud storage medium.
- ii. To investigate perceptions held regarding cloud storage.
- iii. To investigate the adoption of cloud storage at UCT Faculty of Science, how they operate the services and how they overcome and/or address the challenges that come with cloud storage adoption.

### **5.2 *Discussion of findings***

Findings are discussed in order of the objectives listed above. The research was informed by Management Fashion Theory.

### *5.2.1 Claims made for cloud storage*

The data collected from the internet search on the marketing of cloud storage indicates that marketing and advertising industries are using persuasive and manipulative strategies to actively inspire consumer's desire for the product. According to the internet search data, popularity of cloud storage has increased and this could be because cloud storage solutions are becoming more available and cheaper over time (Nicholas, 2013: n.p.). The literature further argues that some users of cloud storage do not have an understanding of cloud, but they recognise its benefits because of how the product is marketed (Nicholas, 2013: n.p.). In a more general point of view, it seems that in our current digital-reliant society consumers have beliefs that cloud storage is much more reliable than other storage media and they do not take into account that the data is in the hands of a third-party system (Nicholas, 2013: n.p.). In addition to that, an observation was made which led the researcher to believe that consumers do not engage in research before selecting a cloud storage provider and therefore the trend is not stopping, and this seems to be the other reason for exponential growth of cloud storage. The researcher also observed that professionals responsible for marketing and advertising of cloud storage services are becoming more ambitious and proactive in their advertising strategies. In consequence, the cloud storage industries are pushing the product towards customers.

The results from the CBIO team reveal that some researchers have safety concerns with regards to cloud storage. The CBIO researchers feel this way because cloud storage has attracted some scrutiny since its innovation and this undermines their perception of the cloud and cloud storage today. The researcher is then led to believe that socio-psychological factors such as bad publicity of cloud influenced concerns within CBIO researchers about cloud storage as an investment innovation for continued use within their project. As has been noted, Management Fashion discourse matters, because it shapes the diffusion of management techniques, it creates a market for progressive management knowledge or failure of the fashion to progress (Abrahamson & Fairchild, 1999:709). This relates to this study as we see cloud storage technology being used as a product of management fashion setting process involving particular management fashion setters such as marketing industries, IT organisations

and analysts who dedicate themselves to producing and disseminating management knowledge.

On the other hand, The Square Kilometre Array (SKA) and African Research Cloud (ARC) project researcher believes that cloud storage is one of the safest ways to store data. Although safety seems to be of some concern, the SKA/ARC team is still investing resources in acquiring and developing cloud storage platform for storage of their data. This means that some researchers either trust cloud storage enough to adopt it in their projects or it could mean that the benefits of cloud storage are so great they outweigh the potential risks.

### *5.2.2 Perceptions held regarding cloud storage*

The data collected from research case studies indicate that popularity of cloud has increased. For instance, academic institutions are now using cloud for managing data, data storage, data processing, and so forth. The data from the internet search and the literature also support that the rise of cloud storage continues to increase, and it seems as if academic researchers have now found new and efficient ways to manage academic projects and store data. The SKA and ARC researcher has positive perceptions of cloud storage. The SKA and ARC researcher regards cloud storage as the best option to manage, share and exchange data. Based on the case study projects; SKA, ARC, CBIO, cloud storage is the future for storage of digital data and it is building the next era of computing development.

The data from the internet search reveals that in many cases, academic institutions develop networked research and development platforms for data because they experience pressure for organisational change. The main reason behind the organisational change is the rapid advance in scientific knowledge, which has created technological platforms for innovations around big data research challenges. Big data has added new dimension to the research processes across disciplines and platforms. For this reason, it has become critical for researchers and universities to be ahead of the technology curve as a high level of technology infrastructure is in demand. Hence, universities always keep searching for new ways to develop.

### *5.2.3 Adoption of cloud by SKA, ARC and CBIO projects*

The SKA and ARC projects have a cloud-based data centre and these projects are playing a huge role in developing the technical expertise to optimise the cloud platform and big data infrastructure for scientific researchers who are facing big data challenges. This clearly indicates that, with the continuous rising demand to meet big data requirements, universities are now seeking ICT resources to meet these demands in managing big data. The use of cloud storage technology at UCT has many benefits and it plays a significant role in closing the digital divide. However, security concerns have been raised. Perhaps users need further insight and guidelines on the cloud storage technology; perhaps many other secure solutions exist. The UCT Genomics group project “CBIO” is one of the research case study projects that the researcher analysed. The CBIO researchers raised issues around accessibility and security with regards to cloud storage. Cloud storage is a relatively new innovation and researchers at the CBIO project are still finding it hard to entrust their data to third party storage facility, they want a guarantee that their data is going to be safe and reliable in the cloud storage. Also, researchers are concerned about accessibility of data that is saved on cloud storage, as cost for internet access are high and could result to consumer barrier to information; between those who can afford and those who cannot.

### **5.3 *Researcher’s validation and invalidation of claims made on cloud storage***

- a. The researcher supports the claim that ‘cloud storage industries are pushing the product towards customers’. As seen in the example in Section 4.3.1, the cloud advertising industry uses persuasive and manipulative marketing strategies to inspire consumers to desire the cloud storage product and to instil it in consumers’ minds.

- b. The researcher also agrees that consumers have a strong belief that cloud storage is more reliable than other storage media. The participants that were interviewed all agree that cloud storage is the future for managing big data. In addition, the data retrieved from internet supports the notion that consumers consider cloud storage to be a superior solution for storing digital data.
- c. The researcher disagrees with the claim that 'cloud storage users do not take into account that the data is in the hands of a third party.' All researchers from the research case studies (SKA, ARC and CBIO), have significant concerns about losing control of their data stored in the cloud. In fact, they believe that as data owners, they should be the ones who control the overall management of the data stored in the cloud.
- d. The researcher partially validates that 'consumers do not have an understanding of what cloud storage really is, but they recognise its benefits.' The data from the internet search revealed that consumers lack a full and nuanced understanding of cloud storage services. As a result, marketing professionals take advantage of this shortcoming to push the product in consumers' minds, so that they can recognise the product and its benefits.
- e. The researcher disagrees with the claim that 'the benefits of cloud storage outweigh the potential risks.' The CBIO researchers from the case study raised many issues surrounding the adoption of cloud storage and hence they are using cloud services for processing data other than for data storage. Certain issues such as security, costs, ethics and accessibility bring uncertainty to some users.

#### **5.4 Recommendations emerging from the study**

Based on the discussion in Section 5.2, this study makes the following recommendations:

Cloud storage is considered one of the most pioneering technologies of the next years. However, because of its dependence on the internet when accessing stored data and cost associated with it, cloud infrastructure seems to be the biggest obstacle. This means although cloud storage services have the potential to bring significant benefits to educational institutions in Africa, the problem of cost associated with internet access need to be addressed. The Information Technology (IT) sector on the other hand, is a highly competitive environment and although cloud storage growth would have a positive effect on South African institutions, government institutions are finding the costs very high which limit them in adopting cloud storage services. Cloud storage users raised concerns over the security and safety of their data stored. This means that there is a growing need for security measures of cloud storage to ensure that data stored is neither tampered with nor discarded. Likewise, it is essential that these online storage services have data ethics and policy in place that meet their clients' needs.

## **5.5 Conclusions**

Based on the discussion of the main findings, the following conclusion may be drawn.

Cloud storage allows for easier collaboration among universities and it is now part of an enhanced global network. Taking into account adequate bandwidth, the future is indeed cloudy; perhaps the biggest challenge is a change of mind-set. Cloud storage adoption by SKA, ARC and CBIO is on the rise and researchers are ready to face challenges of the data revolution in this new era of data-intensive research. It is however unfortunate that cloud infrastructure seems to be a problem in South African universities; partly the reason why many government universities have not adopted cloud storage to manage their big data. The findings of this study also reveal that "cloud can be a very useful solution in education" (Tomasz & Bajdor, 2015:1084). Moreover, the literature in Library and Information Studies (LIS) concluded that introduction of cloud services to education would increase students' engagement with learning, and offers new possibilities for enlarging and widening the horizons of the type of knowledge that they access. According to Goldner (2010:275) cloud brings several benefits for libraries and gives them a different future; such as "the cooperative effect of libraries using the same, shared hardware, services and data rather than

hosting hardware and software on behalf of individual libraries.” This can result in lowering the total costs of managing library collections and enhancing the both library user’s experience and library staff workflows (Goldner, 2010:275), and may also enhance the relationship and partnership between academic libraries and researchers who can develop a shared stake in the collaborative management of research data and outputs in a mutually accessible space. To echo the sentiments of Tomasz & Bajdor (2015:1084), a wide range of benefits and a likely positive impact on the level and quality of education make a strong case for implementation of cloud in universities (Goldner, 2010:275).

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## APPENDICES

## Appendix A: Research Interview Guide and Questions

1. Perceptions of the cloud storage at UCT Faculty of Science, in terms of its reliability, feasibility and the efficiency (for the storage and management of research data)
  - a. What are your views regarding cloud storage?
  - b. Which type of cloud storage are you using?
  - c. Why did you opt for cloud instead of other storage systems?
  - d. What do you think about the reliability of the cloud?
  - e. What do you think about the security of the cloud?
  - f. If we define feasibility as an ability to conveniently accomplish desired outcome or act, what can you say about the feasibility of the cloud storage?
  - g. In your opinion, what are the benefits of migrating to a cloud storage solution, if any?
  - h. Do you think cloud storage is the future?
  - i. Are you, as the user, prepared to accept some loss of control over your data, and entrust this to the cloud provider?
  - j. Do you believe that the decision to use cloud storage in this particular project was in any way influenced by the current perceptions of the cloud in a social context?
2. How is the cloud storage at UCT used for research data in the Science Faculty? what kind of research data do they store, where, and from which users?
  - a. Please estimate how much research data you store in the cloud
  - b. What kind of data? And from which users?
  - c. In your experience, can the cloud storage be successfully used by all of the devices that need to access the data?
  - d. How do you deal with infrastructure problems such as internet availability and electricity blackouts that may affect the cloud storage system?
  - e. Do you implement a data management plan in your cloud storage system?
  - f. Do your security, compliance, database and other services work across data storage platforms (e.g. hard drive to cloud)?
  - g. Is cloud a primary based storage for your data?
  - h. What is the financial commitment associated with using cloud services?

## Appendix B: Interview Consent Form

Investigating the perceptions of reliability, efficiency and feasibility of modern data storage technology: a case study of cloud storage adoption at UCT Faculty of Science.

I..... have been requested to partake in the aforementioned study. I hereby give Mpho Netshiongolwe consent to interview me on [date].....

The researcher explained the content and nature of research thoroughly. I understand that I may withdraw my participation on this study at any moment and that all information shared with the interviewer would be treated with high confidentiality.

Information relating to real names and any other personal identification is protected in such a manner that, no content of the work arising from the interview will link directly to the interviewee unless mutual agreement is reached between the two parties. Pseudonyms will be employed as opposed to real names.

I give permission to have the interview recorded for the sake of the researcher not losing any valuable data.

Signature: .....

Date:.....

## Appendix C: Invitation Letter

Library and Information Studies Centre  
Level 6  
The Chancellor Oppenheimer Library

Dear Sir/Madam

My name is Mpho Netshiongolwe. I am undertaking a research study towards my Masters of Library and Information Studies at UCT in the Library and Information Studies Centre. The topic of my research is **Investigating the perceptions of reliability, feasibility and efficiency of modern data storage technology: a case study of cloud storage adoption at UCT Faculty of Science**. I have identified three groups of project that I want to interview for my study, namely (i) The Square Kilometre Array project (ii) The African Research Cloud project (ii) The Computational and Biology Group (CBIO).

I would like to get an insight from two representatives from each group, exclusively those with experience of cloud storage at UCT and those who are storing their data in the cloud. I do not know who to contact directly within the Department of Astronomy, hence I would appreciate if this could be forwarded to the relevant people.

My ethics have been approved. I have attached the research questions, ethics approval letter and formal request interview letter. The questions will take 10-15 minutes to complete.

Should you have any questions regarding this research in any way, feel free to contact me on this UCT email.

Kind regards,

Mpho Netshiongolwe

Researcher

[ntsmph007@myuct.ac.za](mailto:ntsmph007@myuct.ac.za)

## Appendix D: Department Ethical Clearance Letter



**Library and Information Studies Centre**  
University of Cape Town  
Upper Campus

Private Bag XI, RONDEBOSCH, 7701 South Africa  
Level 6 Hlanganani, The Chancellor Oppenheimer Library  
Tel: +27 (0) 21 650 4546  
E-mail: [lisc@uct.ac.za](mailto:lisc@uct.ac.za)  
Internet: [www.lisc.uct.ac.za](http://www.lisc.uct.ac.za)

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UCTLIS201706-04

30 June 2017

Ms Mpho Netshiongolwe  
Library and Information Studies Centre  
University of Cape Town

Dear Ms Netshiongolwe

I am pleased to inform you that ethical clearance has been granted by the Ethics Review Committee of the Library and Information Studies Centre on behalf of the Humanities Faculty of the University of Cape Town for your Master's study entitled: *Investigating the perceptions of reliability, feasibility and efficiency of modern data storage technology: a case study of cloud storage adoption at UCT's Faculty of Science.*

I wish you the very best with your study.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Raju'.

A/Prof. J. Raju  
Chair, Department (LISC) Research Ethics Committee