DIGITAL PRESERVATION IN INSTITUTIONAL REPOSITORIES IN NAMIBIAN ACADEMIC LIBRARIES: A CASE STUDY OF THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY (NUST) AND THE UNIVERSITY OF NAMIBIA (UNAM)

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ABSTRACT

This study investigated long-term digital preservation activities in Institutional Repositories (IRs) digital contents at Namibian academic libraries (Namibia University of Science and Technology (NUST) and University of Namibia (UNAM)). The study intended to determine the procedures and policies which are governing and safeguarding intellectual knowledge preserved within IRs; to ensure long-term future access as well as skills, support required and challenges encountered. A qualitative research approach with a semi-structured interview guide was used to collect data, an observation method was additionally used to gather data on IR digital preservation policies at NUST and UNAM. The study's population comprised of the NUST and UNAM officials, including IT support officials, librarians, faculty journal editors as well as the Research and Publication officers. A total number of 14 participants were purposefully selected as key informants from NUST and UNAM.

The findings from this study revealed that, short-term preservation strategies such as conducting regular backups, system/software upgrades and maintenance as well as using open file formats i.e. PDF are the main techniques used at NUST and UNAM. The study also discovered a significant lack of knowledge amongst staff members on the concept of long-term digital preservation. Furthermore, the study revealed that the aspect of policies and guidelines has not received comprehensive attention at both institutions. Challenges such as lack of training and skills; lack of funds; lack of long-term preservation practices; and a lack of IR policies to safeguard long-term preservation were also identified.

The study therefore concluded that the current measures established by NUST and UNAM will not guarantee long-term preservation and access to current stored digital content. The study further concluded that there is an urgent need for NUST and UNAM to immediately address the current challenges hampering long-term digital preservation practices to ensure continuous access and preserve institution's intellectual knowledge output. The study recommends comprehensive training and education on long-term digital preservation for information professionals, it further recommend the two institutions to develop comprehensive IR policies and for them to explore various long-term digital preservation techniques to ensure future access to IR stored digital content.

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LIST OF ABBREVIATIONS AND ACRONYMS

ALA - America Library Association

ASCII American Standard Code for Information Interchange

CCSD - Consultative Committee for Space Data System

CD - Compact Disk

CESSDA - Consortium of European Social Science Data Archives

DPC - Digital Preservation Coalition

DP - Digital Preservation

DVD - Digital Versatile Disc

EAD - Encoded Archival Description

EIRS - Electronic Information Resources

FRBR - Functional Requirements for Bibliographic Records

HTML - Hyper Text Markup Language

ICT - Information and Communication Technology

IRS - Institutional Repositories

ISO - International Organization for Standardization

IT - Information Technology

LIS - Library and Information Studies

NUST - Namibia University of Science and Technology

OAIS - Open Archival Information System

OCR - Optical character recognition

OS - Operating System

PDF/A - Portable Document Format/Archiving

PDF - Portable Document Format

PHP - Hypertext Preprocessor

RDA   - Resource Description and Access

SGML   - Standard Generalized Markup Language

SQL   - Structured Query Language

TEI   - Text Encoding Initiative

UNAM   - University of Namibia

XML   - Extensible Markup Language

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DEDICATIONS

This thesis is dedicated to my late mother Martha Ndeshihafela Samuel, for raising me to be a courageous and dedicated woman and to my son Lineekela whom I would like to inspire with this work.

DECLARATIONS

I, Sylvia Patricia Umana, hereby declare that this is a true reflection of my own research and that this work or part thereof has not been submitted for a degree in any other institution of higher learning.

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Sylvia Patricia Umana

CHAPTER 1: INTRODUCTION

1.1 Orientation of the study

Institutional Repositories (IRs) are relatively new and essential concept for many academic institutions Giesecke (2011). IRs are essential to any academic institution as they may often be used to measure status and profile of an institution and may increase funding opportunities based on its research output (Mensah, 2013). Successful and reliable IRs are measured against their ability to provide long-term access to stored content, thus achieving long-term access in IRs is dependent upon effective and efficient digital preservation practices. With digital content taking a hip in the present information age, libraries need to realise the importance of preserving IRs digital content (Gbaje & Zakiri, 2013). IRs may generally be described as digital holdings of intellectual knowledge produced by the faculties, research staff and students of a certain institution (usually an academic institution) with an intended purpose to avail knowledge to end-users within and outside the institution (Anbu, 2010).

Hockx-Yu (2006) noted that, besides enabling access and distribution of research output, it is naturally within IR roles to aim for long-term preservation of stored IR digital content. Institutions of scholarly and intellectual research are expected to take interest in creating, disseminating and preserving knowledge by establishing IRs, but most importantly, they are expected to maintain these repositories to ensure secured future access to stored content regardless of technological advancements (Christian, 2008). Academic libraries are therefore indulging and embracing the notion of Information Communication Technologies (ICTs), by establishing IRs and depositing intellectual knowledge at a rapid pace in academic institutions (Vrana, 2010).

According to Amollo (2011), academic libraries seem to overlook the significance of incorporating long-term digital preservation policies and mechanisms to ensure future access. Mensah (2015) noted that, the development of IR is accompanied by several weaknesses that need to be addressed in the sense of managing digital content to ensure long-term preservation and access worldwide, especially in Africa. Additionally, there seem to be a few studies conducted in the area of digital preservation of IRs (Maddali, Barve & Amin, 2012). According to Igberaese, Samboa and Saliu (2014) attitude and knowledge of librarians concerning digital preservation has not made much progress.

Digital preservation (DP) is a term used to refer to the ability to secure electronic materials surviving technological changes without concern for alternation, loss of readability and access over a pro-longed period of time (America Library Association (ALA), 2007). DP therefore requires new workflows, new skills and close co-operation across different professions ranging from traditional preservation management skills to computing science (Hockx-Yu, 2006). Digital preservation strategies are believed to preserve and enable long-term access to IR stored information. The rise and access to digital content has been directed towards strategies such as migration, emulation, file formats, technology watch among others (Becker et al. 2009). Although there is a growing awareness on the urgent need to incorporate long-term digital preservation activities into IR roles, "digital preservation has not been embedded as an integral part of the repositories' workflow and there is neither much experience nor commonly agreed best practice as to how digital preservation is best performed" (Moseti, 2016: p1).

According to Wheatley (2004) as cited in Hockx-Yu (2006), long-term preservation and access can be achieved as follow:

- data should be maintained in the repository without being damaged, lost or maliciously altered;

- data can be found, extracted and served to a user;

- data can be interpreted and understood by the user; and

- all the above can be achieved in the long term.

The management of IRs further came under scrutiny in recent years as various authors such as Juan, 2012; Li and Banach, 2011; Mapulanga, 2013 observed that long-term digital preservation of IR content appears to be a major concern in academic institutions as they are struggling with the processes of managing digital materials produced to ensure long-term access. This study therefore aimed to investigate long-term preservation practices of digital content in IRs at NUST and UNAM.

1.2 Statement of the problem

The problem is that, some libraries have not yet recognized digital preservation as an integral part of IRs workflow and there is neither much experience nor commonly agreed best practices as to how best long-term digital preservation should be performed (Baro, 2010). The subject on long-term digital preservation in the context of IRs has also not extensively been explored either (Maddali, Barve & Amin, 2012) and Namibian is not exempted from this common challenge. The existing literature on digital preservation in Namibia places emphasis on digital preservation from a digitization angle without provision for strategies employed to manage digital content such as studies conducted by Hillebretcht (2010), Lukileni and Mnjama (2017) on digital preservation of audio-visual material in Namibia. Furthermore, the topic on IRs as researched by Henok and Yule (2019) directed importance on the usage and impact of UNAM IR without necessary outlining how long-term preservation is observed. Meanwhile a similar topic on Electronic Records Management in Namibia by

Nengomasha (2009) exclusively focused on government institutions. In this regard, the best practices of IRs digital preservation particularly in Namibian academic universities have not been documented. Thus the possible risks of future information inaccessibility due to technological obsolescence are also unknown. This is the main problem that this study aimed to particularly investigate in Namibian academic universities. Amollo (2011) and Giesecke (2011) warned that poor digital preservation practices of IRs in terms of lack of preservation education, skills and management policies can lead to future challenges where stored information will be rendered inaccessible due to technological evolution (Amollo, 2011; Giesecke, 2011). The purpose of this study was to fill the gap in literature by investigating long-term preservation practices of digital content in IRs at NUST and UNAM in order to determine future access possibilities.

1.3 Objectives of the study

The main objective of this study was to investigate current preservation practices of digital content in IRs at NUST and UNAM library. The study was guided by the following specific objectives:

a) To examine current preservation strategies of digital content in IRs

b) To investigate if there are preservation policies regulating IRs

c) To assess the level of support received by staff towards digital preservation of IRs

d) To examine skills required or possessed by staff in managing IRs digital content

e) To explore any challenges experienced in IRs long-term preservation practices

1.4 Significance of the study

The results of this study will contribute to the existing literature on the topic of IRs long-term digital preservation practices in the Namibian context and hope to inform

decisions on policy implementation across the study sample and all other relevant institutions.

1.5 Limitations of the study

This study only focused on preservation of IRs (mainly text) content, thus excluding other types of digital collections or formats. Hence it is recommended that other studies look into preservation of other digital formats/collections in various institutions including academic libraries. There is significant lack of knowledge amongst staff members on the concept of long-term digital preservation, thus information gathering was shallow.

1.6 Delimitation of the study

The study mainly covers the Institutional Repositories at NUST and UNAM, excluding any other universities in Namibia. This study only focused on IRs role players, thus excluding users of IRs as well as other library staff members who have no role to play in IR maintenance.

1.7 Context of the study

Namibia has three accredited universities (Namibia University of Science and Technology, University of Namibia and the International University of Management). However, only two of universities NUST and UNAM were in position of well-established IRs at the time when this study was conducted. IRs at NUST and UNAM have both been in existence for more than eight years. The NUST repository widely known as the Ounongo Repository was first established in 2010 and aims to collect, preserve, and distribute digital material from the NUST community. The repository hosts over 550 digital scholarly material from various faculties of the university at the time of the study (Namibia University of Science and Technology, n.d).

The UNAM Scholarly Repository which is much older than that of NUST was established in 2002. Similar to that of NUST, UNAM's Scholarly Repository also commits to collect, preserve, and distribute digital material of a scholarly nature. The repository hosts more than 1859 scholarly items from various faculties and departments at UNAM (University of Namibia, 2011).

Both Ounongo Repository and UNAM Scholarly Repository promote the importance of digital repositories as important tools for preserving and facilitating digital preservation of organisation's legacy and scholarly communication alike.

Although the two institutionary repositories are richly populated, there is no clarity on proposed technological measures in place that would ensure long-term preservation and access to the stored IRs digital contents. It is worth noting that, while ICTs promise quick and effortless access to digital information, they similarly pose significant challenges in ensuring that current content is preserved through one or various technological strategies such as emulation, migration, technology watch, file formats preservation among many other to be explored in chapter two of this study (ALA, 2007). A lack of workflows pertaining to long-term preservation may yield obsolete and inaccessible to stored digital content.

Conversely, the global challenge outlining few studies conducted on the subject of digital preservation as noted by Maddali, Barve and Amin (2012) also seems to prevail in Namibia. With this foundation, a few concepts are worth noting in the context of this study, these are: institutional repositories, long-term digital preservation. Based on this study's pre-analysis, there were few to no studies conducted on the topic to investigate long-term digital preservation practices and particularly of IRs in academic libraries' context. This is unpacked as follows:

From a Namibian context, aspects of long-term digital preservation, IRs, strategies, academic libraries have not adequately been addressed in Namibian literature. A few studies conducted on these aspects by authors such Hillebretcht (2010) on digital preservation of audio-visual material in Namibia focused on digital preservation from a digitization angle. Another author Henok and Yule (2019) conducted a study on the usage and impact of IR at UNAM without necessary outlining long-term preservation. Nengomasha (2009) however conducted "A Study on Electronic Records Management in the Namibian Public Service in the Context of E-Government" and concluded that officers' failed to follow procedures and standards from the E-Government guidelines; there is an absence of a records management disaster plan including digital preservation strategy; and inadequate resources, which includes lack of staff and skills to manage records in general and in particular, electronic records. While Nengomash's study looked at aspects of preservation of e-records, her study mainly focused on government institutions. Hence a need to investigate similar situations in academic libraries focusing on IRs. Another study by Lukileni and Mnjama (2017) looked into preservation on audio visual material, the study focused on physical preservation of audio-visual records. Noting the gaps as they unfold, this study aimed to investigate the current digital preservation practices of IR digital content and establish how this global crisis may affect Namibian universities.

1.8 Definition of terms and concepts

The objective of this section is to define the terms used in this study.

Institutional Repositories: IRs has best been defined by Anbu (2010) as digital holdings of intellectual knowledge produced by faculties, research staff and students of

a certain institution (usually an academic institution) with an intended purpose to avail injected knowledge to end-users within and outside the institution.

Digital preservation: for the purpose of this study, DP has been used to refer to the ability to secure electronic materials surviving technological changes without concern for alternation, loss of readability and access over a pro-longed period of time (America Library Association (ALA), 2007).

Preservation strategies: preservation strategies may be referred to as "well considered and documented approaches concerning electronic information resources" (Kavishe & Dulle, 2016. P4) in this case, regardless of how it was acquired digitally.

Long-term access: the retrieval or recovery of data through reliable systems designed to provide long-term access to archived content (Masinter & Welch, 2006).

Long-term preservation: this refers to the practice of maintaining digital objects overtime to ensure continued future access to stored digital content (Dolye, 2009).

1.9 Research methodology

This section briefly outlined the research methodology of the study. A detailed discussion on the study's research methodology is presented in chapter 3.

This study involved a qualitative, multiple case study research design was adopted to gain in-depth information on the IR digital preservation practices from IR managers at NUST as well as from faculties, research units involved in the processes and flow of depositing intellectual content into IRs at UNAM.

The target population for this study comprised of 48 library staff at NUST (J. Grobler, personal communication, June 05, 2017), 46 library staff at UNAM (L. Mbangula, personal communication, June 05, 2017), Seven Faculties at UNAM and one

representative from the UNAM Research and Publications Unit. This gave a total population of 102.

A purposive sampling technique was used to select a total sample size of 14 participants who were entrusted to have comprehensive knowledge on the processes involved in long-term management of IRs. The participants comprised of one IT Librarian at NUST, five faculty librarians at NUST, and the Director of the Library at NUST. While the sample at UNAM comprised of two IT Librarians, the University Librarian, three Faculty Journal editors comprising of one representative from each faculty (Humanities, Education and Science) as well as one representative from the UNAM Research and Publication Unit to determine guidelines and level of support towards content deposited into IRs at UNAM. The parties, processes and flows involved in depositing content into IRs at NUST and UNAM vary, thus resulting in an unequal sample size between the two institutions.

Semi-structured interview guides were used to collect data from the participants through face-to-face interviews. An observation check-list was additionally used to assess digital preservation principles.

Permission to collect data from the selected university campuses was sought from UNAM and NUST authorities. Faculty Deans at the Director of Research and Publication Unit at UNAM were similarly approached for consent to collect data. The researcher scheduled official appointments through telephone and email prior to the appointments with the participants. The interview appointments were scheduled to the convenience of the participants, at a location that allowed for privacy and non-

disturbance. A digital voice recorder was used during the face-to-face interview process and all participants were asked to sign a consent form.

Data was analysed using content analysis, by transcribing, grouping, coding and interpreting according to the research themes. Data was presented descriptively.

1.10 Research ethics

The Economic and Social Research Council (2004) as cited in Gray (2009) briefly defined research ethics as "moral principles guiding research" (Gray, 2009: p69). In this regard, ethical clearance was sought from NUST and UNAM. Gatekeeper consent to collect data at NUST was sought from the Director of the Library and from the University Librarian at UNAM Library. Faculty deans and the Director of Research and Publication Unit at UNAM were similarly approached for consent to collect data.

Participants consent were sought by issuing an informed consent form enclosing a special section that allowed them to voluntarily sign to be recorded , notes were taken in addition to the audio recordings and where participants refused to be recorded. The researcher ensured that the participants were fully aware that they can withdraw at any time from the study without any damming consequences. Participant's names are nowhere mentioned in the study at all. To attain confidentiality, raw data collected will be secured on a hard disk with encrypted files for a period of 5 years before it is permanently deleted.

1.11 Structure of the thesis

This section outlines the arrangement of the thesis

Chapter 1: Introduction – this chapter is an introduction to the thesis; presenting the orientation of the study objectives, research problem, methodology used and ethical considerations

Chapter 2: Literature review – the chapter provides comprehensive literature with relevance to the research objectives.

Chapter 3: Research methodology – chapter 3 outlines and discusses how the case study qualitative method was applied to the study. Elements of data collection and analysis as well as validity and reliability are presented in this chapter.

Chapter 4: Data analysis and presentation – analysis of data collection

Chapter 5: Discussions and interpretative of findings – provides a comprehensive discussion of the data presented in chapter four, with literature emanating from similar studies.

Chapter 6: Summary, conclusions and recommendations – the last chapter summarises, concludes and provides recommendations as informed by the results of the study.

References: provides a list of all sources, articles, papers and all relevant source material used in the paper.

Appendices: this section provides all procedural documents used in conducting the study. It includes informed consent letters, research permission and ethical clearances letters, as well as the interview guides used to collect data.

1.12 Summary

This chapter provided an overview of the study by outlining the background of the study, statement of the problem, objectives of the study, significance of the study, limitations and delimitations of the study, literature review, theoretical framework, the methodology of the study and ethical issues. The next chapter will critically review the literature on long-term preservation practices of digital content in IRs at NUST and UNAM in order to determine future access possibilities.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter aims to provide an analysis on previous research conducted on digital preservation (DP) of IRs in academic libraries. A literature review is "an important chapter in the thesis, where its purpose is to provide the background to and justification for the research undertaken" (Bruce, 1994: 218). It is therefore a valuable two-faced sword that aids to identify gaps in existing literature on the topic under investigation, while similarly enabling further discovery of relevant information relating to the research topic. Literature review is effective in allowing the researcher to understand the current state concerning a subject area of interest, in order to identify and address loopholes in that particular knowledge (Arshed & Danson, 2015).

Information used in this chapter is sourced from various online databases, journals, books, conference papers as well as published and unpublished theses.

This chapter addresses the themes of the study, which are to;

    a) examine current preservation strategies of digital content in IRs

    b) investigate if there are preservation policies regulating IRs

    c) assess the level of support received by staff towards digital preservation of IRs

    d) examine skills required or possessed by staff in managing IRs digital content

    e) explore any challenges experienced in IRs long-term preservation practices

2.2 Digital preservation

For the purpose of this study, digital preservation has been used to refer to the ability to identify electronic materials surviving technological changes without concern for alternation, loss of readability and access over a pro-longed period of time (America Library Association (ALA), 2007). Successful digital preservation activities require

employing effective digital preservation strategies (Mensah, 2015). According to Thomas (2005) "a digital preservation strategy is a well-considered and documented approach to the preservation of digital objects, to ensure that access to the born-digital archives accessioned by a repository can be maintained indefinitely" (Thomas, 2005, P1).

2.3 Digital preservation strategies of IR digital content

Libraries need to ensure that electronic information or objects stored within IRs are not only accessible in the present, but in the long run and can withstand the rapid development of technology. Kavishe and Dulle (2016) advises that information professionals such as institutional repositories managers should be able to adopt effective measures and strategies to ensure long-term access. According to Dolan-Mescal et al. (2014), "long-term digital preservation is not just about tomorrow, it is also about formulating a plan for today that will make your digital files more organized, efficient, professional, secure and useful. And this, in turn, will only make collections, archives and institutions stronger" (p. 89).

A study by Adekannibi and Wahab (2015) on preservation and conservation techniques of special and academic libraries in Nigeria found that refreshing, technology preservation, and migration were among the most commonly used digital preservation techniques by special and academic libraries in Nigeria. Anyaoku, Echedom and Baro (2017) similarly noted that, techniques for the preservation of digital information include technology preservation, technology emulation, information migration, encapsulation and copying or refreshing. Moseti (2016) found that, Kenyan universities and individuals involved with scholarly content were aware of the need to maintain the long-term accessibility of their research information and took measures to guard against

its loss or inaccessibility. According to Kirchhoff (2008) migration and emulation are the two primary strategies used for long-term preservation; migration involves transforming digital content from its existing format to a different format that is usable and accessible on the technology in current use; emulation involves developing software that imitates earlier hardware and software. Migration is a strategy that requires a deep understanding of the content being preserved, whereas emulation is a more technology-based strategy, requiring a deep understanding of existing hardware and software (kirchhoff, 2008). Moreover, not all the digital preservation techniques are being used particularly because of lack of awareness. This means that digital preservation techniques are not effectively in use in Africa (Olatokun, 2008). Hockx-Yu (2006) additionally stated that, when dealing with long-term digital preservation practices, there is a need for more automation and tools such as automated metadata generation and extraction, as well as automated file format recognition and validation.

A study conducted by Anyaoku, Echedom and Baro (2017) on "Digital preservation practices in university libraries: An investigation of institutional repositories in Africa" found that only few university libraries have successfully created and are managing IRs to preserve their electronic materials in Africa. Furthermore, the study found that only a few African institutional repositories engage in information migration, followed by encapsulation and refreshing as the main long-term safeguarding of IRs content to ensure future access. This indicates that the majority of the responding institutions provide long-term digital preservation in their IR (Anyaoku, Echedom & Baro, 2017).

In an attempt to secure long-term access, a number of preservation strategies on preserving electronic information resources in IRs databases have been developed. It is

also vital to note that not all preservation methods may apply to any kind of software. These preservation strategies range from backups, migration, emulation types of preservation methods for electronic information resources which appears to be more popular. Preservation methods have been categorized into two groups, namely; short-term preservation and long-term preservation, both can be directed to ensure long-term accessibility of stored digital content (Hitchcock, Brody, Hey & Carr, 2005). Emphasis will however be placed on long-term preservation strategies.

2.3.1 Short-term preservation strategies

Short-term preservation strategies are actions performed to provide a temporary solution for a sudden unavailability of data, such as disaster recovery and backup, development and maintenance of tools as well as file formats (Robertson & Bochert, 2014).

2.3.1.1 Disaster recovery and Backups

Disaster recovery and backups refer to storage and repossession of information to a different storage device, which is done to ensure that information stored is recovered and preserved for a longer period of time. This is performed in the event when the original storage device storing the needed information is unavailable or corrupted (Kavishe & Dulle, 2016). Backup activities are understood to provide short-term data access and are usually performed by copying and storing content on multiple sites to ensure readily available data in the event when one storage fails. Thus, while backup, system redundancy, and byte replication maybe used by digital preservation organizations, these actions alone are not sufficient for digital preservation (Kirchhoff, 2008). Robertson and Bochert (2014) advised that, since backups and disaster recovery plans provide short-term solutions, they may not be sufficient to ensure survival and long-term access overtime and therefore cannot play part in long-term preservation,

rather they serve towards long-term preservation in a long run. However, IR managers should ensure that back-up checks and maintenances are regularly conducted by making regular copies of new files and changed files in the event that a server my crush (Robertson & Bochert, 2014).

2.3.1.2 Development and maintenance of tools

According to Capron and Johnson (2002), strategies such as having a storage device (floppy disk, CD/DVD), hardware (computers) that can connect to older media devices and also having software that can read older files from the storage devises are possible methods that can be used to secure long term access to information. These devices are able to access old computers and software to retrieve essential content to be intergraded into the new software (Capron & Johnson, 2002).

2.3.1.3 File formats

Another method to consider when preserving electronic information resources is the range of file formats. Hunter (2000) notes that choosing a file format that is not easily affected by rapid change of technology is a very vital strategy, taking into account that file formats that go unsupported within short period of time should be avoided in digital preservation. Technology and file formats evolve rapidly, thus, it is likely that without appropriate plans, policies and techniques in place to safeguard IRs digital content for future access, knowledge may be lost infinitely.

Furthermore, Kirchhoff (2008) noted that without comprehensive long-term preservation measures to monitor the advancement of technology and file formats, stored knowledge is at a high risk to be lost over time. Meaning, not only should digital content be preserved using short-term preservation methods, but both short-term preservation methods should be mixed (Kirchhoff, 2008). Paper (2008), indicated that

crucial information should not be held in files that will no longer be compatible with the future software because as electronic information becomes more and more complex and integrated. The threats of file format obsolescence is set to increase (Paper, 2008).

However, the storage media has changed over the years, meaning that stored files on virtual servers and cloud may also be vulnerable to corruption, given that the data were initially on the local database, there are still opportunities for corruption in the records (Robertson & Bochert, 2014). Hence, it is prudent to use open file formats such as the popular Portable Document File (PDF), Hypertext Markup Language (HTML) and Extensible Markup Language (XML), because they have open specifications and tend to have wider community support (Hunter, 2000).

Francke, Gamalielsson and Lundel (2017) observed that, the distinction between various PDF versions of IRs file is not always considered by many institutions. This may be problematic in light of the long-term preservation and accessibility of the repository content due to constant change. Thus encouraging depositing of files in PDF/A-1 or PNG formats where possible (Francke, Gamalielsson & Lundel, 2017). At the University of Kenya for example, students are required to submit their theses in PDF format to be uploaded to the IR, an open file format recommended to guarantee long term availability and portability of the document across different computer platforms (Moseti, 2016).

2.3.2 Long-term preservation strategies

Long-term preservation refers to comprehensive systems and practices or activities conducted in ensuring that the current archived or stored digital IR content is managed in such a way that it will be accessible over a long period of time. Long-term

preservation strategies are therefore, practices performed to manage electronic information overtime, regardless of technological advances. As suggested by several experts, there are a number of long-term digital preservation approaches, although there is no single appropriate approach for all information types, circumstances and organizations (Shimray, & Ramaiah, 2018).

Below are some methods believed to form part of long-term digital preservation methods:

2.3.2.1 Migration

Migration refers to as the transfer of resources into a new software and hardware platform (Hakala, 2001). Gbaje (2011) defined migration as the process of transferring data from an endangered platform to a current platform. Migration thus covers a wide range of activities to periodically copy, convert, and transfer original information from one generation of technology to subsequent ones (Igberaese, Sambo & Saliu, 2014). The purpose of migration is therefore to preserve the authenticity of digital objects to ensure that it will be accessible over a prolonged period of time without loss of display and format likely to be caused by technological advancements. Migration as a long-term digital preservation strategy is perceived to greatly focus on the object itself, rather than the environment in which the object is stored, this is done so that the object is not lost or corrupted in the event of hardware and software development which may affect accessibility (Gbjae, 2011).

Reis and Lindley (2007) mentioned that, it is important that migration is fully documented by metadata, and ideally it should also be reversible. To guarantee successful migration, backward migration needs to be performed and should yield result in an exact recreation of the original object. The drawbacks associated with this method

of preservation is that, it does not guarantee a hundred percent successful migration as some objects may be affected during the migration process. This extend of mutilation is described as "acceptable loss" (Reis and Lindley, 2007).

A study conducted by Gbaje (2011) on Digital Preservation Strategies of Nigerian information centers revealed migration (by transferring digital objects from one computer hardware to a newer computer hardware) of digital objects as the only digital preservation method carried out by all the national information centers (Gbaje 2011).

2.3.2.2 Emulation

Emulation refers to creating new software that mimics the operations of older software and hardware in order to reproduce its performance. It helps to maintain integrity of the original look and feel of the IR material (Igberaese, Sambo & Saliu, 2014). Thus, emulation emphasises on the technological setting in which the object was originally created (Hoeven, Wijngaarden, & Remco Verdegem, 2005). Emulation therefore, replicates the technological environment in which the object was created in order to present the data in its original form as possible. It involves preserving the bitstream of the object and creating an access version by using current technology to mimic some or all of the environment in which the original was rendered (Reis & Lindley, 2007).

In this regard, Granger (2000) points out that, the essential idea behind emulation is to be able to access or run original IR data/software on a current platform that emulates the original platform. This practice requires sufficient metadata concerning the environment in which the application was originally designed to work (Hakala, 2001). Considered to have great potential for long-term digital preservation,

emulation would be a greater option to attain significant properties like functionality or look and feel compared to migration, as migration does not guarantee preservation through format changes (Reis & Lindley, 2007).

2.3.2.3 Refreshing

This form of preservation strategy is conducted by copying digital objects from one storage medium to another storage medium usually a newer medium of storage (Gaur & Tripathi, 2012). Kolle, Reddy, Parmeshwarand and Basavaraj (2014) affirmed by offering an example that, refreshing as a form of preservation method is directed by transferring data from an old storage media like an obsolete CD-WRW to a modern CD-RW. Refreshment is thus a fundamental practice for any digital preservation program to succeed, as it tackles decay and obsolesce issues pertaining to media storage. Refreshment on its own is however an incomplete practice and needs to be complimented with other digital preservation methods such as migration techniques to enable long-term access and readability of stored records (Kolle, Reddy, Parmeshwarand & Basavaraj, 2014).

2.3.2.4 Technology preservation

Technology preservation is defined as a method for ensuring ongoing access to digital objects. It requires keeping the old technology, i.e hardware (computer) and software (Adobe PDF Reader) used to create and access IR's digital information in their original form and environment, in the event of technological obsolescence (Igberaese, Sambo & Saliu, 2014). Gaur and Tripathi (2012) related that technology preservation is vital by means of preserving the information object with all its hardware and software necessary to comprehend its content. Kolle et al. (2014) narrates that technology preservation is primarily concerned with the technological atmosphere rather than the object itself. It therefore demands that the digital objects be collectively maintained

with the actual hardware and software to enable access of stored digital objects. Arguably this method of preservation is costly and would require enormous space to store the hardware. Additionally, keeping older machines may not be a viable option as older operating systems and software applications as well as appreciate licenses run the risks of degrading and ultimately bound to crush, considering that technical support towards older hardware and software could also discontinue overtime (Kolle et al., 2014).

2.4 Policies regulating preservation of IR

A digital preservation policy is defined as a plan of action to ensure safekeeping of digital objects, such a plan of action assist to address questions of what needs to be preserved, why, for what purpose, and for how long. Digital preservation policies are thus essential for managing the risks associated with rapid computer hardware and software (Gbaje & Mohammed, 2013).

Well-constructed regulating policies are an important part of long-term digital content preservation, considering the rapid pace at which technology evolves daily. Thus, long-term digital preservation policies need to guide how long-term access will be maintained and ensured for the future. According to Lefuma (2004) preservation policies direct information centres towards adopting measures needed to initiate effective strategies to guard electronic information. Developing preservation policies motivates creation of IR preservation strategies as well as decisions about what content would require short, medium, or long-term preservation should be driven by preservation policies. As IR content grows rapidly, it is important to look at how policies have been developed to guide the implementation of digital preservation for IR content (Li & Banach, 2011).

Some African countries such as Zambia and Ghana appear to be lagging behind in terms of well-established policies and guidelines for digital IR preservation, be they in print, let alone in electronic format, thus operating within a no policy framework (Kanyengo, 2006; Mensah, 2015). Ogbebor (2010), similarly reported that most African countries do not have preservation policies of information both on paper and e-form. The dangers associated with operating IRs with weak or no preservation policies can be perceived as a ticking-time-bomb, because in the event of technological obsolescence, librarians would not be in a position to react to the change with the urgency that is needed (Olatukun, 2008).

In contrast to this, a recent study conducted on preservation skills and strategies of electronic information resources in Kwazulu-Natal by Kavishe and Dulle (2016) recorded an elevated number of libraries with digital preservation policies, which directs digitisation and digital resources acquisition practices. The study concludes that digital preservation policies are not weak across all African countries. Another study by Anyaoku, Echedom and Baro (2017) found that majority of the IRs in Africa have digital preservation policies to guide the implementation of digital preservation for the IR content, although others are in the drafting process.

2.4.1 Best-practices of digital preservation policies

In order to promote and ensure long-term permanent access to digital scholarly resources in IRs, several policy implications need to be addressed by libraries/departments under which the development of IR rests. Policy frameworks are significant in addressing guidance to current and future access. Such a policy framework should consist of components that would ensure that there will be

permanency in knowledge resources whether they are in print or in digital form (Kanyengo, 2006).

A good digital preservation policy should sketch how content will be acquired but most importantly, it should practically outline how long-term activities will be conveyed in the event of technological obsolesce.

Sheldon (2013) gathered digital preservation policies, strategies and plans available for cultural heritage organisations from other parts of the world such as North America, Europe and Australia, in order to establish sustainable digital preservation frameworks towards digital stewardship discussions. To achieve this, 13 policies, which consisted of four universities, six states and provinces, and three national bodies, from around the world were considered. The research then identified common digital preservation principles, and developed a list of 19 high-level taxonomies that digital preservation policies should cover, and are as follows: restrictions

a) **Access and Use** – This refers to a statement of principle which allows continued access and use of digital information

b) **Accessioning and Ingest** – These are procedures conducted to add digital objects into the repository

c) **Audit** – Ways of ensuring authenticity and integrity of digital content deposited into the repository, this can be internal or external audits

d) **Bibliography** – This refers to the supporting information within the submitted document

e) **Collaboration** – Partnerships formed with external organisations to meet and share ideas on digital stewardships

f) **Content Scope** – This defines digital content accepted within the repository

g) **Glossary/Terminology** – Definition of terms used within the stewardship community

h) **Mandates** – Responsibilities among the stakeholders involved in developing and maintaining the repository

i) **Metadata or Documentation** - Metadata documented for preservation throughout lifecycle

j) **Policy/Strategy Review** – Series of repository policies and strategies

k) **Preservation Model/ Strategy** – Refers to suggested procedures to be adopted to ensure continued digital content preservation

l) **Preservation Planning** – A way of monitoring the digital environment for technological changes that might occur, in addition to best practices to ensure long-term preservation of digital content.

m) **Rights and Restriction Management** – Refers to boundaries in place relating to copyright, donation agreements, security and user access

n) **Roles and Responsibilities Security** – High-level roles/responsibilities of institutions and staff

o) **Selection/Appraisal** – Collection policies formulated to guide preservation of digital content

p) **Security Management** – Risk assessment, disaster planning and security procedures

q) **Staff Training/Education Storage** – Continued training and education provided for staff/producer/submitter

r) **Duplication and Backup** – Constitutes of duplication of digital content stored in multiple locations for long-term preservation

s) Sustainability Planning – Plans to address financial stability to maintain digital content in the repository

With the above set of principles, it is alleged that predicting the future of digital preservation policy planning evolution is quite challenging (Sheldon, 2013).

From an African perspective, Drijfhout (2007) noted that African countries such as South Africa do not seem to indicate positive building blocks of digital preservation policies. Thus, digital preservation policies have been proposed to set out principles as follows (National Archives of Canada, 2001, pp. 3-10):

➢ **Planning and strategy** – An overall preservation strategy guiding plans and actions reflecting the scope of the preservation mission by identifying all key result areas for development and implementation, and plan resources accordingly.

➢ **Acquisition, selection and disposal** – describes the physical nature and condition of the records, measured against the capacity of to preserve and ensure access to them in the present and the long term. The nature and condition of the item for example; file format can determine whether or not to acquire or retain records, particularly those technology dependent records.

➢ **Preservation management of collections** – preservation strategy is recognized to be risk management of the overall digital holdings.

➢ **Disaster and emergency preparedness** – a plan consisting of procedures to protect digital holdings by responding to emergencies (e.g., fire, flood, power failure, pest infestation, growth of mold, vandalism, accident) and by leading immediate recovery actions.

- ➤ **Copying** – Refers to number of copies kept based on the value to be considered for treatment, when the copy version has the radical impact of replacing the archival record, (e.g. migration of physical or logical formats of electronic records).

- ➤ **Preservation strategies** - for example, refreshing, transcribing, migration, emulation

- ➤ **Access** – refers to retrieval of digital content from the IRs

- ➤ **Stakeholders and partnerships** – Refers to joint participation or collaboration from various stakeholders concerning the development of IRs

- ➤ **Public awareness and communication** – communication is extended to all stakeholders involved, as well as to supporters and the public, to spread the importance and value of the material held in IRs and the importance of its preservation.

- ➤ **Monitoring and review of policy** – Refers to constant review of the policy at hand to ensure up-to-date procedures and strategies concerting long-term preservation of IRs digital content; and by incorporating the preservation function and programs in internal departmental audit and evaluation plans, as appropriate (National Archives of Canada, 2001, pp. 3-10)

2.5 Support towards IR preservation practices

IR management support is a function performed through collective support of all individuals in an organization working together to ensure that digital content in the repository is well preserved to ensure long-term access (Mensah, 2015). Continuous support and commitment from stakeholders such university finance, library management, academic staff and users involved is required to safeguard and ensure future access to stored IR digital content (Jain, Bentley & Oladiran, 2008). Igberaese,

Sambo and Saliu (2014) remarks that, libraries as well as librarians require strong management support, efficient & effective strategy or policy, positive attitude & actions, adequate knowledge to manage & preserve information and sources, to ensure long-term digital information management and preservation of IRs. Thus, library boards or management need to show more commitment towards the preservation of library resources such as digitalisation of IR content, this kind of support is crucial for successful execution of long-term digital preservation projects (Igberaese, et al., 2014).

To attain successful and effective flow of digital preservation, collaboration among librarians, information technologists, archives and records mangers, faculty, and university administrators and policymakers need to be established and maintained (Yakel, Rieh, Jean, Markey, & Kim, 2006). A lack of management support towards digital preservation initiatives has been proved to be one of the major drawbacks by studies such as that conducted by Igberaese, et al. in (2014). In their study, Igberaese, et al (2014) revealed a lack of management support to be a challenge, hence the lack of training in digital preservation skills and robust policies (Igberaese, et al. 2014). A study by Shameenda (2011) on preservation and conservation of library materials, techniques and practices in the University of Zambia, confirms weak commitment from the University of Zambia management on funding of libraries at the University of Zambia (Shameenda, 2011). A study on "Digital preservation in the context of institutional repositories at the University of Ghana" conducted by Mensah (2015) also found that, there is inadequate support from university management towards availing funds to enable training and staff development skills, experiences and expertise on DP activities. In order to implement effective and efficient preservation policies governing digital information, there is need for commitment from both institutional and national

organisations to provide support, specifically financial and training support towards preservation of digital content (Kanyengo, 2006). Jain et al. (2008) further advised that, top management of universities must be committed to matters of IRs by approving policies and operating procedures and providing resources for operating and updating the IR.

2.6 Skills required to manage digital content

Essential skills and competencies required of an information professional to work in the digital environment have been a significant discussion topic in the field of Library and Information science (LIS) (Nonthacumjane, 2010). The expertise needed in the management of digital preservation plays a vital role towards the success of long-term preservation. The development of Information Communication Technologies (ICT) has caused a paradigm shift towards library operations in terms of services and activities. Due to these inventions, the roles, competencies, skills and knowledge of Library and Information Service professionals have similarly transformed (Nonthacumjane, 2011). Whereas information was previously transferred from librarians to users, technological expansions have consequently influenced the mode of information storage, causing the majority of information to be exchanged between the users and the computers in recent years (Gbaje, 2011). Therefore, librarians should be equipped with Information Technology (IT) skills that will not merely enable them to remain relevant in a digital era, but more so to perform electronic information resource preservation and ensure its long-term access (Moloi & Mutula, 2007). Khan and Bhatti (2017) specified that digital preservation management competencies mean the ability to manage digital library infrastructure, define policies and standards for digitization, cost planning, manage staff, train library users, knowledge of digital library evaluation, and digital skills to backup digital contents. Concurrent to this is Raju (2014) who expanded that librarians

must possess knowledge of digitization, metadata creation and management, preservation of digital information, and computer skills which are useful to work in online information environments. Skills required to engage in long-term digital preservation are further elaborated as follow:

2.6.1 Information technology (IT) technical skills required

The skills required to manage and preserve digital content for durable future access broadly demands knowledge in IT, generic, communication and management skills. Thus, preservation of digital objects necessitates IT skills such as optical character recognition (OCR), imaging technologies, markup languages (HyperText Markup Language (HTML), Standard Generalized Markup Language (SGML) and Extensible Markup Language (XML). In addition, Web technology cataloging and metadata, indexing, database technology, user interface design, programming, and project management were also identified to be essential to DP (Tennant, 1999; Sreenivasulu, 2000). Tzoc and Millard (2011) correspondingly identified and discussed similar skills relevant to perform DP. In their study, they identified the skills required to manage and preserve digital content as follow:

Web application development – experience using common scripting languages, relational databases in the creation of dynamic date-driven web sites and applications.

Markup languages – HyperText Markup Language (HTML), Standard Generalized Markup Language (SGML), Extensible Markup Language (XML) are web design and web standards and are vital for web development. The markup languages in digital repositories are used to encode storage and descriptions for migration, this is with especially with XML.

Web technology cataloging and metadata, indexing - familiarity with emerging or established metadata and cataloguing standards including Dublin Core, EAD, TEI,

FRBR and RDA as well as controlled vocabularies. With these set of skills IR content is described to enable identification and access.

Database technology – refers to database knowledge and experience with relational database design, deployment and management including proficiency with SQL on both commercial and open source database, serves by carry out DP strategies.

Programming – these are scripting languages with less formal procedural scripting languages like PHP, Perl, JavaScript, Ruby and Python.

Digital preservation – knowledge and experience with preservation of both analog and digital materials and ability to manage the ongoing preservation of digital collection content, essential for securing future access to stored digital content in IRs.

Optical character recognition (OCR) - the process of electronically identifying text in a bit mapped page image or set of images and then creating a file containing that text in ASCII code or in specified word processing format. OCR ensures the full text reading of documents containing a mixture of fonts in different sizes and styles (Tzoc & Millard, 2011).

A study conducted by Choi and Rasmussen (2006) revealed that technical understanding of digital library architecture and software knowledge of technical and quality standards; Web markup languages; database development and management systems; and Web design skills are all relevant qualities any librarian managing digital content should consume through trainings/workshops or formal education (Choi & Rasmussen, 2006).

2.7 Challenges for digital preservation

Digital preservation appears to be a significant problem for many academic institutions worldwide, as they seem to be struggling with constructing measures and strategies to

preserve scholarly and cultural records, this is a result of information being produced at rapid pace leading to complicating preservation practices (Li and Banach, 2011; Moseti, 2016). Generally, emphasis has been placed on access, usage, promoting discovery and praising benefits associated with IRs establishments, but not on DP of IR content (Baro, Oyeniran & Ateboh, 2013). Maddali, Barve and Amin, (2012) note that studies pertaining to digital preservation support towards future access has not seen much research, hence the risk of future conundrums. Amollo, (2011) similarly observed that, academic libraries worldwide are taking initiatives to digitize their collections, resulting in IRs formations. Nevertheless, library administration takes little account of long-term electronic preservation efforts and does not seem to be a priority when setting up IRs to ensure future long-term access (Amollo, 2011). Thus, there is an inadequate documentation and investigation on experiences required and best practices on how DP should best be performed (Baro, 2010).

The implementation of DP in the context of IR can be described as a surfacing concept which needs to be addressed urgently as it is a currently a growing consent amongst IR managers (Li and Banach, 2011). The establishment of IR in African academic and research institutions seem to be developing at a snail pace and requires urgent attention, because many academic libraries seem to be struggling (Christian, 2008).

The common challenges regarding the long-term preservation activities of IRs pertain to minimal funds, change fatigue, lack of training, lack of engagement and lack of support and recognition from decision makers. The lack of engagement is in terms of willingness and training often leads to difficulties in digital preservation engagements,

leaving some librarians feeling that they have the mandate to perform digital preservation, however not granted the authority (Rinehart, Prud'homme & Huot, 2013).

Sambo, Saturday and Usman (2014) also confirmed that technology obsolescence, lack of standards, lack of policies, lack of training and manpower as well as a lack of management support are the main challenges likely to hinder progress towards long-term digital preservation practices. Bailey et al. (2006) similarly identified problems in acquiring content, finding appropriate staff, and obtaining faculty buy-in for the program, adequate funding, developing workflows, and resolving copyright issues as major challenges in developing repositories.

These common challenges as experienced by many academic institutions worldwide are further elaborated as follows:

2.7.1 Lack of digital preservation training skills

Saur and Verheul (2006) identified that digital preservation as a major challenge, in the sense that there is an inadequate ratio of digital preservation skilled personnel with the required knowledge and expertise in ICT to manage current and future IR digital information.

From an African perspective, Kavishe and Dulle (2016) noted that technical digital preservation skills are mandatory to librarians managing digital information, these requirements however seem to lack among staff who's work scope is limited to dealing with preservation of digital content. Aggravating this situation is the existence of very few institutions capable of offering specialized training in preservation of electronic information resources, hence a limited number of information professionals who hold qualifications in ICTs related subjects (Asongwe & Ezema, 2012).

An investigation into "Digital preservation practices in university libraries: An investigation of institutional repositories in Africa" by Anyaoku, Echedom and Baro (2017) found various challenges pertaining to long-term digital preservation of IRs in various African countries. The results of the study found various challenges such as: no dedicated staff compliment are committed to manage the IR; none of the repository staff are professionals, as they are on the job training; a lack of resources such as insufficient RAM to host backups; shortage of staff members to manage the IR thus work overload prevails, lack of expertise on IR software such as DSpace; limited budget; continuous power failure; inadequate training institutions on digital preservation in Africa; lack of technical skills from librarians to troubleshoot problems; legal issues; staff hesitant to submit research output to the IR; and lack of awareness on the existence of the IR.

Kavishe and Dulle (2016), observed that there is a scarcity of professionals with qualifications relate to Information Technology (IT) working in libraries. This points to a lack of skills shortage among staff members tasked to manage electronic information to ensure future access. Thus, training pertaining to digital preservation is deemed necessary. Some universities such as the University of Khartoum, IRs are solely managed by IT department officials with little involvement from the librarians, due to the lack of technological skills retained from the librarians (Abdelrahman, 2017). While technical capabilities mark the core business of professional practices to ensure long-term preservation, Nonthacumjane (2011) renowned that other sets of skills such as: personal attributes, encompassing technical and analytical skills, interpersonal qualities and critical reflective practice are equally significant competencies to be

acquire by professionals within the library sciences field. Mensah (2015) recommended that staff work with DP of IRs should have at least: a degree in Information Technology or Computer Science, and diploma in archival studies and library studies.

Challenges related to long-term digital preservation are further specifically discussed below as follows:

2.7.2 Technology obsolescence

Technology obsolescence refers to the end of media storage support of outdated hardware, software and file formats replaced with by newer technology due to constant technology evolutions (Brown, 2008). It is therefore an outcome of inconsistency, lack of continued learning & support on the part of both preservation software knowledge and hardware held by the parties dealing with digital preservation, in this case IR digital content (Kanyengo, 2006). For example, if an IR's standard document format is PDF, this means a PDF software (Adobe PDF Reader) will be required to read a PDF document. This software's however do not remain the same overtime, hence today's PDF software reader version would certainly not be able to read PDF documents to be created in a few years' time. Constant software and hardware upgrades become necessary to ensure that IR content will still be accessible in a long-run. Hockx-Yu (2006) similarly observed that digital preservation challenges are not only limited to the volume of data to be preserved. The rapid technology evolutions demand continuous transformations of hardware and software on which digital information is hosted. Thus, technology obsolesce has been categorised as the greatest technical threat to ensure continued access to digital information, reducing the lifespan of digital information resources compared to paper (Hockx-Yu, 2006). Storage space also plays a vital role in ensuring long-term digital preservation, by ensuring that the media storage device hosting the data has enough memory space to enable smooth operations and to

accommodate the growing volumes of acquired materials (Beargie, Charlesworth & Miller, 2014).

2.7.3 Funding

Digital Preservation is a costly process, especially for countries in Africa that are coping with various problems, of disease, poverty and general slow economic development (Kanyengo, 2006). Funding digital preservation has been identified to be one of the major challenges, because managing digital preservation, especially the importance of integrating digital preservation into mainstream operations of libraries can be quite costly (Saur & Verheul, 2006).

In addition, Mensah (2015) also found that, there are no specific budget allocated to support IRs activities, these financial resources are rather pulled together into the overall budget of the library within which they operate, leading to competition of resources among different divisions within the library. Magama (2017) moreover identified that insufficient budgets and lack of budgets hinder progress to purchase additional software packages, help for system maintenance and ongoing training that may impede long-term access to stored digital content. Sambo, Saturday and Usman (2014) confirm that technology obsolescence poses a threat to long-term preservation of IR digital content, because information sources and media in the electronic age are rapidly changing while some are fast becoming obsolete. This means institutions involved with long-term digital preservation should regularly monitor and study technology trends to ensure continuous availability for future access to the IR. Most of the libraries in this study lack sufficient funding to promote the use of preservation and conservation techniques. Hence, it is recommended that a percentage of the library's

budget be statutorily allocated for preservation and conservation of library materials (Adekannibi & Wahab, 2015).

2.7.4 Management support

According to Sambo, Saturday & Usman, (2014), the lack of support from management towards digital preservation initiatives has contributed to the lack of professional skills and training available for librarians involved within the scope of digital preservation. This is an indication that the challenges of digital preservation of IRs in African countries such as Nigerian libraries are likely to persist. Cullen and Chawner (2008) commented that, there is a lack of ongoing support from senior management in getting involved with allocating training funds and digital preservation quality control measures. A study conducted by Mensah (2015) on Digital Preservation in the Context of Institutional Repositories in Public Universities' Libraries in Ghana, concluded that, support in terms of training, funding and engaging staff dealing with DP of IRs has not met sufficient consideration.

2.7.5 Lack of guiding policies

Digital preservation policies can be described as well-documented approaches outlining measures of responsibilities and tasks to be conducted in order to ensure long-term future access to stored IR digital content (Lefuma, 2006). The absence of well-established preservation of digital content policies compromises on effectiveness and efficiency of information service delivery (Hedstrom & Montgomery, 1998; Sambo et al, 2014). This problem seems to be common among African countries as articulated by Olatukun, 2008; Satish and Umesh, 2005, who stated that most of African information centres that preserve EIRs have got week policies. The absence of well formulated DP policies to guide and protect IR content compromises prompt response and action to rescue digital content in the event of technological obsolescence (Kavishe

& Dulle, 2016). This means, without robust DP policies, there is no action and direction on approaches to be conducted to protect future IRs electronic information.

2.8 Theoretical framework

Theory is a term used to refer to an explanation of a certain social phenomena, by identifying a number of factors or conditions to pass a counterfactual test for casual relevance and whose interaction effects should be taken into consideration (Abend, 2005). A theory is further defined by Welman, Kruger, and Mitchell (2005, p. 21) as a "statement or a collection of statements that specify the relationships between variables with a view to explaining phenomena such as human behavior". Theories are thus useful in shaping, directing and providing focus to a study (Flinders & Mills, 1993). This study is informed by the Open Archival Information System (OAIS) Reference Model developed by the Consultative Committee for Space Data System (CCSD) in 2002 (Ball, 2006).

2.8.1 The Open Archival Information System Reference Model

Long-term digital preservation concerns came to scholars' attention even before the birth of IRs in 2002, as a result, an Open Archival Information System (OAIS) was developed and published by the Consultative Committee for Space Data System (CCSD) in 2002 to guide towards generating suitable standards for long-term archiving (Ball, 2006; Allinson, 2006). The term "Open motivates the possible future archiving standards and frameworks to be formed in open forums to minimize archival restrictions (CCSDS, 2012). The OAIS is thus intended to identify the necessary features of an archival information system (Ball, 2006).

McDonough (2012) declared the Open Archival Information System (OAIS) a "theory of digital preservation" constituting digital preservation practices by supplying a

conceptual and theoretical idea concerning the functional components of a digital repository; the environment and information objects being stored (McDonough, 2012). Allinson (2006) evaluated the OAIS model and its relevance to long-term preservation of IRs digital content and found that the OAIS is widely applicable to long-term preservation and is useful in providing mutual terminology and communication as far as preservation is concerned. Allinson (2006) further observed that any well-established repository should consider long-term preservation, and the OAIS model makes a useful reference point to ensure that preservation is not forgotten (Allinson, 2006).

Organisations such as Sherpa DP and PRESERV who explored the OAIS model found the OAIS model to be double standard, based on the fact that the only weakness of the Model is considered to be its strength. The OAIS weakness refers to the defect of concrete implementation on how the digital preservation community can endorse the certification of a digital repository which is often believed to result in ambiguity and continuity (Chandra & Gokhale, 2012).

The OAIS is made up of two models namely; the *functional model* and the *information model*. Both functional and information models offer virtuous insights on long-term digital preservation aspects and are considered useful in directing this study.

2.8.1.1 The functional model

The functional model of the OAIS defines archival tasks, functions and workflows. It thus identifies and describes the core set of mechanisms within which an OAIS-type archive meets its primary mission for preserving information over the long-term and making it available to the designated community and this has been decomposed into six functional entities, that are taken together to fulfill the OAIS's dual role of preserving and providing access to the information in its custody over a prolonged period of time.

These functional entities are namely; *inject, archival storage, data management, preservation planning, access and preservation* (Digital Preservation Coalition (DPC), 2014). Below is an illustration of the OAIS functional model.
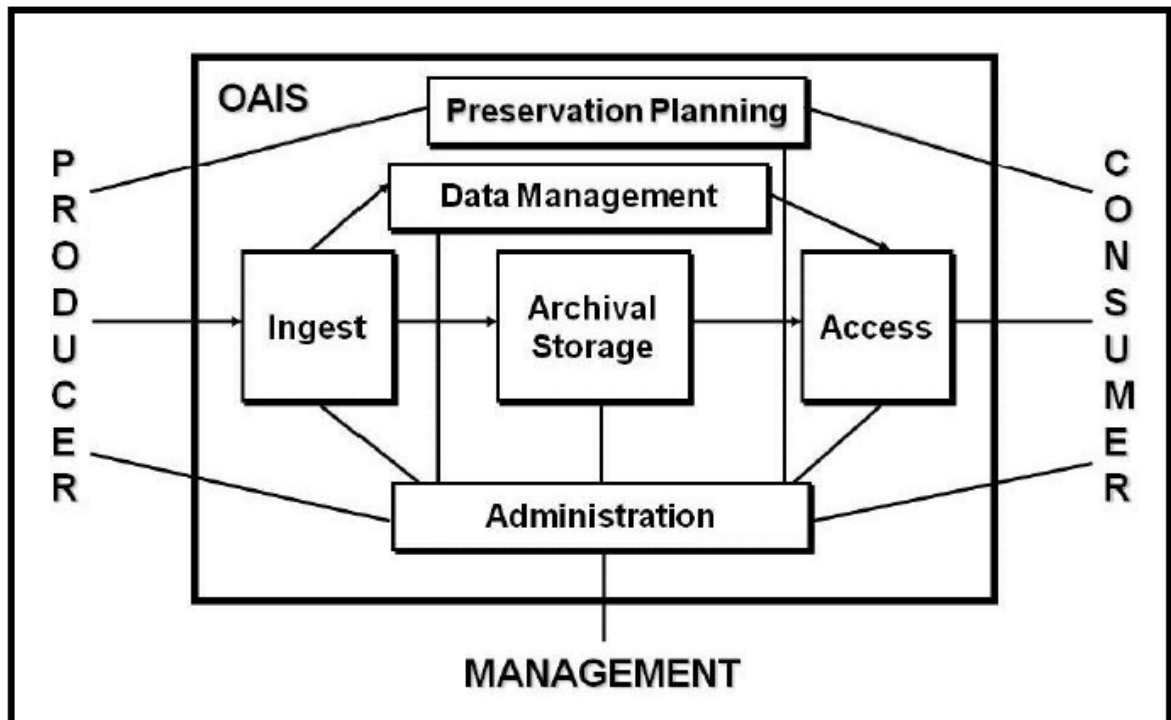
Figure 1. OAIS functional model (DPC & Lavoie, 2014)

The *Ingest* entity places value on information submitted by producers in preparation for archival storage, ensuring that information provided is valid and complete with sufficient metadata to ensure that it is suitable for storage and management to support the retrieval and finding aids. The *archival storage* entity manages the long-term storage and maintenance concerning digital information materials commended by the OAIS in various storage formats. This responsibility is achieved by frequently performing refreshment or migration mechanisms to control occurring system errors to evaluate the outcome of preservation processes as well as disaster recovery policies to mitigate the effects of catastrophic events.

Data management function supports search and retrieval of archived information, its functions thus include maintenance of assigned databases by performing queries and

acquiring reports in response to queries issued (Digital Preservation Coalition (DPC), 2014). The administration function ensures the management of OAIS ' daily operations such as communicating with consumers and management. Preservation planning function can serve as the most essential function for digital preservation of IR content by monitoring the external environment frequently in search of new technological developments and risks that might affect conservation. Lastly, access manages processes and services of locating, requesting and retrieval of information stored within the OAIS for the users of a specified community (Digital Preservation Coalition (DPC), 2014).

2.8.1.2 The Information model

The OAIS information model on the other hand defines the different objects received for archival, preservation and dissemination purposes. The information model specifically draws attention to the type of information necessary for long-term preservation and dissemination, i.e metadata information that enables archived object identification (Consortium of European Social Science Data Archives (CESSDA), 2013). The Digital Preservation Coalition (DPC) (2014) describes the OAIS information model as an entity built around an information package concept, thus conceptualizing the information structure processes within the archival system. An information package therefore consists of the object that is the focus of preservation, along with metadata necessary to support its long-term preservation, access, and understandability, compiled into a single logical package. Below is an illustration of an OAIS information model pertaining to long-term preservation of IR content.

Figure 1: OAIS Information Model
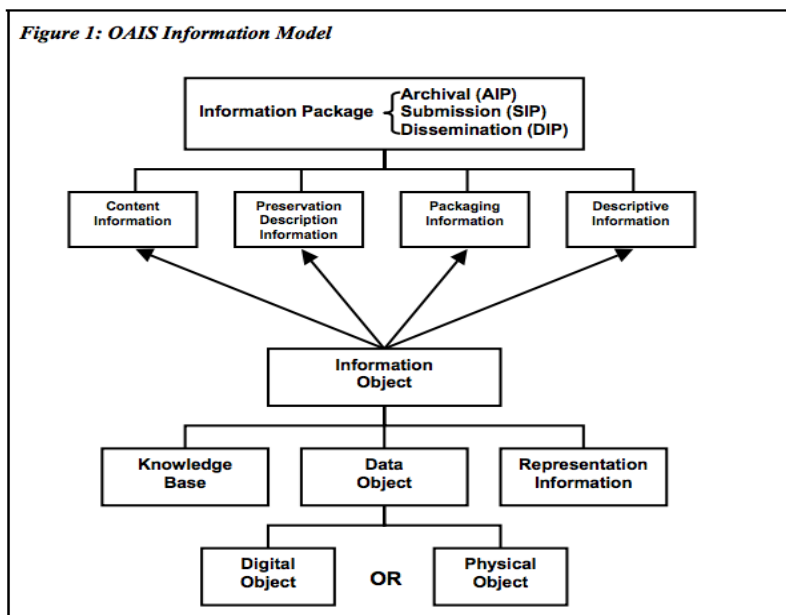
Figure 2. OAIS information model (DCP & Lavoie, 2014)

In the context of OAI information model, *Content data object*, according to Lavoie (2000), knowledge is cultivated once an individual has interpreted and understood the information at hand, this information may be presented in print or digital format referred to as data objects (Lavoie, 2000). Content data object also specifies the preferred format of which information is acquired i.e print or electronic, in the event of digital objects the content data function of the OAIS ensure safeguarding stored content and ensure availability and access in a form that is meaningful to the Designated Community. *Representation information* is an essential linking component that requires information necessary to render and understand the bit sequences constituting the Content Data Object. Representation information might similarly a description of the hardware and software environment needed to display access to content (Digital Preservation Coalition (DPC), 2014). In order to achieve long-term access to stored content, information acquired from producers and consumers should encompass supplementary metadata to support and document OAIS preservation process, this is

referred to as *preservation description information*, containing information necessary to adequately preserve the Content Information it is associated with (Lavoie, 2000).

2.8.1.3 Reason for using OAIS model

The OAIS model has previously been used by various authors in dealing with long-term digital preservation aspects. Gbaje and Mohammed (2017) used the OAIS model to examine issues pertaining to long-term digital preservation from an information and process point of view in Nigeria. Magama (2017) also used the OAIS model to identify digital preservation strategies used to preserve digital records in Masvingo province in Zimbabwe.

Taking into account the objectives of this study, the OAIS model was suitable for this study due to its comprehensive functional entities that covers all aspects of preservation. In accordance with the vision of this study, the OAIS model functions such as preservation, access and administration particularly speaks to the first two objectives of this study. The model therefore provides a comprehensive framework for digital preservation and access functions (Digital Preservation Coalition (DPC), 2014)

In line with the first objective of this study which was to examine current preservation strategies of digital content in IRs, the model directs on how long-term preservation strategies can be followed to ensure future access. Thus, it helped look into keeping digital records permanently accessible and understandable even if the original computing system becomes obsolete. This can be achieved by means of developing detailed preservation strategies, conserving a 'technology watch' to monitor software, hardware, operating systems and determining which formats are at risk of obsolescence, evaluating risk analysis of Digital Records and recommending updates and migration (Glamogan, 2018).

Additionally, archival institutions are expected to possess Collection Policies which define coverage for digital formats alongside analogue (Glamogan, 2018). The emphasis of the model on developing and adhering to policies and standards that enhance preservation and long-term access under its administration function also proved to be in accordance with that the second objective of this study which aimed to investigate preservation policies regulating IRs at two Namibian academic institutions. The model also advances the notion that generate standards that comply with the archive data formatting and documentation (Magama, 2017).

Overall, the OAIS reference model was relevant for this study in providing a comprehensive framework for digital preservation functions considering the primary mission for preserving information through six functional entities; inject, archival storage, data management, preservation planning, access and preservation.

2.9 Summary

This chapter provided an analysis on literature conducted on the topic of digital preservation of IRs in academic libraries. The analysis of the literature was therefore addressed according to the five objectives of the study, which helped in contextualizing and identifying gaps that this study intents to satisfy. Through the literature review, it comes to light that some academic libraries, particularly in Africa are yet to understand the importance of embedding long-term digital preservation techniques into daily operations in order to safeguard future access to digital content. The literature reviewed consequently identified that at most, academic libraries in the business of preservation do not seem to be aware that some preservation strategies they employ are merely short-term digital preservation strategies and that long-term strategies are recommended. Considering the technical knowledge required to successfully preserve digital content, information professionals such as librarians, archivists find themselves unsure whether

they should be at the forefront of administering long-term digital preservation practices or if this is a responsibility of IT support personnel to the library. The literature is silent on how academic libraries intent to solve current challenges such as lack of skills, finances, policies, obsolescence and lack of technological infrastructure pertaining to long-term digital preservation in going forward. The main conclusion on this chapter is that, digital preservation of IR content appears to be a major concern in academic institutions as they are struggling with the processes of managing digital materials produced to ensure long term access. The literature gap on this topic is even broader in the context of Namibia, where the practices involved in ensuring long-term access to stored digital IR content are not documented, thus unknown.

The chapter also looked the OAIS Reference model and its usefulness to this study. The next chapter will outline the methodology employed to conduct this study

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The research methodology chapter describes the methodology employed to conduct this study. Research methodology refers to a systematic way employed to solve a research problem, it is also the procedure by which researchers go about describing, elaborating and predicting the phenomena understudy (Rajasekar, Philominathan & Chinnathambi, 2006). This chapter therefore aims to discuss the research design of this study on digital preservation of institutional repositories in Namibian academic libraries. The philosophical assumption aligned with the study's research designed will similarly be deliberated. Secondly, the chapter will specify the population and sample to which the study confined to, followed by drawing suitable research instruments that were used to collect research data. Issues of procedures obeyed before and during the process of conducting the study are similarly presented in this chapter. In addition, the chapter will further outline and discuss descriptive methods used to analyze qualitative research data. Finally, the chapter reviews the study's research ethical considerations, before concluding the chapter with a summary.

3.2 Research paradigms

A research paradigm implies a pattern, structure and framework or system of scientific and academic ideas, values and assumptions (Olsen, Lodwick, & Dunlop, 1992:16). Similarly, Bryman (2012) defined the term research paradigm as an action that describes a group of beliefs, which dictates and influence researchers' traditions on how research should be conducted and how results interpretations should be done (Bryman, 2012). In other words, paradigms serve as windows in which researchers view the world.

Thomas (2010) observed that, every form of research is influenced by one or another philosophical assumption (ontology, epistemology and methodology), which constitutes or validate the study's research methods undertaken to construct desired knowledge (Thomas, 2010). This entails that, the manner in which any researcher chooses to conduct research may be influenced by one or another philosophical assumption. These philosophical assumptions can be based on different perspectives of reality (ontology), how knowledge is acquired and validated (epistemology) as well as on how research is conducted (methodology) (Creswell, 2012). Extensive philosophical assumptions debates occur among different schools of thought, widely accepted as paradigms. The research world sees three main research paradigms, namely: interpretivism, positivism and pragmatism. Interpretivism was found to be most suitable paradigm for this study. It is briefly unpacked below:

3.2.1 Interpretivism

Epistemology is 'a way of understanding and explaining how we know what we know', (Crotty, 2003). Interpretivism epistemological assumptions intent to understand and describe meaningful social action and experiences, implying that human experiences, common sense and opinions of those being studied play a vital role in generating knowledge. Interpretivism is thus concerned with the view that common sense is a vital source of information, considering that it is used in guiding people in daily existing. This means the notion of generating 'objective and objective truth' as regarded by the positivists may be disregarded by this school of thought. According to the interpretivists, facts cannot be classified as truth, objective nor neutral, more so in social science research contexts. Instead, the interpretivists provoke that real is dependent on the context and peoples' interpretation of information. This denotes that information

generated can only be meaningful if gathered and interpreted from its natural context and are not aimed for generalization purposes (Plooy-Cilliers et. al., 2014).

With regards to ontology, Crotty (2003:10) defined ontology as "the study of being" and it is concerned with "what kind of world we are investigating, with the nature of existence, with the structure of reality as such". The ontological assumptions consequently responds to the question 'what is there that can be known?' or 'what is the nature of reality?' Guba and Lincoln (1989:83). Interpretivism ontology therefore, encourage the view that knowledge and meaning are produced through social interactions and do not remain static, thus, relationships between the researcher and the participant are crucial in generating rich, meaningful and contextualised knowledge. The ontological understanding from an interpretivists' view entails that the world is complex and dynamic in nature. Therefore, meaning is or should be constructed, interpreted and experienced by people within the natural settings, so as to weigh how environment may influence presentation of those involved (Neuman, 2000). In this regard, knowledge and meaning are then produced through social interactions and do not remain static, thus, relationships between the researcher and the participant are crucial in generating rich, meaningful and contextualised knowledge. Interpretivism ontology hence submits to the idea that reality is subjective, since people think, feel, act and experience differently (Plooy-Cilliers, 2014). Hence, nothing is considered right or wrong, rather only different and the research process is believed to be subjective (Klein & Myers, 1999).

Additionally, the methodology philosophical assumption sees interpretivists relying on interviews and observations in generating knowledge. Based on the idea that

interpretivist researchers study reality subjectively, the methodological assumptions also aims to capture the insider's feelings, inner thoughts, opinions and experiences to deduce knowledge within the natural context (Neuman 2000; Ahmed 2008) by means of inquiries such as in-depth interviews, focus group discussion and unstructured observations to generate knowledge (Plooy-Cilliers, 2014). On the basis of this analysis, the research tradition or theoretical perspective underpinning this study took an interpretivism worldview to gain insights or in-depth and contextualised information on the Institutional Repository (IR) digital preservation practices in Namibian academic libraries.

3.3 Research design

Blanche, Durrheim, and Painter (2006) defined research design as a strategic framework for action that serves as a bridge between research questions and the execution or implementation of the research. Welman, Kruger and Mitchell (2005) described research design as a selected procedure or guide specifying how the chosen method may be applied to address the ultimate goal of the study.

This study used a multiple case study approach, which involved two academic institutions, namely NUST and UNAM. A multiple case study was suitable for this study as it enabled the researcher to explore more than one institution in addition to using multiple sources of data resulting in comprehending the phenomenon understudy. While multiple cases study designs just like any other research design poses its own strengths and weaknesses, it is anticipated that there are more advantages than disadvantage to multiple case study designs (Gustafsson, 2017). The benefits associated with multiple case studies are viewed to be robust in a sense that, research findings gathered from multi cases are often considered to be compelling and credible due to the ability that allows the researcher to gather deeper comprehension on the phenomenon

being explored fact that (Herriot & Firestone 1983; Gustafsson 2017). This was suitable for this study as it enabled the researcher to explore the phenomenon in the data which served as a point of interest to the researcher. The limitations pertaining to multiple case study designs are mainly concerned with issues of expenses and the amount of time that goes into it. Thus, "the conduct of a multiple case study can require extensive resources and time beyond the means of a single student or independent research investigator. Therefore, the decision to undertake a multiple case study cannot be taken lightly" (Yin, 2018:54). This is often due to the influx of data emanating from various sources of data which makes data analysis and interpretation time demanding (Anderson, 2010). Despite the unique challenges associated with the aforementioned research approach, this study still found it appropriate to adopt a multiple case study, taking into consideration the benefits that radiate with multiple data sources and in-depth perspectives which produces a broader indication of long-term digital preservation practices in Namibian academic libraries.

Meanwhile, qualitative research is understood as the analysis of words and images rather than numbers; thus it is concerned with meaning rather than behavior, while attempting to document the world from a point of view of people under study (Silverman, 2000). Although qualitative research pays less attention on generalization of findings, it is safe to say that the results obtained through qualitative methods could serve as a valid representation of IRs digital preservation practices to Namibian academic university libraries.

The qualitative method was chosen due to its abilities to generate rich, detailed data believed to be collected cautiously, by leaving the participants' perspectives intact and unharmed (Tewksbury, 2009). Qualitative data collection methods such as interviews

were used to generate rich, in depth opinions on preservation policies regulating IRs, assessing support activities towards digital preservation of IRs, skills required or possessed by staff in managing IRs digital content as well as to exploring possible limitations pertaining to long-term preservation practices in Namibian academic libraries to determine its future accessibility possibilities. This research design was also chosen to provide multiple contexts for understanding the phenomenon under study. Thus, qualitative research is advantageous in vividly demonstrating phenomena or conducting cross-case comparisons and analysis of individuals or groups (Anderson, 2010; Denzin, 2000; Sharan, 2009), in this case, on investigating Institutional Repositories (IRs) digital preservation practices at NUST and UNAM.

3.4 Data collection methods

Data collection are methods for impact evaluation that vary along a continuum, at the one end this continuum are quantitative methods and the other end of the continuum are qualitative methods for data collection (Huberman, Mathew & Miles, 1996).

This study used interviews and observation data collection methods. According to Otieno (2009), qualitative methodologies demands comprehensive observations, explanations so as to produce and understand the fundamental phenomenal in detail, thus it disregards collection of data by excluding the setting within which elements involved in an investigation occur (Otieno, 2009). Qualitative data collection methods such as interviews were used to gather data from the IR librarians, Information Technology supporting staff and other stake holders involved in the submission and management of IRs. Observation methods were also used to gather data from the IR digital preservation policies at NUST and UNAM.

3.4.1 Interviews

Zhang and Wildemuth (2009) defines interviews as tools used to obtain people's experiences, inner perceptions, attitudes, and feelings of reality. Bryman (2001) noted that, there are different types of interviews, ranging from structured, through semi-structured, and unstructured interviews.

Edwared and Hollard (2013) assigned structured interviews to quantitative methods, while assigning semi-unstructured and unstructured to underlying qualitative philosophy. This study used semi-structured, face-to-face interviews. Face-to-face interviews require the interviewer to physically be present in asking question concerning the study to assist where clarity on questions is anticipated (Doyle, nd). Face-to-face interviews followed a semi-structured approach of which Welman, Kruger and Mitchell (2005) described as informal and are used to explore a general area of interest in depth. Face-to-face interviews are beneficial in placing the interviewer in an advantageous position to judge the quality of the responses of the subjects and notice if the question were properly answered (Walliman, 2005). Therefore, face-to-face interview methods were used to gather rich, contextual information on the preservation of IR digital content to ensure its long-term access. In order to understand how knowledge is experienced by the participants, the researcher attempted to move into the natural setting of the organisations understudy, to experience the context from which processes and activities involved in managing digital content of IRs using face-to-face interviews.

3.4.2 Observation

Observations are methods of data collection which requires the researcher to witness occasions within a specified research arena (Bryant, 2011). Observation methods are

considered valuable in aiding the researcher comprehend issues that may have been omitted or overlooked by the researcher during the interview narrating process (Cohen, Manion & Marrison, 2000). Therefore, participant observation method was used to contextualise information pertaining to IR policies coverage in terms of general long-term digital preservation principles in conjunction with the responses harvested from interviews. This was necessary in order to contextualise information pertaining to IR policies coverage in terms of general long-term digital preservation principles in conjunction with the responses harvested from interviews (see Appendix I).

3.5 Population

Population is defined as the entire society in which a sample to carry out research is to be drawn. It is a set of people or events from which the sample is selected and which the study results were generalised from (Bless & Higson-Smith, 2006). Patton as cited in Nengomasha (2009, p. 116) recommends that the "key issue in selecting and making decisions about the appropriate unit of analysis is to decide what it is you want to be able to say something about at the end of the study". Population comprise of groups, individuals, humans, products, events and even organisations (Welman, Kruger & Mitchell, 2005). In this case, the total target population size for this study was 102. This comprised of 48 library staff at NUST, 46 library staff at UNAM, seven Faculties at UNAM and one Research and Publications Unit at UNAM.

3.6 Sample

Sampling is a process whereby the participants are selected from the target population to ensure that the selected subjects are representative of the total population (Schaefer, 1998). Bless and Higson-Smith, (2006) however referred to sample as the subset of the whole population investigated by a researcher and whose characteristics are generalised to the entire population. Qualitative inquiry sample sizes are less restrictive, thus the

sample size depends on the motive of the study and the intended use of the results emanating from the study (Patton, 2002).

Non-probability sampling technique entails non-rondomised methods to draw a sample, thus it permits subjective/judgment sampling. Four methods of non-probability sampling include; convenience sampling, purposive sampling, quota sampling and snowball sampling (Showkat & Parveen, 2017). This study used purposive sampling to select suitable participants.

Blanche et al. (2006) defined purposive sampling as a sampling technique based on careful selection of cases that are typical of the population being studied and is often used to create small, relevant samples in qualitative research or case studies. Patton as cited in Gentles, Charles, Ploeg and Mckibbon (2015) renowned that, "the logic and power of purposeful sampling lie in selecting information-rich cases for in-depth study. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, studying information-rich cases yields insights and in-depth understanding" Patton (as cited in Gentles et. al., 2015, p. 264). Therefore, purposive sampling technique was most suitable for this study, as it allowed the researcher to identify participants stocking relevant information, knowledge and expertise desired to produced further knowledge in the area of digital preservation in the context of IRs in Namibian academic libraries.

A non-probability - purposive sampling technique was used to select a total sample size of 14 participants who were believed to have comprehensive and expert knowledge on the processes involved in long-term management of IRs. The participants comprised of one IT Librarian at NUST, five faculty librarians at NUST, and the Director of the

Library at NUST. While the sample at UNAM comprised of two IT Librarians, the University Librarian, three Faculty Journal editors comprising of one representative from each faculty (Humanities, Education and Science) as well as one representative from the UNAM Research and Publication Unit to determine guidelines and level of support towards content deposited into IRs at UNAM. The parties, processes and flows involved in depositing content into IRs at NUST and UNAM vary, this resulted in an unequal sample size between the two institutions.

3.7 Research Instruments

Research instruments are tools used to gather or collect research data for a specific study. According to Parahoo (1997) as cited in Langen (2009), a research instrument is a tool used to collect data, research instruments thus measure knowledge attitude as well as skills. Based on the research design and methods of specified for thus study, two data collection instruments were used.

An interview guide consisting of semi-structured questions was used to address all the study's objectives. Therefore, semi-structured interviews comprised of pre-set informal questions and were generally used to explore a general area of interest in depth this method allowed the researcher to formulate further questions triggered by participant responses during the face-to-face interviews.

A check-list comprising of common principles pertaining to safeguarding IR digital content in pursuit to ensure long-term access was additionally used to further address the second objective of the study (to investigate if there are preservation policies regulating IRs) with an aim to assess how policies guiding IRs at NUST and UNAM (if applicable) ensured long-term access.

Interview guides are qualitative data collection instruments, used for "incorporating a series of broad themes to be covered during the interview to help direct the conversation toward the topics and issues about which the interviewers want to learn" (Qu & Dumay, 2011, p. 246). The researcher intending to use a semi-structured interview guide should thus prepare questions concerning the study's themes, allowing flexibility (Qu & Dumay, 2011). Observation checklist as a qualitative data collection instrument may be used following interviews to focus on aspects that were not evitable during interviews (Mudzielwana, 2012).

3.7.1 Structure of research instrument

The research instruments used to collect data were structured following the research objectives to guarantee relevant, quality data output. In this manner, two research instruments were used (interview guides and observation checklist). Due to different IRs stakeholders chosen to participate in the study, four interview guides were formulated to ensure that each participant only addressed questions relevant to their expertise or knowledge. The four interview guides were formed to map data from; a) UNAM Faculties and Research Unit, b) IR IT technical support officer, c) Library managers and d) IR Librarians at NUST (see Appendix E – H). Each interview guide was arranged succeeding the study's research objectives and questions formulated were ensured to speak to the objectives. Interview questions were arranged in the way that allowed grand tour questions to direct general questions as way of introducing the topic, and mini tour questions were used to direct specific questions. Possible probing questions were equally outlined in the interview guide.

A structured checklist was a useful instrument used to confirm essential common principles considered to safeguard IR digital content in pursuit to ensure long-term

access. This was used to contextualise information pertaining to IR policies coverage in terms of general long-term digital preservation principles in conjunction with the responses harvested from interviews. The checklist was thus structured by listing the common digital preservation principles, which the researcher observed and commented on (see Appendix I).

3.8 Validity and reliability

Validity is defined as the extent to which the instrument measures what it is supposed to measure. It thus requires that an instrument is reliable, although an instrument can be reliable without being valid (Kimberlin & Winterstein, 2008). Reliability on the other hand maybe regarded as the consistency of the analytic procedures which should include acknowledging and accounting for personal methods and biases that might influence the findings (Noble & Smith, 2015). Although the concepts of validity and reliability are believed to originate from the quantitative worldview, they are also relevant in qualitative research as they define the strength of data. Therefore, reliability denotes "sustainable" and validity connotates "well grounded" (Ritchie & Lewis, 2003). The questions of validity and reliability are worth discussing in qualitative research just as in quantitative research, though they might be treated differently. In qualitative research for example, validity can be achieved by collecting and analysing valid, strong and convincing arguments of participants. In some qualitative research studies, validity and reliability are also referred to as concepts of trustworthiness and credibility (Creswell 2014). Meanwhile, reliability and validity in qualitative research has always been doubted by positivists who debate that validity and reliability cannot be achieved in a naturalistic approach, hence supposing that trustworthiness of findings using qualitative research approach is compromised (Shenton 2004).

Lincoln and Guba (1985) widely developed and used criteria for evaluating qualitative content analysis referred to as "trustworthiness" in support of the argument that the inquiry's findings are "worth paying attention to" (Lincoln & Guba, 1985).

Qualitative validity entails that the researcher checks accuracy by employing certain measures and procedures, while qualitative reliability signifies that the researcher's approach is stable across different researchers and different projects (Gibbs, 2007).

With reference to this study, validity was achieved by employing strategies such as instrument piloting, triangulation and using rich, raw descriptions gained from the interviews (Creswell, 2009). Firstly, validity was attained by the researcher's effort in pre-testing all four interview guides among four participants who formed part of the study. Upon conducting the interviews, the researcher noted additional significant questions and repetitive questions that arose during the pre-test interviews. This lead the researcher to amend the interview guides before having to conduct further interviews, which later proved to sail smooth. Hence, Adu (2015) attests that piloting data collection instruments guarantees the occurrence of reliability, validity, consistency, dependability and replicability in any study. Thus, Pre-interviews may help to determine whether the interview questions are suitable for obtaining rich data that answer the proposed research questions (Elo and Kyngäs, 2008). Credibility of a qualitative research thus depends on the ability and effort of the researcher.

Secondly, to ensure added trustworthiness of research findings, the researcher employed a triangulation approach at which a variety of data collection methods such as interviews and observation were used. In addition, triangulation also applied when the researcher sourced data among different groups of participants (management staff, Librarians, IT personnel, Academic and administration staff members) to build coherence. Researchers who embrace triangulation of data collection methods are likely

to maximise accuracy of their research findings, as this multifaceted approach aid in building coherent and justification of the study's findings (Creswell, 2009).

Lastly, the nature of this study in itself is an advantage in a sense that, the collection of in-depth data from face-to-face interviews enabled the researcher to gather rich and saturated narratives provided greater chance to convey detailed descriptions on the research phenomenon understudy. This is supported by Creswell (2009) who expressed that providing detailed descriptions such as numerous perspectives about a theme results in more realistic and richer findings, adding to the validity of the study. Creswell and Miller (2000) added that validity determines the accuracy of the research findings from a researcher, reader or participant's point of view, thus validity is also identified to be a strength in qualitative research.

Moreover, reliability may be achieved by selecting reliable, dependable and trust-worthy participants to convey those strong, valid arguments (Brock-Utne, 2010). In qualitative research, Stenbacka (2001) argues that, because reliability is primarily concerned with measurements, it thus has no relevance in judging qualitative research matters. Due to this, qualitative researchers sometimes prefer to refer to this idea as "dependability" as opposed to reliability. Dependability refers to the stability of data over time and under different conditions (Lincoln & Guba, 1985). Therefore, it is important to state the principles and criteria used to select participants and detail the participants' main characteristics so that the transferability of the results to other contexts can be assessed (Elo et al., 2014). Based on this argument, "dependability" in this study could easily be easily assured, once the instruments were pre-tested and thereafter cleared of errors such as repetitive questions. Additionally, the sampled participants purposefully comprised of individuals who best represent and have

knowledge of the research topic. Lastly, the researcher ensured that every step was recorded systematically and the report reflects original narratives and descriptions given by the participants to ensure unique, context base results.

3.9 Data collection procedure

The researcher sought permission to collect data from the selected university UNAM and NUST management. Permission was further sought from library management of UNAM and NUST to collect data at the libraries. Faculty deans at UNAM and the Director of Research and Publication Unit at UNAM were similarly approached for consent to collect data. The researcher telephonically called to confirm the availability, venue and time which the participants were comfortable and available to be interviewed. The interviews at NUST were conducted by a research assistant, who had no affiliation with NUST. All participants preferred to be interviewed in their offices, (as this was most convenient for them and their work schedule). The researcher introduced herself and the topic she was researching on, and also explained why the participants was chosen to be part of the study. An informed consent form was thereafter issued to the participants to sign. A digital voice recorder was used during the face-to-face interview process with participant's consent. Each interview lasted between ten to thirty minutes.

Shortly after the interviews were conducted, the researcher went on to conduct observations on policy documentation available on the IRs at each institution. This was observed by following the check-list guidelines to measure against those outlined in the NUST and UNAM IR policies, this procedure took Seven minutes at both institutions.

3.10 Data Analysis

Data analysis is an essential concept in qualitative research, as such, findings are understood through analysis of data (Flick, 2013). It is a process of bringing order,

structure and meaning to the mass of collected data (Hital & Alabri, 2013). Flick (2014) referred to qualitative data analysis as the interpretation and classification of linguistic material, with an aim to create meaning of data gathered. The qualitative data is analysed using content or text analysis methods by transcribing, grouping, coding and interpreting according to research themes. Qualitative data analysis is usually based on three stages that is, preparing and organising data; coding the data; and presenting the data in the form of text, tables and figures (Adu 2015).

In this study, an inductive content analysis method was used to transcribe, process and analyse data from this study, by means of categorizing, coding and abstraction as recommended by (Elo & Kyngäs, 2008). Content analysis is the processes of outlining the main thematic issues of the study to be systematically and objectively be processed into meaningful information, such as research reports (Smith, 2000). It is also the processes of analysing written, verbal or visual communication messages (Cole, 1988). According to Marshall and Rossman (2011), the method of inductive content analysis is applicable when interpreting written records stemming from gathered perspective. Thus, researchers who analyse data by means of inductive content analysis are informed to arrange qualitative data by using open coding and creating categories for abstraction (Elo & Kyngäs, 2008). These categorisations allow the researcher to merge data and deduce meaning and understanding of the context in which a phenomenon is being analysed and the categories derived from it (Bryman, 2004; Elo & Kyngäs, 2008). Content analysis was further used to analyse data gathered from observation through means of text interpretation by simply comparing the observation check list against the digital preservation strategies covered in the IR policy at instution A.

In conjunction with the above specified conceptions on inductive content analysis, the following steps were employed in analysing qualitative data which was gathered through face-to-face interviews and observation methods in this study:

In preparation to analyse data, the first step involved organising raw data gathered in form of field notes, audio and other documentation. By organising the raw data, the researcher ensured that each audio recording could be identified by providing file names based on the type of interview, participant and the respective institution where data was collected. For example, raw audio file names contained file names such as IG1_IRIT_B and IG4_IRL_A (Interview Guide 1 for IR IT officials at institution B and Interview Guide 4 for IR Librarians institution A). This marked the first stage of coding. According to Saldana (2011) coding ensures meaning and explanations through techniques categorisation of data. Data from this study was thereafter coded, enabling the researcher to form minor clusters of information forming the beginning of analysis.

Additionally, with the above arrangements in place, the researcher then continued to precisely (word-for-word) transcribe the audio interviews onto a document using Microsoft Word (MSWord). Once audio data was transcribed into typed text, data was then explored by reading the text several times in order to acquaint with the datasets, as this becomes beneficial in establishing insights, themes and categories deriving from the data (Clark & Creswell, 2010; Thomas, 2006). Once again, coding applied at this stage by means of identifying emerging themes and meanings from the various perspectives in accordance to the research objectives of the study.

Lastly, with reference to this study, themes were established by interpreting and analysing data concepts from various exact perspectives on long-term digital

preservation of IR in Namibian academic libraries and through which meaning could be constructed by data interpretation. The themes established for the study induced significance from the specific objectives of this study. Content analysis was further used to analyse data gathered from observation through means of text interpretation. Data emanating from interviews and observation methods was integrated to measure IR policies strength at Namibian academic institutions in terms of common principles considered to safeguard IR digital content in pursuit to ensure long-term access.

3.11 Research ethics

Ethical concerns are central to the topic of research in general. Research ethics are a set of standards used to refer to the moral and professional attitudes and behaviour concerning research (Marianne, 2014). Ethics exist to protect those selected to participate in the research (Flick, 2014), thus they are important in qualitative research, taking into consideration that, good ethical qualitative research equals being able to anticipate what might arise, but also respond to the unexpected, working in a thoughtful and reflective way (Ritchie & Ormston, 2003). Research codes and ethics should thus be observed by ensuring that the participants are well informed about the study and its purpose through voluntary informed consent forms, insurance to privacy, and confidentiality by not mentioning names of participants (Flick, 2011).

In the context of this study, ethical clearance was sought from UNAM. Gatekeeper consent to collect data at NUST was sought from the Director of the Library and from the University Librarian at UNAM Library. Faculty deans and the Director of Research and Publication Unit at UNAM were similarly approached for consent to collect data. The researcher being a NUST employee did not collect data at NUST, thus a research assistant, who has no affiliation with NUST in any way was employed and oriented on

all specified ethical and procedural issues in order to gather data on behalf of the researcher at NUST, in addition to this, the research assistant signed a clause of confidentiality.

Participants consent was sought by issuing a consent form: enclosed as a special section that allowed participants to voluntarily sign for their voices to be recorded, notes were taken in events where participants refused to be recorded. The researcher and the assistant ensured that the participants were free to withdraw at any time from the study without any negative consequences. In such a case, all the information that the participant already gave, was disregarded and not used in the study. Participant's names were not mentioned at all. Confidentiality was attained by securing raw data collected on a hard disk with encrypted files, and it is to be kept for a period of 5 years before it can be permanently deleted.

3.12 Summary

This chapter aimed to discuss the methodology related to this study. Accordingly, discussions relating to research philosophical assumptions (ontology, epistemology and methodology) along with interpretivism research paradigm which was identified in guiding this study was outlined in this chapter. Additionally, the chapter outlined the research design which employed a multiple case study, qualitative approach, thus, engaging qualitative data collection methods of interviews and observation. Subjects on population and sampling techniques central to the study were likewise discussed. The research instruments being interview guides and check-list for collecting data were similarly outlined in this chapter. Although the sample size is quiet nominal, validity and reliability was ensured by pre-testing the tools, knowledgeable participants in the area of investigations and systematic recording of the research process. The chapter equally highlighted purposive sampling technique to select the participants. Qualitative

data analysis was also covered in this chapter. The chapter additionally looked at the procedures and ethical considerations adopted by the researcher.

The next chapter (chapter 4) presents data collected from both NUST and UNAM on digital preservation of IRs.

CHAPTER 4: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

The aim of this study was to examine long-term online preservation activities in Namibian academic institutions for IR material , particularly NUST and UNAM. This chapter presents data that was collected through semi-structured interviews and non-participant observation method from UNAM and NUST. This chapter presents views and opinions given by the participants on issues related to long-term preservation of IR digital contents. For the purpose of confidentiality and anonymity, the names of the institutions are withheld and only represented with alphabetical symbols such as institution A and institution B. A descriptive analysis is used to present the data, with direct quotations from the participants in some cases . Data is presented based on the key thematic issues which are as follows:

- ➢ Preservation roles and activities
- ➢ Importance and consideration to long-term preservation
- ➢ Policies and guidelines in place to govern IR digital content
- ➢ Support towards digital preservation activities of IR
- ➢ Budget allocation and training support to IR activities
- ➢ Skills required to manage digital content for long-term access
- ➢ Challenges associated with IR digital preservation

Four interview guides have been developed and used to collect data among the various IR stakeholders. All four interviews were therefore designed to address the goals of the analysis discussed in this chapter under different themes. On the other hand, the observation checklist was used to discuss more IR policy issues and how long-term IR material protection is integrated into existing policies. Data emanating from observation method is presented in a table format in addition to the interview narratives.

While data gathered through face-to-face interviews were transcribed verbatim and is presented in form of narratives and direct quotes from the respondents in this chapter.

4.2 Participants of the study

Data was collected through semi-structured interviews from librarians (IR librarians, IT librarians and library top management; such as library director/university librarian and Heads of Departments in the library), IT support officers, research and publication unit as well as journal editors responsible for IR content submission, who are addressed according to job titles i.e IT librarian etc at both intuitions. Additional data was collected by non-participant analysis from policy documents. The aim of the analysis was to collect data from different stakeholders involved in IR activities. A total of 14 participants were interviewed face-to-face as well as observation of one policy document from institution A.

The table below illustrates the number of participants interviewed at each academic institution.

Table 1. Number of Interviewees

Institution	Total number of participants	Number of participants Interviewed by category				
		Library manager	IR Librarian	IR IT support officer	IT librarian	Research publication unit/Faculty journal editor
Institution A	7	1	5	1	-	-
Institution B	7	1	-	-	2	4

Total number of participants N=14

4.3 Background information

To create IR digital content preservation activities, the researcher sought to understand whether any of the academic institutions had a department within the institution

responsible for long-term IR preservation. The study revealed that at institution A, the responsibility is shared among two departments: mainly the library department as the custodian of IR as well as the ICT support department. This was similar with institution B, where the responsibilities are also shared between two departments: the library department and Computer Centre. It was identified through the interviews that, institution B has no dedicated department dealing with issues relating to IR. The institution simply has a repository in which people are required to give 20% of their work as recounted by an IT librarian from the institution B ; " *There's none, it's just people who have been asked to give 20 percent of their database work, but they're not alone in the repository. I know, we don't have a dedicated IR group, let alone conservation team, but we're planning to nominate one* ". Another IT librarian narrated, "t*here is no specific dedicated department, rather role players assigned to deal with the IR"*It emerged from the study that both institutions use D-Space as the IR software solution.

4.4 Preservation strategies of IR digital content

The first objective of this study was to examine current preservation strategies of IR digital content. Consequently, this objective discussed the roles and responsibilities of IRs with regard to digital document management; existing long-term preservation strategies; value of long-term preservation; storage space issues; disaster management plans and recovery backups; level of satisfaction on current preservation methods as well as assurance on possible future access to store IR content. These subject areas are vital in determining how knowledge is preserved for long-term access.

In meeting this objective, the responses were gathered among the IR IT support officer, IR Librarians involved and the library manager at institution A. While at institution B, data was gathered from the IT librarians as well as the library manager. The disparity

between participants is brought about by the processes involved in the workflow. Therefore, at each organization, the group overseeing IR varies, resulting in participant variation. However, the goal is to document how digital IR content is preserved, irrespective of the 14 different stakeholders involved in each institution. It is thus crucial to note that each group had a specific interview guide, which was based on the knowledge that relates to their tasks concerning the IR.

4.4.1 Roles and responsibilities of stakeholders

In researching current digital content protection approaches in IRs, the author sought to examine the positions assigned to different IR workers. The long-term IR conservation dimension of roles and responsibilities is important to this study objective as it helps to establish an understanding of what activities are considered and performed in order to ensure a continuous future.

The researcher interviewed five IR librarians that work directly with IRs at institution A. In order to garner information on the scope of works on IR the researcher asked the following question ***"I understand that you are a stakeholder in developing the IR content, what is your role regarding the IR"?***

In response to this question, one IR librarian narrated *"our department mainly deals with adding, depositing and uploading contents into the system. We are also responsible for adding new faculties and departments, however 90% of the database maintenance is done by systems administrators".*

Another IR librarian narrated that *"I am simply responsible for uploading what we receive from lecturers and making sure that content is uploaded under the correct folder/s."*

Additionally, one other IR librarian responded saying *"my role includes depositing and archiving articles in IR; requesting copies of items to be archived for lecturers and*

departments; research for permissions through Sherpa-Romeo website before archiving; creating records and do quality control".

Furthermore，an IR librarian involved with IR at institution A similarly recited that their main role pertaining to IR is to upload research output into the repository. The IR IT support officer at institution A also noted that its position in the IR was primarily concerned with *"ensuring that the IR server is operating efficiently and upgrading to new versions are done periodically.*

Institution B was asked a similar question **"I understand that you are a stakeholder in developing the IR content, what is your role regarding the IR"?** One IT librarian at institution B reported that *"My job focuses primarily on uploading PDF files and resources following global trends in the preservation of thesis, thesis and articles".*

4.4.1.1 Management of IR electronic documents

In assessing the role of librarians in digital preservation, responses from five IR librarians at institution A and two IT librarians at institution B were gathered once again**.**

The researcher prompt responses from IR librarians at institution A by probing the following question "***do you manage digital content deposited into the IR in anyway?*** The overall response from all five IR librarians at institution A was "no". One IR librarian explained further that *" A responsibility for handling digital content is limited due to a lack of IT skills and knowledge ".* Another IR librarian remarked that *"I don't manage digital content in anyway, the systems administrator is responsible for that scope of works ".* In response to the same question above, one IT librarian at institution

B narrated that "*their role concerning the IR is mainly focused on occasionally scanning and uploading of files onto the IR database.*"

4.4.2 Digital preservation activities

The author requested opinions at both institutions A and B on current digital conservation activities taking place. The answers from library managers, IR IT officials and IT librarians are as follows:

Library mangers

The researcher asked library managers, ***do you have an idea on what activities are being conducted to ensure long-term access of IR content"?***

The library manager at institution A responded: "*I assume that primarily database servicing, backups and software upgrades (D-space) are part of the conservation activities.*"

In response to the question above, the library manager at institution B narrated that "*I am certain that backups are conducted for the IR system. What I am not sure about is the file format preservation*".

IR IT support officials

The IT support officer at institution A was consulted on the current preservation strategies of IR. In response to the question ***"which activities are considered part of the scope of the digital preservation function within the IR?"*** The IR IT support officer responded "*We do database updates using D-space software. So we are essentially only responsible for making sure it is on and upgrading it to a newer version.*". The researcher also explored whether other activities are being carried out and what exactly the upgrade entail . The respondent reported that: "*We actually create a new server when we update, which is a test server. We do all the testing on that server because there are always new software innovations*".

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Following this response, the researcher once again probed if other preservation methods such as migration, emulation etc. were considered. The respondent responded that: "*I can't really say that we are migrating because it's more like updating. We do this by taking the data from the previous version and migrate it to the newer version-there is no difference in the data. What we do is create a completly new version of the operating system, such as a newer D-space version, and then we just move the information to the newer version.*"

IT Librarians

Responding to the question ***"which activities are considered part of the scope of the digital preservation function within the IR"?*** The two IT librarians at institution B narrated that, digital preservation activities at institution B involve conducting backups and regular upgrades of the IR. One IT Librarian narrated that *"There is a backup and upgrade done by the ICT department every night"*. This process is carried out with the use of virtualization technology, holding snapshots of the IR's virtual machine, according to the respondent, more backup is carried out for the actual content, statistical content, metadata database and its' actual files.

Based on the respondents' answer, the researcher further probed the IT librarian on the use of long-term preservations techniques such as migration, emulation etc and how these techniques are used. The IT librarian reported*: " We haven't done any migration so far, because we're trying to stick to open file formats because the server is mainly text-based PDF, which is widely supported. We may need to move if we collaborate other than PDF formats when they are no longer supported"*.

Following this response, the researcher further investigated on *"what happens in the event where the PDF version has advanced?"*. The IT librarian indicated that:

"We didn't really think about that, although I don't recall when files didn't open the PDFs hosting now. Nonetheless, I think somebody should be committed to reviewing the credibility of this file and seeing if it is still supported. The need to relocate will then be decided". The respondent further reported that there is a need for regular check-ups on the files hosted by the repository, in ensuring that they are all accessible. According to the respondent *"another issue is the testing of backup recovery. I don't think this is happening at present".*

In response to the question *"which activities are conducted to ensure that the current IR content will be accessible in a long run?"* Another IT librarian assigned to IR roles at institution B narrated *"That process includes the ICT department's database servicing and backups. My main role is to upload files/resources in PDF format following global trends in the preservation of theses or articles".*

Following the analysis on digital preservation practices to ensure long-term preservation of IR content, the above accounts from library managers, IR IT support officer and IT managers indicate that backups and system upgrades are the main preservation methods at both institutions understudy.

4.4.3 Disaster management plan

Participants were asked on issues concerning the presence of disaster plans to protect or recover lost data. The question regarding disaster plans was directed to library managers at both institutions A and B, the IR IT support officer at institution A as well as the IT librarians at institution B.

The researcher asked the two library managers at both institutions A and B ***"does the IR have an information disaster plan in the event the server crashes"?*** The library manager at institution A reported that *"The ICT department's data center conducts backups of all our databases every night. A copy is saved on another virtual server to make it easier to recover an extra one if this one crashes"*.

The practice at institution A on information disaster plan appears to be similar to that at institution B. According to the library manager at institution B, *"the ICT department have two backup facilities, one on campus, and another at an off campus location Regular backups are conducted, and are required to be tested at least twice a year"*.

In response to the question ***"does the IR have an information disaster plan in the event where the server crashes"?*** The IR IT support officer from institution A added that in terms of disaster plan, *"A remote/online database is available from anywhere and a backup is performed. In an event anything goes wrong, we can always go back to the backup"*.

Further responding to the question on disaster plan, two IT librarians were interviewed from institution B. One IT librarian related that *"the computer center of the university conducts backups of the IR machine and the actual content, and we also backup the IR content from the library side"*. The second IT librarian also referred to nightly backups conducted by the computer center as a form of disaster recovery plan.

4.4.4 Backup recovery

This dimension sought answers from institution A's one IR IT support officer and institution B's one IT librarian. Participants were therefore asked to describe how easily backups can be restored in the event of primary system failure or natural or manmade

catastrophe. The response by the IR IT support officer at institution A and IT librarians at institution B presented that, backups can to be recovered within one to two weeks at both institutions A and B. The IR IT support officer at institution A narrated that backups are recoverable quicker because *"we have a server running online and it is accessible from anywhere. We also have a clone of the said server. This is done to ensure recovery of the backup, and most importantly the data"*. The respondent referred to an incident involving the removal of the database replica, triggering a new server configuration from scratch. In doing so, it took about two weeks to transfer the data successfully to the newly setup server. The IT librarian at institution B also related that IR data was lost once, but could be recovered within one week. According to the respondent, the server crashed due to limited storage space, causing file corruption as a result.

4.4.5 Storage space

The researcher investigated the availability of IR storage space, to which the IT librarians at institution B observed *"a total of 300G, of which 70% is already in use"*. The respondent significantly specified that the storage capacity was not solely meant for the repository, but included the library operating system as well as content from the repository. The storage space for IR could not be determined at institution A, because the IR IT support officer did not have the necessary information to determine the amount of storage space utilized or availed to IR.

4.4.6 Importance of long-term digital preservation

The study also aimed to establish the importance of long-term digital preservation for IRs. Responses were gathered from IR librarians, library manager and IR IT support officer at institution A. While IT librarians and the library manager were consulted at institution B. The researcher posed the following question "***do you consider long-term***

preservation of digital documents to be an important task of libraries? Can you please elaborate your answer?" The general response from both institutions was that long-term preservation is "very important", with one institution B IT librarian arguing that DP is vital for libraries as it ensures the consistency of current information for the future. In addition, another IT librarian from institution B reasoned that long-term DP is of significance for libraries because *"We want longevity to ensure that whatever information we now have is still available to future generations. Therefore, libraries have an important role to play in ensuring the learning continues".*

Additionally, IR librarians at institution A also considered long-term preservation to be of great value because;

- It is part of collection development

- It is the responsibility of the library to make sure the institutions' intellectual knowledge remains accessible in the future

- The search and need for information can be very spontaneous

- If content is not preserved, this deprives the community from valuable knowledge

- The next generation would like to see what has been researched and what have been the research outcome for these years, so it is very important.

To amply the importance of long-term DP the library manager from institution A responded *"I think it is very important because, it provides an community of accessible information that can be utlised by future researchers. It also contributes to the advancement of the institution as a research institution".* The library manager from institution B narrated *"It is very relevant because we're working with exclusive things*

like theses and rare books. When we digitize them, the element of digital preservation should always be included. This term in Namibia should be extremely important ".

The above responses regarding views towards importance of long-term preservation from both institutions A and B indicates that there is an understanding and value placed towards long-term digital preservation of IR content.

4.4.7 Level of satisfaction towards current IR digital preservation activities

Additionally, the study investigated the level of satisfaction by library managers towards current preservation strategies to ensure long-term access. The researcher posed a question to the library managers ***"how satisfied are you with the current preservation practices of digital content in the IR? Can you please elaborate on why you are satisfied/dissatisfied"?*** In response to this question, satisfaction was expressed towards current digital preservation activities at institution A. The institution A library manager expressed that *"at this stage I am satisfied, because we haven't identified any critical short comings at this stage and the software is constantly upgraded"*. Whereas a level of dissatisfaction was felt at institution B. In response to the level of satisfaction towards current digital preservation activities, the library manager at institution B expressed dissatisfaction towards current preservation practices due to uncertainly of testing backup recoveries. The respondent narrated that *"I think almost everything is being done in backup relationships, but we didn't really try to check if the recovery system is actually working, so we didn't test the recovery. However, I am also worried about the conservation of file formats, we should consider setting up a program and procedure to address this issue"*.

The above responses on the level of satisfaction with current preservation techniques signals dissatisfaction towards current techniques to ensure long-term preservation,

considering fear expressed by the library manager at institution B towards the lack of file format preservation consideration to ensure future access.

4.4.8 Responsibility for long-term digital preservation

The study further sought to source understanding on whose mandate it is to ensure long-term digital preservation of digital content. Thus, the library managers, IT librarians and IR IT support officer were asked the following question ***"who do you think should be responsible for ensuring long-term digital preservation and why"***. The library manager from institution A responded *"in my opinion, it is a shared responsibility. Librarians, have the technical know-how to add metadata and description, but the ICT aspects of digital preservation of it can be managed by the ICT section of the university"*. The library manager at institution B similarly remarked *"I tend to think that librarians and archivists are responsible for long-term conservation because they are in the information management field. Therefore, they must liaise with IT professionals for their technical element"*.

The library manager at institution B further elaborated that a collaboration between IT and Library professionals is necessary, because professionally, librarians are trained in knowledge management and therefore understands issues concerning management of knowledge. The library manager at institution B further stated that, IT professionals sometimes tend to be more practical, with interest in latest technologies and most effective technologies, with little interest in knowledge management and document preservation.

Consequently, the two IT librarians at institution B advised that the task should be a collaborative effort between library professionals and IT professionals. One IT librarian

further affirmed collaboration, because *"librarians have knowledge management skills, capacity and standards. They play a role in advocating for easier methods od documenting and preservation methods. in place".* The respondent continued; *"I don't believe IT professionals alone are able to withstand the conservation of information because they often don't need to pay attention to the actual content. We had to educate some on file format issues because they don't know that file formats might not be accepted anymore in the future. The librarians should therefore step in with this information and then introduce IT professionals".*

Following the responses under this subtheme, it is clear that respondents hold libraries responsible for ensuring long-term preservation activities.

The study also intended to investigate the participant's assurance towards secured IR knowledge future access. The responses were gathered from library managers at institution A and B, IR IT support officer at institution A and IT librarians at institution B. The researcher enquired "***do you think information stored in the IR will still be accessible in 20 - 50 years to come? Please explain your answer".*** The responses from library managers at both institutions expressed confidence in continued future access to contemporary IR knowledge. Responding to possible long-term future access, the library manager at institution A is confident that IR digital content will still be accessible for a long time, because *"we have the staff with necessary skills to ensure that future access is enhanced, by performing activities such as regular maintenance of servers and databases as well as by applying the necessary standards for preservation i.e adding the metadata and the description so that it is accessible".*

The library manager at institution B commented that future access is possible, *"because there is interoperability with other databases, if problems arise, consultations can between institutions can take place in order to identify best practices"*.

The IR IT support officer at institution A remarked that *" We can't be too sure of these issues because changes are happening all the time. Nonetheless, judging by how we store the data, I agree that the information can live for a longer period of time and can still be available"*. The respondent continued *"as I previously mentioned, we always have the data kept safe and we can find ways to actually transfer it to a new system"*.

Moreover, one IT librarian from institution B noted *"I think if we continue with the current practices adopted we will still have access in the long-run. However, more effort needs to be addressed in the area of testing backups so that our repository is trustworthy, as this is not happening at present"*. Another IT librarian at institution B also noted that contemporary IR content is highly likely to be accessed, because *"the database is being maintained by performing backups, so the backup systems in place will help drive towards that.*

4.5 Policies and guidelines in place

One of the objectives of this study was to investigate the availability of policies which govern digital preservation activities for IR at institution A and B. Under this theme, the responses were gathered across all participants in the study at both institutions A and B. At institution A, the question relating to policies and guidelines was addressed by five IR librarians, one library manager as well as one IR IT support officer. Whilst at institution B, the topic engaged two IT librarians, one library manager, one research and publication unit as well as three faculty journal editors.

4.5.1 IR digital preservation policies in place

Under this theme, the responses were gathered across all participants in the study at both institutions A and B. The responses gathered from library mangers, IR IT support official, IT Librarians, research publication unit and faculty journal editors are as follows:

Institution A

The author questioned five IR librarians at institution A in search of data on IR policies and guidelines. The IR librarians were asked the following question ***"Is there a policy in place governing IR and what does it cover in terms of long-term access?*** The first IR librarian at institution A narrated that they are not aware of any IR policy apart from thesis depositing guidelines as stated in the university prospectus, guiding authors to deposit their copies. Another IR librarian commented that there is an IR policy in place that governs what content should be deposited into the IR, although the policy is due for revision. When asked if the policy covers anything on long-term preservation, the IR librarian responded *"I do not know"*. In response to the question posed, the third IR librarian at institution A narrated that there is indeed a policy governing the IR, however they have not taken a detailed look at it in terms of submissions or preservation statements. The fourth, IR librarian indicated that there is a policy available, which also *"gives guidelines on what should be preserved"*. The fifth IR librarian described that *"we do have a policy in place, but it is not clear on how things should be done"*.

The IR IT support officer at institution A had the following to say in response to the above question: *"I think that will be more of the library question, because they are the custodians of the actual data"*.

Institution B

The same question was posed to institution B, ***"Is there a policy in place governing IR and what does it cover in terms of long-term access?"*** The question was directed at IT librarians, library manager, faculty journal editors as well as the research unit and publications. The general response emanating from institution B regarding IR policy is "no, there is no policy". One IT librarian indicated *"there is no IR policy, we lack documentation around the repository"*. Another IT librarian also confessed *"that there is no IR policy at the moment, but they are working towards establishing a policy for the IR"*. Based on these responses once again, the researcher further prompted the IT librarians ***"are there challenges in operating an IR without policies and guidelines in place?*** One IT librarian remarked: *"yes, we are faced with issues where we don't really know which documents to accept, what are we supposed to accept when depositing material in the IR. Sometimes it just is appropriate what we think and not what it says. Few guidelines are being followed. We currently lack instructions and we also control the framework"*.

In response to difficulties experienced in operating IR without policies, the library manager at institution B narrated that, due to the absence of policies guiding IR contents such as conducting compulsory backups on the IR, it was encountered that the IR server once crushed, and no backup could be recovered. According to the respondent, *"The IR crushed, as there was no policy that made it compulsory to have backups. This happened that our database was on that server, and we had to start from scratch, fortunately the digital documents were not on that server"*.

In further trying to understand IR policies issues at institution B, the researcher additionally sought the opinions of faculty journal editors. The researcher asked the

same question as the IT librarians and Library manager ***"what are the policies and guidelines in place assisting you in submitting content to the IR"?*** In response to this question, one journal editor narrated "*I don't think we have any guidelines established; we just send an electronic copy to be deposited into the IR*". Two other journal editors similarly related that they were not aware of any policy. Following these narratives, the researcher prompted ***"are there challenges in operating an IR without policies and guidelines in place?*** The general response from the faculty journal editor was "no", with one editor who specified that there are *"no problems or challenges experienced. The content is sent to the[sic] dedicated library staff and they upload it to the IR"*. Another editor also renowned that there were no challenges faced in the absence of policies, because it is dealt with by the library *"we just submit the soft copy and it is uploaded";* while another journal editor reported *"there is no challenge at all, and the content is fast uploaded"*.

The research and publication unit however specified that the act of forwarding content for IR deposit is guided by the scholarly communication policy.

The responses in relation to IR policies at institution B indicates that there is no specific policy governing the IR. What exists thereof is a general scholarly communications policy, in which the IR is briefly stipulated to be a responsibility of the university library by collecting research output of the institution's knowledge output. While the overall responses above from institution A communicate that there is an IR policy in place, it does not seem to cater for the current needs, especially towards long-term preservation.

4.5.2 File formats for IR content

The study also looked into investigating preferred formats for IR content. This question was directed to five IR librarians dealing with IR at institution A and two IT librarians

at institution B. The researcher queried the IR librarians at institution A *"is there a specific format for content to be acquired for the IR and what is the required format?"* The overall response to this question was that PDF was the required format for IR contents. One IR librarian at institution A indicated that *"In addition to PDF soft copies, we also require the hard copy of the thesis book. The physical copy becomes a backup which can be digitised if a softcopy cannot be found"*.

The researcher further asked the five IR librarians at institution A *"what type of PDF files do you upload"?* All librarians plainly indicated that these were "just PDF files". Participants at institution B similarly indicated that the IR file format is "just PDF". Thus, based on the responses from both institutions A and B, PDF files predominantly constitute as the ultimate format for IRs understudy.

4.5.3 Observation of IR policy at institution A

Table 4.5.3.1 below shows areas covered in the existing IR policy at institution A. The areas of IR policy coherence represent the conventional areas described among most IR policies in literature. The table presents standardised digital preservation principles that may be covered in the IR policy at institution A.

This observation was not possible at institution B because the institution had no policy statement governing the IR at the time of the study.

Table 2. IR digital preservation principles covered in Institution A IR policy

Content of play	Observed		Comments
	Yes	No	
Access and Use	*		Output is distributed worldwide

Accessioning and Ingest	*		States that digital copies of content will be collected, organized, managed, stored and preserved
Audit	*		
Content format preservation		*	
Collaboration		*	
Content Scope	*		Scholarly, educational or research-oriented items
Glossary/Terms	*		
Mandates		*	
Metadata and Documentation	*		States that Dublin core metadata schema is used
Policy/Strategy review timeframe	*		The policy will be reviewed every three years from the date of its' approval
Preservation strategy: refreshing,		*	
Preservation strategy: migration	*		Briefly stated
Preservation strategy: emulation		*	
Preservation strategy: technology preservation	*		-System monitoring, testing and debugging duties -Monitoring and upgrading utility programs and middleware -Compiling migration strategies to ensure long-term access to assets by users

Preservation planning		*	
Rights and Restriction management	*		
Roles and Responsibilities security	*		A shared responsibility between library and ICT department; with unique responsibilities
Management selection/appraisal		*	
Staff training type and frequency		*	
Sustainability planning		*	
Disaster and emergency measures		*	

As noted, institution A's IR policy outlines digital content protection in the law. Organization A's current IR policy lacks comprehensive practical guidance on long-term digital preservation and access activities. The staff members involved with the IR tasks could not relate to long-term preservation of digital contents as outlined in the policy. While the policy also outlines numerous digital preservation principles covered in most IR policies worldwide, certain areas pertaining to long-term digital preservation of the stored content such as; content format preservation, staff training, disaster and

emergency measures, preservation planning and strategies have not been sufficiently catered for in the current policy upon the researcher's observation.

4.6 Support towards IR digital preservation activities

To meet this objective, questions were asked to determine the support required towards IRs activities from university top management (Vice-Chancellor and Pro-Vice Chancellors) as well as library management (library director/university librarian and Heads of Departments in the library). This was geared towards exploring budget allocations, training opportunities in the areas of IR preservation as well as consultative engagement sessions with relevant stakeholders pertaining IR. Seeing that there is an appetite and potential plans to do more to preserve IR content for future access despite the current constraints; the researcher proceeded to investigate the type of support needed to ensure effective online preservation of IR content. Thus, in determining the type of support required towards successful preservation of IR content, the researcher asked the library managers, IR Librarians, IR IT support officer, faculty journal editors and IT Librarian questions towards supports in budget allocations, training as well as IR policy establishments.

4.6.1 IR budget allocation

In order to establish the level of support towards digital preservation activities, the study explored matters related to budget allocations towards IR content preservation. To establish an accurate determinant of budget allocation , the researcher asked the IR librarians dealing with IR at institution A the question *"is there a dedicated and adequate budgetary allocation for digital preservation activities for the IR?* The response to this question was "no" and "I don't know". All five IR librarians at institution A had no knowledge on IR budget allocations. The library manager at

institution A however clarified that the IR budget *"is spread all over the operational budget, so it is part of the entire library budget"*.

Furthermore, the researcher asked the IR librarians "***is your unit consulted by management on issues concerning the development of the IR?*** One of the IR librarians from institution A narrated that *"sometimes, especially towards the repository interface design"*. The same question was also directed to the IR IT support officer, to which the response was *"the library consults us when amendments are made and for suggestions and inputs. The support is relatively favorable"*

At institution B, the researcher asked the similar question "***is your unit consulted by management on issues concerning the development of the IR?*** One IT librarian explained that *"If there is a need for IR operations, we are simply trying our luck to find something through the operating budget of the library "*. Another IT librarian similarly narrated *"no, there is no specific budget for IR, it falls under the entire library budget. If there is a license or server to be purchased, it is done for the whole library, not specifically for the IR"*.

The library manager at institution B relatedly *indicated "we do not have a specific budget assigned for activities concerning IRs preservation.*
The above responses recounting issues surrounding IR budget allocations indicate that there is no specific budget allocation for preservation activities related to IR at both participating universities.

4.6.2 Required support

The researcher further investigated the required support to enable long-term preservation activities. Questions were posed to IT librarians, IR IT support officer and library managers. They were asked "*what type of support would you require to successfully conduct IR preservation activities"?* The responses towards the required support ranged from financial support, training as well as human capital.

At institution A, the response from the library's manager indicated that, more support is needed in approving IR policies, but the most pertinent is the intervention by university management in enforcing its usage across the entire institution. According to the respondent "*if the policy is not enforced by university management, such as the Deputy Vice Chancellor of Academic Affairs and Research, it will not carry much value towards the authors in submitting their research output".* The IR IT support officer at institution A also indicated that more training and skills pertaining to digital preservation is required.

At institution B, one IT librarian opined that financial support is important as there will be a need to allocate money to purchase plugins for D-space that will evaluate and validate the integrity of the PDF files hosted in the IR. This would be useful to confirm whether the files are still accessible or not. Such automated tools become convenient when the collection expands and it becomes impossible to trace and monitor over thousands of documents without automated tools. Furthermore, the library manager at institution B also encouraged that financial support is required towards creating an independent library section dealing with the IR issues, as well as appointing adequate staffing and the equipment required. In addition, financial support is mainly required to

be increased in order to allow training, buying applications and equipment, as well as approval of crucial positions such as appointing an IR librarian.

4.6.3 Training support

The researcher investigated the type of support required to successfully conduct long-term digital preservation activities; the researcher once again probed from five IR librarians responsible for depositing IR content at institution A the following question ***"what areas regarding IR would you like to be trained on?"*** was asked. Out of the five IR librarians, at least four expressed that they would appreciate receiving training in the areas of IR maintenance and D-space software itself. One of the IR librarian emphasised: *"training on D-space and institutional repositories would be vital, because there's more to dealing with IRs than just uploading research papers. We didn't go into detail at this stage, so it would be great if we could have a workshops in order to advance our skills. Upskilling will be instrumental in the advancing IRs".* In response to the question, the fifth IR librarian narrated *"training is necessary to refresh one's memory, because things keep changing and we have to be up-to-date".* The respondent further reported that they would equally appreciate training on policy revision.

The training needs and support at institution B was investigated among two IT librarians, one IT librarian expressed satisfaction towards the current skills. The other IT librarian however specified a need for training in operating LINUX systems as well as added training in using application programing interfaces. The IT librarian moreover narrated that application programing interfaces allow interaction between various applications, such as enabling IR software (D-space) to be integrated with other applications.

In addition, in exploring the level of support for long-term IR electronic preservation activities, faculty journal editors at institution B were also asked whether there was collaboration between the faculty / unit with the library on the development and growth of IR at institution B. Of the four units interviewed, only one out of four related to have been consulted on issues concerning IR. One of the faculty journal editors acknowledged that *"during faculty meetings, a representative from the library is always present to give updates on library related issues, which sometimes lead to discussions on the IR"*. When asked ***"what motivates faculties to submit content to the IR?"***, the general response from the faculty journal editors was that sharing research output with the IR ensures visibility and access of research output and intellectual knowledge globally.

4.7 Skills and knowledge required in managing IRs digital content

The researcher interviewed the library managers, IT librarians and IR IT support officer in order to understand skills and expertise required to successfully manage digital content.

4.7.1 Current skills available to perform digital preservation activities

The researcher asked the library manager at institution A ***"do you have staff with the requisite skills and knowledge on the preservation of digital content for the IR to ensure long-term access"?*** The library manager responded by implying that the librarians dealing with IR did not undergo special training on IR issues, because *"it is more self-training"*. There are manuals that guide the librarians on D-space and content upload. In addition, the researcher continued to ask the library manager at institution A ***"how adequate do you regard digital preservation skills among librarians and the IT support officers involved with the IR?"*** The library manager responded by saying that

"I don't think librarians are taught in depth about digital preservation. I think emphasis is placed on theory than practical instructions, which would have been more useful".

As for the technical IR team, the library manager acknowledged that they are equipped with the skills on the IR software (D-space), and further narrated that there is abundant information on D-space which becomes useful for self-training. Asked if librarians should be trained in managing electronic resources, the library manager narrated that, training librarians on electronic document management is essential, *"because the world is changing and the demand on the librarian is changing. People's needs are changing; and we need to remain relevant; by identifying our user's needs and like a chameleon change to suits those needs to stay relevant".*

In response to the question above, the library manager at institution B responded *"I would say we have some basic knowledge in digital preservation knowledge."* The respondent reported that staff members dealing with IRs attended training which includes aspects on digital preservation, although *"the training may not have been conducted on a total expertise level."* The library manager further expressed that staff members are often encouraged to identify staff development opportunities in areas where they can learn something new.

4.7.2 Technical skills required to conduct digital preservation

The researcher engaged one IR IT support officer at institution A and two IT librarians at institution B. To establish the required conduct on digital preservation, the researcher asked the following question ***"what skills and knowledge are required to do your job in maintaining the IR"?*** The IR IT support officer at institution A highlighted that skills such as IT, operating systems such as Linux/Ubuntu and Windows are necessary.

In addition, the respondent recommended that one also need to be experienced in java programing languages. Thus, having a qualification in software development or IT goes a long way in conducting these activities. When asked how often training is conducted in helping to keep afloat with the latest technology, the officer narrated *" we have never been trained, essentially we just had to educate ourselves and try to understand how the system functions and how we can provide help to further improve it"*. The respondent further remarked that D-space is a complex system, thus, additional skills and training are required in that area.

In response to the question on available staff skills, the one IT librarian at institution B renowned that, database management skills are necessary in conducting this job. Thus, having knowledge in database management helps in understanding the repository database in the background. One also needs knowledge in Unix/Linux operating systems, as well as web interfaces, which helps in understanding layers of the web, thus Extensible Markup Language (XML) knowledge is vital. Additionally, a qualification in IT becomes vital when one occupies such a position. Another IT librarian's response was *"this job requires one to have database management; metadata skills/knowledge especially relating to Dublin Core; citations; adobe acrobat to edit the documents; needs attention to detail because one punctuation or none can lead to errors on the database. It also requires one to be afloat with technology. Be technologically oriented to be able to notice and remove duplicates on the database to ensure consistency"*. To do this, the respondent further reported that *"you definitely need to have an educational background in library and information science for cataloguing and a certain qualification in IT even a diploma, to perform basic IT functions on databases"*.

4.7.3 Training frequency on keeping afloat with the latest technologies

The study also sought to examine how often staff members dealing with preservation of IR content get training. Thus, the researcher questioned the library managers, IT librarians, IR IT support officer and IR librarians ***"how often do staff dealing with IRs get trained or attend workshops regarding long-term digital preservation"?*** In response to this question, the library manager at institution A reported *"it is self-training, but if they can identify areas in which they require training, this can be arranged"*. At institution B, the library manager indicated that both staff members assigned with IR tasks received training in that area. Specialised training was on D-Space, and another training was offered in digitisation and short courses.

The library manager at institution B also opined that library professionals should have IT skills in order to successfully engage in preserving digital content to ensure long-term access. Thus, according to the respondent, library courses should integrate IT with librarianship in their curriculums. The respondent continued, *"I mean the librarian should understand and be very well informed on the digital library applications that the libraries use, because in most cases, IT professionals without background in information and knowledge management sometimes have no particular interest in library activities, e.g file formats preservation. Technical skills are important, but how the data has to go in and how it has to come out requires expertise of the user department (library)"*.

The above responses on training intensity to keep up with the latest technologies indicate that there is an imbalance in training opportunities for digital preservation among IR preservation workers. More training is required to be offered in the area of digital preservation among the staff dealing with it. It also emerged that training

opportunities in this area has not yet been considered for staff members dealing with IR.

Furthermore, the researcher asked the library manager at institution A "***what skills and qualifications would you consider important if you were to hire a digital preservation librarian"?*** In response to this question, the library manager was selective towards hiring a candidate who is *"IT oriented with IT training and experience"*. The respondent further described that they would also the candidate should be someone who pays attention to detail. Additionally, the candidate should have librarians' skills such as knowledge and information management, metadata standards etc. The respondent further renowned that "she/he must be wonder person".

Based on the question above, the library manager at institution B response was *"I would go for a librarian , but ideally with advanced training and experience on electronic technologies and repositories as well as information conservation. This is because, in addition to the IR, digital preservation would include other online materials such as archiving archives for electronic assets to which we currently subscribe.. Thus, a candidate with a background in library studies qualification and additional training qualification in IT and digital preservation management area, electronic records and digital resources management would match this positions' requirements"*.

Based on the above responses, a suitable candidate to manage IR long-term preservation activities would need to be well grounded in library and information science field, as well as a background in ICT. At the moment, this is a rare combination in current positions.

4.8 Challenges experienced towards IR long-term preservation

The last objective of this study intended to examine whether there are any challenges experienced by the academic institutions understudy when dealing with long-term preservation of IR digital content. The results emerged that there are various hiccups experienced in the process of preserving IR digital content. With regards to problems experienced at institution A, the IR IT support officer expressed problems such as internet/network, lack of training and insufficient expertise on the software hosting the IR. These issues sometimes hinder the process of installing the required tools to conduct backups and upgrades punctually. The respondent further alluded that, the IR site is sometimes inaccessible due to network issues. Furthermore, librarians involved with the processing IR material at institution A, also expressed that the lack of ICT skills and training towards the IR host (D-space) is sometimes a challenge, especially when deleted items (that do not match the required IR standards). In addition, IR librarians concerned with depositing material to the IR at institution A stated that; due to a lack of authority and expertise in the management of digital content, there are numerous documents in the database that do not meet the required document quality to be maintained in the IR

The IR librarians also voiced challenges towards the lack of willingness and cooperation from authors/researchers to submit academic research output to the IR. One librarian reported that *"there are also cases where some documents appeared under wrong departments"*. The library manager at institution A additionally expressed distresses towards of the lack of policy enforcement across the entire institution personnel from top management.

The problems experienced by institutions B were directed to the lack of automated tools and software to manage digital preservation, as well as lack of in-depth knowledge of

document or file format preservation, one IT librarian narrated. Another IT librarian at institution B also reported that, the lack of manpower to assist in performing comprehensive specific IR functions towards preservation needs to be considered as a matter of emergency. The respondent reported *"there is work overload at the moment. I would need assistance in creating IR as a stand-alone library section, with its own assigned staff dealing with IR issues"*. The library manager at institution B similarly expressed concern towards file format and its preservation aspect which is not being fully being attended to at present. The library manager further recounted the lack of advanced automated tools in the area of notifying writers when their research output has been consulted for example. Additionally, there is a lack of willingness from writers to share research output with the IR. The lack of financial allocation to purchase plugins supporting preservation hinders progress in preserving IR content also pose as a challenge, because, although D-Space is free open sourced, there are add-ons that may be required to enhance preservation of IR content.

4.9 Summary

This chapter presented data collected from semi-structured interviews and non-participant observation research methods between two academic institutions anonymously presented as institution A and institution B. The aim of this study was to investigate digital preservation of IR digital content to ensure long-term access, in terms of; preservation activities, skills, policies, support and challenges experienced in this subject area. Thus, data emanating from interviews was geared towards investigating issues preservation activities, skills, support and challenges experienced on the topic. Moreover, data gathered from observation method in addition to interview methods was obtained on issues concerning policies and guidelines of IRs at the two academic institutions.

The study found that, both institutions A and B uses D-Space as the IR software solution. The study also revealed that the IR functions at both institutions are shared collaboration between the library department as the custodian to the IR as well as the ICT support department. It was additionally presented that the current preservation activities are mainly performed on the basis of short-term preservation methods such as backups and system/software monitoring and upgrading. The study thus saw that some institutions operate IRs without policies and guidelines in place, let alone procedures to be followed in the light of formats submission and how long-term preservation should be secured.

 It also emerged that different skill sets were needed to ensure long-term digital content survival. Finally, the chapter highlighted some shortcomings concerning the protection of the IR in both academic institutions in terms of: lack of skills and education in electronic content conservation, lack of standards and little or no support for policy enforcement. Chapter five will provide an in-depth discussion on the above findings.

CHAPTER 5: DISCUSSION OF FINDINGS

5.1 Introduction

According to Hess (2004), the purpose of the discussion of research findings is to explain its' meaning to the reader. It should thus be written to ensure that the discussion based on the study's data is understood by the end reader (Hess, 2004). Thomas (2010) opined that the discussion chapter "should be broadened by describing how your results and your interpretation of the results are supported by, consistent with, or related to the results (evidence) from other published studies" (Thomas, 2010).

As outlined in chapter one, the purpose of this study was to investigate the current preservation practices of digital content in IRs at NUST and UNAM libraries in Namibia. The study was further guided by the following specific research objectives:

a) To examine current preservation strategies of digital content in IRs;

b) To investigate if there are preservation policies regulating IRs;

c) To assess the level of support received by staff towards digital preservation of IRs;

d) To examine skills required or possessed by staff in managing IRs digital content;

e) To explore any challenges experienced in IRs long-term preservation practices.

This chapter narrates the research findings presented in chapter four. The discussions are thus arranged according to themes derived from specific objectives of the study, such as; preservation activities, skills, policies, support and challenges experienced in this subject area.

5.2 Preservation strategies of IR digital content

One of the objectives of this study was to examine the current preservation strategies of IR digital content. In this regard, the study examined the roles and responsibilities concerning IRs; current long-term preservation strategies; significance of long-term preservation; issues of storage space; disaster plans; level of satisfaction on current preservation methods as well as assurance on possible future access to store IR content.

The responses under this objective were gathered among the IR IT support officer, IR Librarians involved and the library manager at institution A. While at institution B, data was gathered from the IT librarians as well as the library manager (such as library director/university librarian and Heads of Departments in the library). Background information as previously reported in chapter four indicates that both institutions use D-space software in managing and preservation their IRs' digital content. D-space appears to be the most popular software used by most African countries to manage IR content (Anyaoku, Echedom & Baro, 2017).

5.2.1 Roles and responsibilities towards IR activities

To define conservation techniques and practices used to ensure the long-term preservation of electronic IR information, the researcher investigated the roles and responsibilities of the IR IT support officer, the IR librarians involved and the library director at institution A. While at institution B, data was gathered from the IT librarians as well as the library manager. This aspect was explored in order to understand the division of labour among the stakeholders involved towards preservation of IR content.

According to Pennock (2006), digital preservation requires considerable input from stakeholders who give valuable input on technical, financial, organisational and cultural

issues involved in ensuring that authentic, meaningful and reusable resources are preserved. Following this narrative, this study disclosed that the roles and responsibilities of librarians toward IRs in Namibian academic institutions are distributed among various IRs stakeholders. At institution A for example, the roles and responsibilities are divided among the IR IT support officer, IR Librarians involved and the library manager.

This study found that the roles and responsibilities of the IR IT officer's duties include the update and maintenance of IR software, while the roles and responsibilities of librarians with respect to IR are to add new content by depositing research results and adding metadata, lobbying for research content and reviewing research papers submitted for the IR. The practices towards roles and responsibilities towards IR at institution A are similar to those performed at institution B; where division of labour towards IR preservation activities involved depositing and adding descriptive metadata for new research content by one IT librarian, while another IT librarian deals with upgrading and keeping maintenance of the IR software. The roles performed by librarians above mentioned stakeholders at the two academic institutions in Namibia such as assigning description metadata and maintaining the software on which the IR is running is essential towards IR smooth operation and enabling contemporary access.

Based on the above results of the library on IR preservation roles, Sutradhar (2006) also confirmed that activities such as administering, registering and authenticate the submission of documents in IRs are essential for long-term preservation. Hence, software and hardware handling training are required for staff dealing with IRs (Sutradhar, 2006).

In addition, the study revealed a void and inadequacy in the role of long-term preservation techniques such as migration and emulation techniques, monitoring and evaluation of the sort of formats and versions of digital content for IR has not been assigned at both participating institutions. In addition, file formats for content preservation to ensure their authenticity and long-term access is also overlooked within the current roles. The results on roles carried out towards IR long-term digital preservation of this study are comparable to those of Anyoaoku, Echedom and Baro (2017) who established that the role pertaining to digital curation of IR digital content has not really been fully defined in some African countries, hence the scarcity of specialists training programs offered (Anyoaoku, Echedom and Baro, 2017).

The study also found that there is no dedicated staff member or department to specifically deal with long-term digital preservation IR issues at both institutions. As narrated by one IT librarian at institution B " *We have no dedicated IR team, let alone restoration group"*. Although the respondent further asserted that it is within the library's plans to create a section within the library with an IR librarian to specifically deal with these issues, this indicates that the two Namibian academic institutions are yet to assign tasks pertaining to long-term digital preservation of IR electronic content.

5.2.2 Preservation activities

This study found that existing long-term DP processes at the two Namibian academic institutions seem to concentrate in general on short-term strategies such as backups and device updates other than long-term sustainability strategies such as migration, emulation among many others as highlighted in the literature.

According to Kirchhoff (2008), backup activities have long been understood to provide short-term data access and are usually performed by copying and storing content in multiple sites to ensure readily available data in the event when one storage fails. Furthermore, while well managed backup systems may guarantee solutions to problems encountered in short periods such as one-month period, it may never resolve long-term challenges related to digital data (Kirchhoff, 2008).

The results of preservation activities for the two Namibian academic institutions are presented and further discussed in detail below in 5.2.2.1 to 5.2.2.5.

5.2.2.1 Backups and system upgrades

The study revealed that, current preservation methods of IR digital content at the two Namibian academic institutions in attempt to guarantee future access to contemporary academic knowledge includes conducting multiple backup activities, this is performed by copying the IR database to multiples places to ensure recovery in the event when the primary data fails.

Thus, when participants in this study were asked to outline the activities conducted to ensure that current IR content will still be accessible in a long run, participants mentioned that conducting regular backups as the main digital preservation activity. In addition to conducting backups, participants from both academic institutions under study additionally regarded software/system upgrades as part of preservation activities. Moreover, this study found that another mandate regarded to be part of IR long-term preservation was ensuring accessibility, monitoring networks, as well as to upgrading to a newer version. Noting that backup alone is not a viable form of long-term preservation, the results emanating from the study indicate that the two Namibian

academic institutions understudy have not yet given long-term preservation a thorough thought.

The results of this study are in agreement with Gbaje and Mohammed's (2017) study conducted on long-term accessibility and re-use of institutional repository contents of some selected academic institutions in Nigeria, which found that digital preservation activities such as migration, emulation shown to ensure long-term preservation and access were not used in academic institutions in Nigeria. The absence of digital preservation activities such as migration, emulation understood to enhance long-term preservation thus compromise long-term access to stored IR content, as supported by McGath (2012).

Contrary to this, a study conducted by Mensah (2015) on digital preservation in the context of institutional repositories in public universities' libraries in Ghana yield different results. Mensah (2015) study found sufficient amount of various activities conducted towards DP functions such as; "backup issues; transformation/migration of formats; file format identification; server management; space management; secure storage management; technology watch; development and maintenance of tools; development of preservation policies and strategy; preservation education; training and outreach". According to the end results of Mensah's study, this is an indication that there is knowledge on issues concerned with long-term DP of IR in Ghana.

Similar to Mensah's study is Anyoaoku, Echedom and Baro (2017) who in their recent study on "Digital preservation practices in university libraries: An investigation of institutional repositories in Africa" also found that that the majority of African university libraries (Zimbabwe, Nigeria, South Africa, Tanzania, Sudan, Kenya, Egypt,

Lesotho, Ghana and Uganda) provide long-term digital preservation techniques such as mostly migration, followed by encapsulation and few conduct refreshing technique for their IR. Confirming this further is Adekannbi and Wahab (2015) who conducted a "Comparative Analysis of the Preservation and Conservation Techniques of Selected Special and Academic Libraries in Nigeria". They also found that refreshing, technology preservation, and migration were among the most commonly used digital preservation techniques by special and academic libraries in Nigeria (Adekannbi & Wahab (2015).

While none of the mentioned long-term preservation techniques (migration, emulation, refreshing) is currently conducted by the two Namibian academic libraries, there is a clear indication that some African university libraries are indeed making efforts to ensure long-term access which other institutions may benchmark from.

This study further observed concern among some of the staff members involved in the preservation of IRs content at institution B, due to a lack of backup recovery tests conducted to ensure file accuracy for recovery. Robertson and Borchert (2014) findings however differ from the findings of this study, perceiving that disaster recovery approaches and backup activities are not durable methods of ensuring long-term preservation and access of digital content. Backup activities are therefore considered as short-term data recovery solutions useful in events of recovering loss or corruption of stored electronic files (Robertson & Borchert, 2014).

Upon further investigating preservation strategies for IRs at both academic institutions it was interesting to note that the library managers at both institutions A and B were not familiar with the preservation techniques in place to safeguard IR digital content.

Responses such as "I think" stemming from library managers creates an impression that a lack of knowledge towards activities being conducted or supposed to be conducted to ensure long-term access of IR content prevails among the top library management. In line with the above finding, Flouris and Meghini (2007) acknowledged that, digital preservation problems have not fully been understood yet, this describes why little effort is sometimes brought forward towards practical and formal methodological aspects of the matter as indicated by (Flouris & Meghini, 2007).

Following the results emanating from the two Namibian academic institutions on relying on short-term DP practices, Hitchcock, Brody, Hey and Carr (2005) advise that, while backups provide valuable solutions towards recovering loss or corruption of the stored content, it is not sufficient to safeguard long-term access, because these are only temporary solutions. Thus, a number of preservation strategies such as; storage media, media refreshing, reformatting, backups and disaster recovery, environment, audit, security, preservation strategy, migration, technology preservation, emulation, records management etc on preserving electronic information resources in IRs databases should be considered, to secure long-term access (Hitchcock, Brody, Hey & Carr, 2005) which the two academic institutions currently do not make use of.

5.2.2.2 Open file formats

This study established that both IR databases at the two academic institutions understudy predominantly consist of PDF text files, this is so, because using open file formats among other preservation activities can safeguard future access, hence it is a widely supported format. Through interviews and observation methods on file formats of stored content, the study could not establish the type or format of PDF version used

to store IRs content. Results from the interview with respondents in this study indicated that the IR content just consist of PDF files.

The scenario at Namibian academic libraries in preserving IR content in light with file formats is similar to what Moseti (2016) found in her study on "Strategies used by universities in Kenya for the preservation of their scholarly content". Moseti (2016) established that students were required to submit their theses in PDF format, an open file format recommended to guarantee long term availability and portability of the document across different computer platforms. Another recent study by Francke, Gamalielsson and Lundel (2017) on "Institutional repositories as infrastructures for long-term preservation" confirm that attention is paid to PDF file format used. This demonstrates that distinction between various PDF versions of IRs file is not always considered, and as a result may turn be problematic in light of the long-term preservation and accessibility of the repository content, thus encouraging depositing of files in PDF/A-1 or PNG formats where possible (Francke, Gamalielsson & Lundel, 2017).

In light with this, the issue with a lack of attention paid to file formats by the two Namibian academic institutions and other libraries in Africa and worldwide remains another concern and challenge which may hinder successful long-term access of intellectual knowledge preserved in within IRs.

Although institution A expressed satisfaction with current methods of preservation, institution B expressed fear of long-term access due to a lack of regard for maintaining file format to ensure future access.

Paper (2008) indicated that crucial information should not be held in files that will no longer be compatible with the future software because as electronic information becomes more and more complex and integrated, the threat of file format obsolescence is set to increase.

However, while PDF is a standard format for many web text files, it might not be the most suitable version for long-term archiving, Robertson and Borchert (2014) advised that using open file formats ensures that files will remain accessible in the future. However, while many repositories content is probably PDFs, it might not be PDF/A which is the suitable version for long-term archiving. Kirchhoff (2008) expounded that technology and file formats evolve rapidly, thus, it is probable that without appropriate plans, policies and techniques in place to safeguard IRs digital content for future access, knowledge may be lost infinitely. Consequently, methods used by scholarly community to protect content for use in the near term differ from those used to preserve content over the long term Digital preservation to ensure the enduring usability, authenticity, discoverability and accessibility of content over the very long term.

Seeing that sometimes documents are handed over to the library in PDF files (not knowing which PDF version the document is), the depositor should ensure to inspect the type of PDF version the document is and then convert it to the archival/preservation PDF version. In so doing, the depositor needs to understand the scope and restrictions of what the library will do; if the files are in a proprietary format, long term, options are limited for the items. It might be best to keep the original and output as an open version for the future (Robertson & Borchert, 2014).

5.2.2.3 Storage space, disaster plans and recovery

Storage space plays a vital role in ensuring long-term digital preservation, by ensuring that the media storage device hosting the data has enough space to enable smooth operations and to accommodate the growing volumes of acquired materials (Beargie, Charlesworth & Miller, 2014). In line with this, the study revealed that sufficient storage space is allocated to allow preservation for future access to IR content at the two Namibia academic libraries. This study also revealed that there are disaster management plans conducted through various backups on and off premises and this has been documented. Data on this study also revealed that in an event of failure, backups can be recovered within one to two weeks. This was measured based on the experiences that occurred before. Also highlighted in the literature review is that, whereas disaster management plan is an important task for IRs to keep the repository in check against various disasters that may occur, it should not be confused with preservation, as having the data may not necessary guarantee access to stored content (Robertson & Borchert, 2014).

Considering the OAIS model in providing a comprehensive framework for several functions required for digital preservation; such as ingest, storage, retrieval, and long-- term preservation of digital objects, the model was used in this study to observe the criterion considered when conducting digital material preservation for IRs at the two Namibian academic libraries.

The OAIS model has also been used by various authors in dealing with long-term digital preservation aspects. Authors such as Gbaje and Mohammed (2017) in their study on long-term accessibility and re-use of institutional repository contents of some selected academic institutions in Nigeria, used the OAIS model to examine issues pertaining to

long-term digital preservation from an information and process point of view. Additionally, another author Magama (2017) on Strategies for preservation of digital records in Masvingo Province of Zimbabwe similarly found the OAIS model useful in identifying digital preservation strategies used to preserve digital records in Masvingo province.

The results of this study on the OAIS functional model in entities were infrequent, therefore not addressed as whole. For example, the entities; *ingest* which involves adding metadata for objects, *data management* performed by database maintenance and backup activities, *administration* by ensuring daily monitoring and *access* to information stored were adequately addressed. Whilst on the other hand, other entities such as *archival storage* which entails long-term storage and maintenance concerning digital information materials commended by frequently performing refreshment or migration mechanisms to control occurring system errors that evaluate the outcome of preservation processes were not addressed, due to incomprehensive policies available to guide long-term preservation activities. Additionally, aspects of disaster recovery policies to mitigate the effects of catastrophic events and *preservation planning* which involves frequently monitoring the external environment in search for new technological developments and risks was also not identified in the two Namibian academic libraries (Digital Preservation Coalition (DPC), 2014).

The above findings from this study therefore correspond with Magama (2017) who also found that with regards to long-term preservation areas catered for by the OAIS model; the strategies for preservation of digital records currently used in Masvingo province such as backup and byte replication, migration, printing and filing, capturing

preservation metadata and cloud computing were the preservation strategies do not guarantee their long-term preservation (Magama, 2017).

5.2.2.4 Importance of long-term preservation

Digital preservation as a series of actions and interventions is essential to ensure "continued and reliable access to authentic digital objects for as long as they are deemed to be of value" (Pennock, 2006 p1).

The respondents in this study noted that long-term preservation is of great significance, because through this practice, continuity of current IR content can be accessed by future researchers/users. This indicates that long-term digital preservation for IR content is considered to be of great value, even though, minor efforts are brought forwards by the two Namibian academic institutions understudy in ensuring practices that would enable continuous access to contemporary IR content. The results of this research corroborate with Moseti (2016) who also found that, Kenyan universities and individuals involved with scholarly content were aware of the need to maintain the long-term accessibility of their research information and took measures to guard against its loss or inaccessibility (Moseti, 2016).

Despite minimal efforts conducted towards long-term preservation practices of IRs digital content, the two academic institutions are certain that contemporary stored IR content is highly likely to be accessible over the years, believed to be possible considering current efforts directed towards regular backup activities, system upgrades and the use of open file formats.

While institution A conveyed satisfied with current preservation methods, institution B expressed fear towards long-term access, due to a lack of attention given to file format preservation techniques towards ensuring future access. Paper (2008) denoted that the threat of file format obsolescence is set to increase whenever crucial information is held in files that will no longer be compatible with the future software because as electronic information becomes more and more complex and integrated (Paper, 2008).

5.3 Policies and guidelines

Another aspect that was looked at in this study was the issue of policies and guidelines guarding towards IR digital content to ensure its long term/future access. It is important to note that developing digital preservation policies is essential in combating the risks associated with rapid computer hardware and software (Gbaje & Mohammed, 2013).

The findings of this study revealed that some academic institutions are operating IRs without guidelines and policies in place. This particular finding is similar to that of Kanyengo (2006) and Mensah (2015) who found that some African countries appear to be lagging behind in terms of well-established policies and guidelines for digital IR preservation, be they in print, let alone in electronic format, thus operating within a no policy framework (Kanyengo, 2006; Mensah, 2015).

In addition, this study also identified that institution B lack policies in guiding towards preservation of IR digital content, while institution A has established a basic IR policy. This study's finding concurs with that of Kavishe and Dulle (2016) who in their study recorded an elevated number of libraries with digital preservation policies, which directs digitisation and digital resources acquisition practices, concluding that digital

preservation policies are not absent or weak across all African countries (Kavishe and Dulle, 2016).

In further examining the findings of this study, it is worth noting that while having an IR policy in place is a noble step taken by some libraries, it is of greater importance to ensure that policies and frameworks adopted are serving significance in addressing guidance to current and future access. This means, a policy framework should consist of components that would ensure that there will be permanency in knowledge resources whether they are in print or in digital form (Kanyengo, 2006). Thus, it should practically outline how long-term activities will be conveyed in the event of technological obsolesce.

A study by Sheldon (2013) on digital preservation policies, strategies and plans from other parts of the world such as North America, Europe and Australia, identified and recommended common digital preservation principles, and developed a list of 19 high-level taxonomies that digital preservation policies should cover:

> (*access and use, accessioning and ingest, audit, content format preservation, content format preservation, collaboration, content scope, glossary/terms, glossary/terms, mandates, metadata and documentation, policy/strategy review timeframe, preservation strategy, preservation planning, rights and restriction management, roles and responsibilities security, management selection/appraisal, staff training type and frequency, sustainability planning and*

disaster, duplication and backups, as well as emergency

measures) (Sheldon, 2013 p.5).

Based on these guidelines, remarkably with pertinent to long-term digital preservation, this study found that certain components pertaining to long-term digital preservation of the stored content such as; content format preservation, staff training, disaster and emergency measures, preservation planning and preservation strategies were not sufficiently catered for in the current policy developed at institution A, as detailed and practical processes on long-term preservation of IR content lacks in the current IR policy. This finding supports Olatukun (2008) who affirmed that the dangers associated with operating IRs with weak or no preservation policies can be perceived as a ticking-time-bomb, because in the event of technological obsolescence, librarians would not be in a position to react to the change with the urgency that is needed.

5.4 Support towards IR digital preservation activities

Libraries as well as librarians require strong management support, efficient and effective strategy or policy, positive attitude and actions, adequate knowledge to manage and preserve information and sources, to ensure long-term digital information management and preservation of IRs (Igberaese, Sambo & Saliu, 2014). Support towards IR digital preservation is therefore, continuous support and commitment from stakeholders such university finance and decision-making management, library management, academic staff and users involved in securing long-term preservation of IR digital content to ensure future access (Jain, Bentley & Oladiran, 2008).

The study aimed to explore and assess the type of support received by staff towards digital preservation of IRs activities regarding; budget allocations, training

opportunities in the areas of IR preservation as well as consultation with involved parties on issues concerning IRs. The study found that there is inadequate support in terms of budget allocation, and funds for training purposes to successfully conduct digital preservation activities. The findings on this are similar to those of Mensah (2015) study on digital preservation in the context of institutional repositories at Universities of Ghana, who also found that management support in terms of assisting staff dealing with DP activities by obtaining skills, experience and the expertise required to conduct successful DP is inadequate (Mensah, 2015).

5.4.1 IR budget allocation support

Further investigating into financial allocation and support towards effective digital preservation revealed that there is no specific budget allocation towards IR activities at the two Namibian academic libraries. The study thus bare that the budget is spread all over the operational budget, forming part of the entire library budget with no specific budget apportioned for digital preservation activities. Similar to this scenario is that at the University of Zambia Library as investigated by Shameenda (2011). The results from Shameenda (2011) identified weak commitment from the University of Zambia management on funding of libraries at the University of Zambia among other inadequacies with matters pertaining to long-term digital preservation of IRs.

The finding of this study also corroborate with Mensah's (2015) study, who found that there are no specific budgets allocated to support IRs activities at universities in Ghana. Mensah's study observed that financial resources are rather pulled together into the overall budget of the library within which they operate, thus having a central operational budget becomes a difficult task to accomplish for most libraries for IR

activities and needs, especially if there is a queue of requests from various sections of the library from the overall budget (Mensah, 2015).

Hedstrom (1998) opined that with limited financial constraints, libraries, archives and other repositories struggle to ensure digital preservation activities are conducted inorder to ensure long-term access (Hedstrom, 1998). It is therefore, essential to ensure continuous support and commitment from stakeholders such university finance and decision-making management, library management, academic staff and users involved in securing long-term preservation of IR digital content to ensure future access (Jain, Bentley & Oladiran, 2008).

The situation on funds towards IRs digital preservation at the two Namibian academic libraries greatly suggest drawbacks associated with IR activities as it becomes difficult to pay close attention to the IR needs. For example, when there is a need to allocate money to purchasing plugins for D-space that will evaluate and validate the integrity of the PDF files hosted in the IR; to confirm the integrity of the hosted PDF files as reported by one IT librarian at institution B. Magama (2017) similarly found that insufficient budgets and lack of budgets hinder progress to purchase additional software packages, in support for system maintenance and continuous training, which may result in hampering the success of long-term access to stored digital content.

5.4.2 Training support

Digital preservation efforts require developing adequate knowledge and skills through training or education. Many studies conducted on long-term preservation often established that more support towards training is required for those involved with dealing with long-term preservation of digital content in various digital repositories

(Anyaoku, Echedom & Baro, 2017; Khan & Bhatti, 2017; Moseti, 2016; Mensah, 2015; Adekannibi & Wahab, 2015 & Shameenda, 2011).

This study revealed that, support rendered towards DP activities especially at institution B in terms of training has made efforts, although much is still required to improve the situation. In this regard, this study established that academic institution B made efforts to train staff members dealing with the IR on issues such as digitisation, specialised training on D-space. However, staff members often bank on self-training through internet and by subscribing to mailing lists with IR like mandates for more insights. In other cases, such as at institution A, both librarians and ICT staff members dealing with IR have never received training on preservation of digital content, thus little effort and support in ingested towards issues in the area of long-term preservation training.

The results of this finding therefore confirm Sambo, Saturday and Usman (2014) who noted that, among other challenges facing digital preservation initiative, lack of support towards digital preservation skills stood the main challenges likely to hinder progress towards long-term digital preservation practices (Sambo et al, 2014). Digital preservation presents the ability to secure electronic materials surviving technological changes without concern for alternation, loss of readability and access over a pro-longed period of time (America Library Association (ALA), 2007). Based on this concept, the major threat regarding DP of IR as expressed by the institution B library manager and the IT librarians at institution B is fear of stored content becoming obsolete. Yet not enough is being done to ensure long-term digital preservation is equipped with special regard on file format preservations as well as comprehensive documented policies and guidelines enabling practical solutions.

Additionally, IT Librarians at institution B through face-to-face interviews directed that, training should be directed to developing expertise in LINUX OS and application programing interfaces to enable interoperability in this regard. It is then probable that due to limited knowledge, training and educational opportunities available on long-term digital preservation, these challenges are likely to continue. The findings of this study thus support those of Igberaese, Sambo, and Saliu (2014), who also related that a lack of financial management support towards digital preservation initiatives such as funding in developing skills and approving robust policies has hindered the progress and possibility of long-term access, conceivably also due to a lack of formal education training curriculum in the country.

5.4.3 Policy support

As mentioned earlier in this chapter under 5.3, long-term future access to contemporary IR digital content also requires the presence of comprehensive policies and guidelines for direction. The results emanating from this study indicate that, for institution A where an IR policy exist; there is need for support by university management to enforce policy usage across the entire institution, whilst the library management need to revise the existing policy to construct a more comprehensive policy outlining comprehensive activities and clear responsibilities pertaining to long-term preservation IR content. Contrary to institution B which operates its IR without comprehensive policies and guidelines, support should be directed in approving policies to be developed and likewise, enforce its usage across the institution. Thus, developing preservation policies motivates creation of IR preservation strategies as well as decisions about what content would require short, medium, or long-term preservation should be driven by preservation policies.

As IR content grow rapidly, it is important to look at how policies have been developed to guide the implementation of digital preservation for IR content (Li & Banach, 2011). Shameenda (2011) also further identified lack of preservation and conservation planning, policies and weak commitment from the University of Zambia management on funding of libraries at the University of Zambia. Lefuma (2004) guided that preservation policies direct information centers towards adopting measures needed to initiate effective strategies to guard electronic information (Lefuma, 2004).

5.5 Skills and knowledge required in managing IRs digital content

This study further examined the skills required or possessed by the identified sample by the researcher managing IRs digital content at the two Namibian academic institutions. This aspect was important in determining whether the skills currently possessed are sufficient to perform digital preservation tasks to ensure future access to contemporary knowledge. Nonthacumjane (2010) noted that essential skills and competencies required of an information professional to work in the digital environment have been a significant discussion topic in the field of Library and Information science.

The outcome of this study revealed that different skills are required by different stakeholders involved in managing IR digital content to ensure long-term preservation of digital content at both sampled institutions. According to Mensah (2015) IRs responsibilities should not be a one-man show. Deliberating on this issue, this study confirms that IR activities are indeed a shared responsibility between the library and ICT departments at both academic institutions in Namibia.

Furthermore, the study revealed that IT librarians at institution B require skills in areas of; digital applications and database management, metadata skills/knowledge especially relating to Dublin Core, citations, adobe acrobat for document editing, needs attention to detail to avoid making simple errors on the database, require a technologically oriented person. We would therefore need a background in library and information science in cataloging fields, as well as an educational background in IT to help them perform basic IT functions on databases. Similar to this finding is Mensah (2015) who recommended that staff dealing with DP of IRs should have at least: a degree in Information Technology or Computer Science, and diploma in archival studies and library studies. However, the above outlined skills are not retained by all librarians dealing with IRs. Librarians who had training on preservation retain more skills than those who have never received training in this area.

The findings of this study yield that, librarian's inequalities in present skills on digital preservation are a result of inadequate training on practical skills on digital preservation activities. The study suggests a need to intergrade IT into librarianship curriculums to offer more technological and practical training on issues pertaining to digital curation. Thus, the current skills retained by librarians dealing with preservation of IRs with special regards at institution B has been described as basic by the library manager.

In addition to skills required to depositing information into the IR, the IT librarians at institution B and the IR IT support officer at institution A highlighted that there is another set of technical skills required to ensure long-term access and retrieval of deposited information, these are related to; database management skills, to understand the database behind, knowledge and understanding of UNIX/LINUX environment,

knowledge on Web interface, XML, understanding of the Operating System (OS) such as Windows/Ubuntu and understanding of java programing languages. Thus, obtaining a qualification in ICT such as systems administration and software development to perform this aspect of preservation is necessary.

This objective further looked at additional skills desired to successfully conduct long-term preservation of electronic resources. Library managers at institution A and B however desired that staff members to deal with long-term IR digital preservation should have knowledge, skills, training and experience on both digital applications and databases; as well as the digital preservation including file formats preservation; digital resources management; and electronic records management.

Conceivably, once long-term digital preservation has been recognised as an essential task for academic libraries, more specific job positions such as "digital preservation librarian" can be created, leading to clearer directions and processes towards long-term access. As highlighted in the literature review, Khan and Bhatti (2017) specified that digital preservation management competencies mean the ability to manage digital library infrastructure, define policies and standards for digitization, cost planning, manage staff, train library users, knowledge of digital library evaluation, and digital skills to backup digital contents. Concurrent to this is Raju (2014) who expanded that librarians must possess knowledge of digitization, metadata creation and management, preservation of digital information, and computer skills which are useful to work in online information environments.

Furthermore, Tennant (1999) and Sreenivasulu (2000) also noted that, the skills required to manage and preserve digital content for durable future access broadly demands knowledge in IT, generic, communication and management skills. Thus, Preservation of digital objects necessitates IT skills such as optical character recognition (OCR), imaging technologies, markup languages (HyperText Markup Language (HTML), Standard Generalized Markup Language (SGML) and Extensible Markup Language (XML). In addition, Web technology cataloging and metadata, indexing, database technology, user interface design, programming, and project management were also identified to be essential to DP (Tennant, 1999; Sreenivasulu, 2000). According to these demands in skills and knowledge in preserving digital objects, current staff members dealing with IR at both Namibian academic institutions understudy need to evolve sooner.

5.6 Challenges experienced towards IR long-term preservation

The last aspect looked at in this study was exploring challenges experienced in IRs long-term preservation practices at the two Namibian academic institutions understudy.

Digital preservation according to Moseti (2016); Li and Banach (2011) is a significant problem for many academic institutions worldwide, as they seem to be struggling with constructing measures and strategies to preserve scholarly and cultural records, this is a result of information being produced at rapid pace leading to complicating preservation practices (Moseti, 2016; Li & Banach, 2011).

The study found various challenges pertaining to preservation, these issues emerged in the areas of; slow network/internet issues, lack of training and skills towards long-term preservation, lack of schools available to train on digital preservation, lack of policies, lack of budget and risks of technological obsolescence.

The challenges are discussed on details below under 5.6.1 to 5.6.5

5.6.1 Lack of preservation practices

The ultimate foreseen challenge for the academic institutions understudy is the possible risks of technology obsolescence likely to be caused by little regard channeled towards long-term preservation techniques, content file format preservation, as well as concern towards lack of conducting backup recovery tests to ensure compatibility and continued access as uncovered by this study. Technology obsolescence is an outcome of inconsistency, lack of continued learning & support on the part of both preservation software knowledge and hardware held by the parties dealing with digital preservation, in this case IR digital content (Kanyengo, 2006). This is a matter of concern, because today's PDF software reader version would certainly not be able to read PDF documents to be created in a few years' time, hence constant software and hardware upgrades are necessary to ensure that IR content will still be accessible in a long-run (Kanyengo, 2006).

This research thus established a void in the two Namibian educational institutions ' understudy roles and responsibilities related to file format and long-term preservation. The results of this study also identified numerous factors that could hinder or hinder effective digital preservation efforts in the long term. The findings showed that challenges experienced by the two Namibian academic institutions were sometimes a result of slow internet/network connection. This drawback may hinder the process of installing the required tools when conducting backups and upgrades of the IR database. Unstable network connections may furthermore affect access due to these network issues. Likewise, Magama (2017) similarly found that while most departments at Muvango province had internet connection, there were slight complains towards the

slow and weak internet/network connection particularly when large volumes of records were uploaded. This is an indication that most libraries suffer from slow and weak internet connection, likely to disrupt preservation activities.

5.6.2 Lack of training and skills on digital preservation

Additionally, another challenge has been associated with a lack of training and insufficient expertise on the software hosting the IR with special reference to institution A. With regards to the scarcity of training and expertise challenge, the results of this study demonstrate that some of the librarians dealing with IR at institution A do not have knowledge in digital preservation of IR content, nor have they received any training in doing so. These findings articulate with those of Kavishe and Dulle (2016) who noted that technical digital preservation skills are mandatory to librarians managing digital information, although these requirements however seem to lack among staff involved in dealing with preservation of digital content in developing countries.

5.6.3 Lack of policies and guidelines

In further exploring the challenges experienced by Namibian academic institution in the area of DP of IRs, the results of this study further yield that there is a lack of IR policy enforcement across the entire institution personnel from top management at institution A as well as the absence of policies supporting long-term preservation at institution B. This particular finding has been described by Olatukun (2008) as a "ticking-time-bomb", because in the event of technological obsolescence, librarians would not be in a position to react to the change with the urgency that is needed (Olatukun, 2008).

It is also interesting to recognize that the lack of no long-term preservation policy at institution B has not been noted by the participants as a challenge, given the narratives in chapter four. This drawback confirms (Satish & Umesh, 2005; Olatukun, 2008) who stated that most African information centres that preserve EIRs have got weak policies while some lack policies in guiding long-term preservation activities (Satish & Umesh, 2005; Olatukun, 2008). Kavishe and Dulle (2016) also advised that, the absence of well formulated DP policies to guide and protect IR content compromises prompt response and action to rescue digital content in the event of technological obsolescence (Kavishe & Dulle, 2016). Matangira (2016) also noted that many African countries face challenges regarding compliance to standards, policies and procedures deemed to support long-term digital preservation initiatives.

5.6.4 Lack of budget/funds

Digital preservation has been considered to be a costly process, especially for countries in Africa that are coping with various problems (Kanyengo, 2006). In this regard, this study unearthed other challenges associated with the lack of funds allocated to IRs activities, such a lack of funds availed to purchase automated tools and software such D-space *Checksum* checker that can be used to validate digital file formats.

Through interviews with the IT librarians at institution B and IR librarians at institution A, it also occurred that there are often no funds to support training, thus widening the gap towards a lack of in-depth knowledge of DP especially towards document or file format preservation. In particular, the IT librarians at institution B specified that due to a lack of funds, modern technology applications needed to enhance long-term DP of IRs (D-space) and ensure pro-longed future access cannot be purchased. Additionally, the IT librarians at institution B further revealed that due to a lack of budget allocation

to IRs activities, there is insufficient manpower to establish and operate comprehensive DP activities as an independent section of the library.

The finding of the above analysis as experienced by Namibian academic libraries are therefore comparable to those experienced by many other African academic organisations regarding long-term preservation. These challenges pertaining to DP of IRs are such as lack of standards, lack of policies, lack of training and manpower as well as a lack of management support are the main challenges likely to hinder progress towards long-term digital preservation practices (Sambo, Saturday & Usman, 2014). In light with this argument, Mensah (2015) discourages the act of pulling all financial resources into the overall library budget, as this leads to competition of resources among different divisions within the library (Mensah, 2016).

5.7 Summary

This chapter aimed to broaden the research findings presented in chapter four (4). The chapter discussed how findings of this study refute and confirm those from other studies on long-term preservation practices in terms of policies, support, skills and challenges on the subject matter.

The study findings showed that digital preservation practices at Namibian academic institutions understudy is a shared responsibility between two departments (library and ICT department). While each department has a role to play towards the practice of long-term preservation of IR digital content, there are certain essential roles that remain unassigned in terms of securing long-term access. The results of the study also revealed that conducting short-term practices such as system upgrades and backup activities have been considered to be the main preservation activities at both academic institutions. Issues relating to policies and guidelines guarding towards IR digital content to ensure

its long term/future access were also discussed in this chapter. The main results on guideline and policy matter immerged that there are academic institutions operating IRs without guidelines and policies in place and governing on how IR digital content should be preserved to ensure its long-term future access. Furthermore, the study established that more support towards securing enduring IR access is required in relations to skills and training, budget allocations as well as approval and implementation of IR long-term preservation policies. Lastly, the study was accompanied with various challenges, such as network/internet connectivity, lack of training and skills towards long-term preservation, lack of schools available to train digital preservation, lack of policies, lack of budget and risks of technological obsolescence.

The next chapter, chapter six (6) will present the overall summary, conclusions drawn from the results of the study and provide recommendations.

CHAPTER 6: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter draws down and concludes the main findings of the study. Herein, recommendations for further studies in the field of digital preservation of IRs are made based on the findings of the study. According to Assan (2013) the conclusion chapter is not a typical summary of all the topics covered in the thesis, it is rather a synthesis of key points which the researcher developed based on the research findings. The purpose of this chapter is thus to blend various issues resulting from the entire thesis (Assan, 2013).

The purpose of the study was to investigate current preservation practices of digital content in IRs in terms of long-term preservation strategies, policies, support, skills and challenges. This study used the OAIS reference model to provide a comprehensive framework for digital preservation functions. Data was collected using face-to-face unstructured interviews from various stakeholders involved with dealing with IRs repositories in one way or another at the two academic institutions (NUST and UNAM libraries), an observation method was additionally used to ascertain IR policies on long-term preservation aspects.

6.2 Summary of the findings

This section of the chapter outlines a summary of the study's findings on long-term digital preservation practices of IRs content at two Namibian academic libraries (NUST and UNAM library).

The study's summarised findings are presented according to the themes below:

- ➢ Preservation strategies of IR digital content

- ➢ Policies and guidelines in place to govern IR digital content

- ➢ Support towards IR digital preservation activities

- ➢ Skills required to manage digital content

- ➢ Challenges experienced in IR digital preservation practices

6.2.1 Preservation strategies

The first objective of this study aimed to examine the current preservation strategies of IR digital content at two Namibian academic institutions (UNAM and NUST). Upon investigating the key strategies performed in order to ensure long-term access for IRs digital content on D-space, the results from this study indicated that, conducting regular backups, system/software upgrades and maintenance as well as using open file formats i.e. PDF are the main techniques used at both institutions sampled for this study.

In addition, despite limited efforts, participants from both institutions A and B of this study thought that long-term preservation was of great importance in ensuring continuity of existing IR material for future access. This also seems to be a phenomenon in some African countries i.e Nigeria where digital preservation activities such as migration and emulation are not always considered as methods to ensure long-term preservation and access of IRs future digital content (Gbaje & Mohammed, 2017).

Even though migration and emulation have been considered to be the two primary strategies used for long-term preservation (Kirchhoff, 2008), this study established that long-term preservation techniques such as; migration and emulation techniques, monitoring and assessing the type (formats and versions) of digital content for IR are currently not being executed at both participating institutions.

6.2.2 Policies and guidelines in place to govern IR digital content

This goal was aimed at investigating IR conservation policies. The findings showed that only one institution was studied among the two academic libraries (institution A) had an IR policy developed to control database usage, space and access guidelines. At institution A, however, the current policy does not include guidance on how to perform IR electronic preservation at institution A. The findings of this research have showed, however, that institution B does not have an IR policy in place to regulate its IR material. As noted by (Mensah, 2015; Kanyengo, 2006), some academic institutions are operating IRs without guidelines and policies in place to govern long-term digital preservation to ensure its future (Mensah, 2015; Kanyengo, 2006).

In accordance to the OAIS reference model, digital preservation policies should cover components such as: *access and use; accessioning and ingest; audit; content format preservation; content format preservation; collaboration; content scope; glossary/terms; glossary/terms; mandates; metadata and documentation; policy/strategy review timeframe; preservation strategy; preservation planning; rights and restriction management; roles and responsibilities security; management selection/appraisal; staff training type and frequency; sustainability planning and disaster; duplication and backups; as well as emergency measures* (Sheldon, 2013).

Based on the guidelines above, the findings from this study revealed that certain components pertaining to long-term digital preservation such as; content format preservation, staff training, disaster and emergency measures, preservation planning and preservation strategies are not catered for in the current policy developed at institution A. Thus, detailed and practical processes on how long-term preservation of

IR content at institution A will be achieved has not been addressed in the current IR policy at institution A.

6.2.3 Support towards IR digital preservation activities

The third objective of this study intended to assess the level of support received by staff towards digital preservation of IRs. The study found insufficient support in terms of budget allocation for IRs electronic preservation initiatives; development funds; and policy enforcement management resources. With regard to the budget, it was found that the two Namibian academic libraries do not have a separate budget dedicated for IR electronic preservation activities. In line with the above findings, Igberaese, Sambo and Saliu (2014) noted that a lack of support towards digital preservation activities such as training and comprehensive policies can negatively impact future access to stored IR content (Igberaese, et al. 2014). Thus, long-term preservation of IR digital content to ensure future access requires continuous support and commitment from stakeholders such university finance and decision-making management, library management, academic staff and users (Jain, Bentley & Oladiran, 2008).

6.2.4 Skills required to manage digital content

The fourth objective was to examine skills required by staff members in managing IRs digital content. This was done in order to determine whether the skills currently possessed by library staff are sufficient to perform digital preservation tasks to ensure future access to contemporary knowledge. The findings revealed that the current skills retained by librarians dealing with preservation of IRs are basic. Thus, staff members currently involved with the IR possess skills and knowledge in the following areas NUST and UNAM are:

➢ Digital applications and database management,

➢ Metadata skills/knowledge i.e Dublin Core,

- ➢ APA citations,

- ➢ Adobe Acrobat for document editing,

- ➢ UNIX/LINUX environment,

- ➢ Knowledge on Web interface,

- ➢ XML,

- ➢ Understanding of the OS (Operating System) such as Windows/Ubuntu

- ➢ Knowledge in java programing languages.

As highlighted by (Khan & Bhatti, 2017; Raju, 2014), the ability to manage digital library infrastructure requires; defining policies and standards for digitization, cost planning, managing staff, train library users, knowledge of digital library evaluation, and digital skills to backup digital contents. Thus, librarians dealing with IR long-term preservation must possess knowledge of digitization, metadata creation and management, preservation of digital information, and computer skills which are useful to work in online information environments (Khan & Bhatti, 2017; Raju, 2014).

Moreover, it has been identified that a suitable candidate for managing IR long-term preservation activities needs to be well rooted in the fields of library and information science, as well as ICT history. However, the findings of this study showed that as a result of inadequate training on realistic digital preservation practices, the disparities of librarians in current skills on digital preservation were recognized. This is especially the case at institutions A where IR librarians in addition to IR IT support officer indicated that they never received training on preservation of digital content. In other occurrences such as those at intuition B, IT librarians noted that they often rely on self-training through means of internet and by subscribing to mailing lists with IR like mandates for more insights.

6.2.5 Challenges experienced in IR digital preservation practices

The final objective of this research was to discuss long-term conservation practices issues faced in IRs. As noted earlier in the literature, electronic preservation is a major problem for many educational institutions around the world, as they continue to struggle with initiatives and strategies to preserve academic and cultural records). Additionally, Sambo, Saturday and Usman (2014) also confirmed that there is an obsolescence of technology, lack of standards, lack of policy, lack of training and resources as well as lack of management support are the main challenges that could hinder progress towards long-term digital preservation practices technology obsolescence, lack of standards, lack of policies, lack of training and manpower as well as a lack of management support are the main challenges likely to hinder progress towards long-term digital preservation practices (Sambo et al, 2014). This study also found various challenges pertaining to preservation directed towards areas of; lack of preservation practices, slow network/internet issues, lack of training and skills on digital preservation, lack of policies and guidelines and lack of budget/funds allocations in support thereof.

6.3 Conclusions

The main objective of this study was to investigate current preservation practices of digital content in IRs at NUST and UNAM library. The study explored current preservation practices of IRs digital content in terms of long-term preservation strategies, policies, support, skills and challenges in this area of study at Namibian academic libraries (UNAM and NUST). Based on the summarised findings of the study, this section presents conclusions drawn from the study.

6.3.1 Current preservation strategies of digital content in IRs

The study's first objective was to analyze current digital preservation strategies of digital content in IRs. The study concludes that the study revealed less precedent for

long-term conservation techniques at NUST and UNAM because more emphasis is placed on short-term approaches such as support and maintenance at both NUST and UNAM academic institutions. According to the America Library Association (2007) comprehensive digital preservation practices should comprise of various activities such as backup issues; developing preservation policies and strategies; securing storage; technology watch; development and maintenance of tools; transformation/migration of formats; file format identification; server and space management; preservation education as well as training and outreach (America Library Association, 2007).

The current study (Kavishe & Dulle, 2016; Magama, 2017; Olatukun, 2008; Paper, 2008; Sambo, Saturday & Usman, 2014) confirms and concludes that the risk of technological obsolescence is likely to affect access to future IR content. Consequently, in conclusion to this finding, it is therefore apparent that the current measures considered as preservation methods at the two Namibian academic institutions may not sustain and guarantee future access to IR content if not addressed soon.

6.3.2 Preservation policies regulating IRs

The study's second objective was to investigate IR-regulating policies. The study concluded that the policies and guidelines regulating long-term protection of IRs in UNAM and NUST libraries were less careful. This is shown by the way institution A runs its IR without clear guidance for long-term conservation and access as well in institution B which in return operates its IR without any policy in place to govern long-term preservation and access. Following the above conc (Hedstrom & Montgomery, 1998; Sambo et al, 2014) observed that, the absence of well-established preservation of digital content policies compromises on effectiveness and efficiency of information

service delivery in the present and future century (Hedstrom & Montgomery, 1998; Sambo et al, 2014).

6.3.3 Support towards IR digital preservation activities

IR management support is a function performed through collective support of all individuals in an organization working together to ensure that digital content in the repository is well preserved to ensure long-term access (Mensah, 2015). Support is therefore crucial for successful execution of long-term digital preservation projects (Igberaese, Sambo & Saliu, 2014).

Therefore, the third objective of this analysis was to assess the level of support for electronic preservation of IRs provided by workers. The study concludes that there is a degree of insufficient support for digital content protection, concerning budget allocation problems for IRs and staff training, as well as lack of policy enforcement to effectively execute digital content and preservation activities.

6.3.4 Skills required to manage digital content

The expertise needed in the management of digital preservation plays a vital role towards the success of long-term preservation, thus broadly demands knowledge in IT, generic, communication and management skills to manage and preserve digital content for durable future access (Nonthacumjane, 2011; Tennant, 1999).

Findings from this objective of this study therefore examined skills required by staff in managing IRs digital content. This objective concluded that, there is generally a lack of knowledge and skills among the participants on digital preservation initiatives. This has been identified to be due to inadequate budget availed to support comprehensive training on skills required to conduct long-term preservation such as knowledge on

long-term preservation file formats. The overall outcome of this objective therefore submits to a common notion observed by Abdelrahman (2017);

Kavishe and Dulle (2016) and Kanyengo (2006) note that inadequate knowledge prevails towards the concept of long-term digital preservation in Africa. The inadequacy is related to the relatively new concept of digital preservation in IR. Li and Banach (2011) implies that lack of skills and comprehensive strategies performed by libraries maybe due to the fact that the subject on long-term digital preservation in the context of IRs is relatively a new concept and needs to be addressed urgently as it is a currently a growing consent among IR managers as perceived by (Li & Banach, 2011). This conclusion indicates that Namibian academic libraries (NUST and UNAM) IRs stakeholders need to evolve their skills sooner through various educational platforms.

6.3.5 Challenges experienced in IR digital preservation practices

Challenges in digital preservation are have been related to: technology obsolescence; lack of standards; lack of policies; lack of training and manpower as well as a lack of management support and lack of engagement are the main challenges likely to hinder progress towards long-term digital preservation practices (Sambo, Saturday and Usman, 2014).

The last objective of this study aimed to explore challenges experienced. This study concluded that the challenges experienced by the two academic institutions pertain to long-term digital preservation efforts which emerged from the findings included slow network/Internet; lack of training and skills towards long-term preservation on file format preservation methods, migration/emulation techniques, LINUX OS, D-space software; lack of schools available to train librarians and IT staff involved with IRs on

specialized preservation of digital content in Namibia; lack of policies; lack of budget support and risks of technological obsolescence. It could be argued that if these challenges are not addressed accordingly, they may lead to future catastrophes such as inaccessible IR content as a result of technological obsolescence.

The OAIS reference model was used in this study to provide a comprehensive framework for digital preservation functions. In this study, the OAIS model looked into the primary mission for preserving information through six functional entities; *inject, archival storage, data management, preservation planning, access and preservation*. These entities are taken to fulfil the OAIS's dual role for preserving and providing access to the information in its custody over a prolonged period of time (Digital Preservation Coalition (DPC), 2014). As indicated in chapter five of this research, the OAIS's primary functional model entities were infrequent at NUST and UNAM, therefore not addressed as whole. This concludes that without comprehensive methods and preservation techniques as suggested by the OAIS model, current digital IR content at the two Namibian academic libraries maybe at risk of future technological obsolesce.

6.4 Recommendations from the study

The study's objective was to gain an understanding of how academic libraries in Namibia ensure long-term preservation to secure future online IR content. The data presented in chapters four and five indicated that Namibian academic institutions must begin to pay attention to the risks associated with barriers to potential access to IR content by resolving current challenges with regard to adequate IR content. .

The author makes recommendations in this section in an attempt to address the current limitations related to the current preservation techniques employed by the two

organizations under review to ensure future access to digital IR material despite rapid technological advances. Recommendations are as follows;

6.4.1 Preservation strategies of digital content in IRs

The researcher recommends that in order to ensure that contemporary IR digital content will still be accessible over a prolonged period of time, it is important for NUST and UNAM academic libraries to explore long-term digital preservation techniques such as migration, emulation, technology watch and file formats preservation. Since both institutions' IRs databases predominantly consist of PDF formats, they may consider preserving IR content in PDF/A formats, which is recommended for digital archives and preservation method. The study also recommends that a team be appointed to pay particular attention to issues concerning IRs at institution B.

6.4.2 Preservation policies regulating IRs

The findings of this study have shown that there is a weakness of none-existing and incomprehensive policies and guidelines towards securing contemporary IR content for long-term access. Based on this conclusion, the researcher recommends that the two academic institutions venture into developing comprehensive IR policies and guidelines addressing how long-term preservation and access of stored digital records can be guaranteed. This conclusion suggests that UNAM and NUST libraries need to develop comprehensive IRs policies, which directs digitisation and digital preservation practices to ensure permanency of IRs digital research output as suggested by (Kanyengo, 2006; Kavishe & Dulle, 2016).

6.4.3 Support towards digital preservation of IRs

The study revealed inadequate support towards preservation of digital content, pertaining to issues of budget allocation for IRs and staff training as well as lack of policy enforcement in place to successfully conduct digital preservation activities. In

this regard, the researcher recommends that more support be directed towards allocating funds for training to develop digital preservation skills such as file format preservation methods, migration/emulation techniques, LINUX OS, D-space software as well as to purchase IR software/application such D-space *Checksum* checker that can be used to validate digital file formats. Approval, implementation and enforcement of IR long-term preservation policies may be another form of support that needs to be rendered by university senior management.

The researcher recommends that it is necessary for NUST and UNAM academic libraries to explore long-term digital preservation strategies such as migration, emulation, software watch and file format preservation to ensure that contemporary IR digital content remains accessible over an extended period of time. Since the IR servers of both institutions are primarily PDF.

6.4.4 Skills in managing IRs digital content

Finally, the study established that there is a lack of comprehensive knowledge and understanding among staff members dealing with IRs on the subject of long-term digital preservation. The researcher recommends to the University of Namibia, the Department of Information and Communication Studies to introduce/incorporate in their curriculum a module/subject/course to theoretically and practically educate and train on digital curation aspects for information professionals.

However, this study suggests continuous support from library management for short courses and seminars on digital curing of digital content as a way to improve the existing preservation skills of already involved staff members and deal with IR at NUST and UNAM. Alternatively, staff members dealing with IRs may enroll for digital curation courses at other academic institutions such that offered at the University of

Cape Town (UCT), South Africa. (UCT Library and Information Studies Centre, 2019: p1).

6.5 Recommendations for further research

This study investigated long-term preservation practices of digital content in IRs at NUST and UNAM in order to determine future access possibilities. Based on the findings from this study, the following is recommendation made for further research:

➢ Since this study focused on the long-term electronic preservation of IRs in document / text dominated academic institutions. Other studies can investigate the long-term digital preservation of digital content formats such as video / audio / text and other digital formats–in institutions other than academia.

6.6 Conclusion

This study concludes that NUST and UNAM are not thoroughly investigating and applying the existing conservation practices for electronic IR materials. This is because the two organizations focus mainly on short-term methods of conservation that do not guarantee long-term survival and access to IR material. This lack of focus was due to various restricting factors related to policy guidelines, lack of funding to sustain the program, and lack of skills to enforce rigorous digital preservation practices. This therefore warrants an urgent need for the two Namibian academic institution to immediately address the current challenges hampering long-term digital preservation practices to ensure continuous access and preserve institution's significant intellectual knowledge output.

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APPENDIX A: RESEARCH PERMISION LETTER (UNAM)

University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneers Park
☎ +264 61 206 3111; URL.: http//www.unam.edu.na

UNAM
UNIVERSITY OF NAMIBIA

RESEARCH PERMISSION LETTER

Student Name: Sylvia Patricia Umana

Student number: 200934821

Programme: MA Library and Information Science

Approved research title: Digital preservation of institutional repositories in Namibian academic libraries: a case study of the Namibia University of Science and Technology (NUST) and the University of Namibia (UNAM)

TO WHOM IT MAY CONCERN

I hereby confirm that the above mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate. Permission is hereby granted to carry out the research as described in the approved proposal.
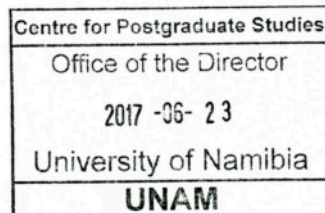
Best Regards

_23/06/17_

Date

Dr M. Hedimbi
Director: Centre for Postgraduate Studies
Tel: +264 61 2063275
E-mail: directorpgs@unam.na

Centre for Postgraduate Studies
Office of the Director
2017 -06- 2 3
University of Namibia
UNAM

APPENDIX B: RESEARCH PERMISION LETTER (NUST)

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

13 Storch Street
Private Bag 13388
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NAMIBIA

T: +264 61 207 2118
F: +264 61 207 9118
E: registrar@nust.na
W: www.nust.na

Office of the Registrar

24 June 2018

Ms Sylvia Patricia Umana
Windhoek
NAMIBIA

Dear Ms Umana

RE: CONSENT TO CONDUCT YOUR RESEARCH WITH THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY STAFF AND STUDENTS

Your email received on 22 May 2018, and the letter from Dr Hedimbi, Director: Centre for Postgraduate Studies, UNAM, has reference.

Approval is hereby granted for you to conduct the research on *"Digital Preservation of Institutional Repositories in Namibian Academic Libraries"* in the Namibia University of Science and Technology. Any information gathered during the research is to be used for the purpose of the study only and must be treated as confidential. The results of the study should be shared with the University. Individual information of staff and students will not be made available, nor will biographical information of staff and students be made available in such a way that individual students can be identified.

You are advised to contact the Director: Library and Information Services, Ms Judy Grobler, and the Director: Department of Information and Communication Technology, Mr Laurent Evrard, to compile a list of possible respondents to your data collection instrument.

I wish you all the best with your research.

Yours sincerely,

Ms Selma Heelu
Assistant Registrar: Academic Administration

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY
P/Bag 13388
Windhoek
NAMIBIA

2018 -05- 2 4

REGISTRAR
OFFICE OF THE REGISTRAR

CC: Deputy Vice-Chancellor: Academic Affairs
Director: DICT
Director: Library Services
Assistant Registrar

157
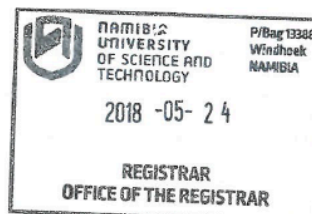
APPENDIX C: ETHICAL CLEARANCE

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UNAM
UNIVERSITY OF NAMIBIA

17 May 2018

The Research Supervisor: **Dr N Hamutumwa**
Department of Information and communication Studies
Faculty of Humanities and Social Sciences
University of Namibia
Windhoek

Dear Dr Hamutumwa

Re: Ethical Clearance for Research Project of MA Student Sylvia Umana

It is with great pleasure that the Faculty of Humanities and Social Sciences' Research and Publications Committee wants to inform you that your student's ethical clearance for the research project **titled "DIGITAL PRESERVATION OF INSTITUTIONAL REPOSITORIES IN NAMIBIAN ACADEMIC LIBRARIES: A CASE STUDY OF THE NAMIBIA UNIVERSITY OF SCIENCE AND TECHNLOGY (NUST) AND THE UNIVERSITY OF NAMIBIA (UNAM)"** has been granted by the Faculty.

The details of this study that Ms Sylvia Umana intends to do have been reviewed during an ethics meeting on 23 March 2018.

The FHSS FRPC wishes you and Ms Umana all the best with this noble project.

Kindly,

Dr M Janik
Chairperson: FHSS FRPC
University of Namibia
mjanik@unam.na

APPENDIX D: INFORMED CONSENT FORM

Researcher

My name is Sylvia Umana, and I am studying towards a Masters of Arts in Library and Information Science. I am conducting a study on "Digital preservation of Institutional Repositories in Namibian academic libraries. Thus, I have chosen you to participate in this study because you form part of your institutional repository to ensure its long-term access to its users. Kindly consider a voluntary participation to share your in-depth knowledge by responding to the questions in the interview guide below regarding your institutional repository.

Title of the study

Digital preservation of institutional repositories in Namibian academic libraries: A case of the Namibia University of Science and Technology and University of Namibia

The purpose of this study is to investigate current preservation practices of digital content in Institutional Repositories (IRs) at NUST and UNAM libraries. The results of this study aim to contribute to the existing literature on the topic of IRs long-term digital preservation practices in the Namibian context, which is seldom documented.

Your responses to this study will be anonymous. Therefore, your identity will not be revealed. The researcher will observe confidentiality by assigning code names for participants that will be used on all research notes and documents as well as by keeping notes, interview transcriptions, and any other identifying participant information in a locked file cabinet in the personal possession of the researcher.

Your participation in this study is voluntary and you may choose not to participate or withdraw from participation in this study at any time. Please note that you will not face any negative consequences should you withdraw from the study. Should you decide to withdraw from participating in the study any anytime, all the information you gave will be destroyed and not used in the study.

After you sign the consent form, you are still free to withdraw at any time. Withdrawing from this study will not affect the relationship you have, if any, with the researcher.

If you have any question regarding this research please contact my main supervisor Dr Hamutumwa: Librarian at the University of Namibia on 0612064658 or email her at nhamutumwa@unam.na

_____

I have read and I understand the information provided above and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Researcher's signature _____ Date _____

_____

Consent for voice recording

I understand that my voice will be recorded and I voluntarily give consent for my voice to be recorded during the face-to-face interview with the researcher.

Participant's signature _____ Date _____

Researcher's signature _____ Date _____

APPENDIX E: INTERVIEW GUIDE (IR TECHNICAL TEAM)

My name is Sylvia Umana, and I am studying towards a Masters of Arts in Library and Information Science. I am conducting a study on "Digital preservation of Institutional Repositories in Namibian academic libraries. Thus, I have chosen you to participate in this study because you form part of your institutional repository to ensure its long-term access to its users. Kindly consider a voluntary participation to share your in-depth knowledge by responding to the questions in the interview guide below regarding your institutional repository. The information provided will be treated with confidentiality as no names will be revealed at all. If acceptable, a cellphone maybe used to capture the responses. The information you are providing is solely for educational purposes.

Background Information

1. Is there a dedicated digital preservation department that deals with Institutional Repository (IR) activities within your library/institution? If yes, can you please state the name of the department?

2. Which software solution do you use (or intend to use) for your institutional repository?

Current preservation strategies of digital content in IRs

1. Which activities are considered part of the scope of the digital preservation function within the IR?

2. How does the software used for the IR play a part in ensuring long-term access for stored content?

3. What measures are in place to make sure that current information in the IR will still be accessible in years to come?

   Possible probing question

   How can you ensure that contemporary digital documents in the IR will still be available and usable in future?

4. How much online/offline storage space are you using for your digital content?

5. What backup provisions does the repository have against content loss or corruption?

6. Does the IR have an information disaster plan to protect its document?

7. In the case of primary system failure or catastrophic natural or manmade disaster, how soon can the IR bring the backup system fully?

8. Do you consider long-term preservation of digital documents to be an intrinsic task of libraries? Can you please elaborate your answer?

9. Who do you think should be responsible for ensuring long-term digital preservation and why?

10. How important do you consider the long-term preservation of digital documents in the IR?

11. Do you think information stored in the IR will still be accessible in 20 - 50 years to come? Please explain your answer.

Preservation policies regulating IRs

1. Are there any written guidelines or policy which guide you on long-term preservation of digital documents in the IR?

   Possible probing questions

   1. If yes, how do the guidelines in place guide you on preservation practices?

   2. If no, why is that so?

Support received by staff towards digital preservation of IRs

1. Is there any dedicated and adequate budgetary allocation for IR activities? Please elaborate your answer.

2. What type of support do you require to successfully conduct IRs digital preservation activities? How would you rate the required support thus far?

3. Is your unit consulted by management on issues concerning your work? How is this done?

Skills required or possessed by staff in managing IRs digital content

1. What skills and knowledge are required to do your job on maintaining the IR?

   Possible probing questions

   1. What educational qualifications are required for this job?

   2. How would you rate your skills and knowledgeable in managing electronic resources?

   3. How often do you get training in keeping afloat with new technologies?

   4. What type of training do you get with regards to IR activities?

Challenges experienced in IRs long-term preservation practices

1. What factors prevent you from carrying out digital preservation practices efficiently if there are any?

2. What is the most challenging part in conducting digital preservation activities?

3. Is there anything else you would like to share regarding this topic?

APPENDIX F: INTERVIEW GUIDE (DIRECTOR AT NUST AND THE UNAM LIBRARIAN)

My name is Sylvia Umana, and I am studying towards a Masters of Arts in Library and Information Science. I am conducting a study on "Digital preservation of Institutional Repositories in Namibian academic libraries". Thus, I have chosen you to participate in this study because you form part of your institutional repository to ensure its long-term access to its users. Kindly consider a voluntary participation to share your in-depth knowledge by responding to the questions in the interview guide below regarding your institutional repository. The information provided will be treated with confidentiality as no names will be revealed at all. If acceptable, a cellphone maybe used to capture the responses. The information you are providing is solely for educational purposes.

Background Information

1. Is there a dedicated department that deals with IR digital preservation activities within your library/institution? If yes, can you please indicate the name of the department?

Current preservation strategies of digital content in IRs

1. Do you have an idea on what activities are being conducted to ensure long-term access of IR content?

2. Does the IR have an information disaster plan?

3. How important do you consider the long-term preservation of digital documents in the IR and why?

4. Who do you think should be responsible for ensuring long-term digital preservation and why?

5. How satisfied are you with the current preservation practices of digital content in the IR? Can you please elaborate on why you are satisfied/dissatisfied?

Preservation policies regulating IRs

1. Is there a policy in place that governs the IR activities?

2. If yes, how does the policy tackle issues on how content should be preserved to ensure long-term access?

   Possible probing question

   1.How current and how often is the policy reviewed?

3. If no, why is this the case?

   Possible probing question

1.Do you plan to formulate one in the future?

2.What are the challenges of operating digital preservation activities for IRs without policies in place?

Support received by staff towards digital preservation of IRs

1. Is there any dedicated and adequate budgetary allocation for digital preservation activities for the IR? How adequate is it in your opinion?

2. What type of support would you require to successfully conduct IRs digital preservation activities? How would you rate the required support thus far?

Skills required or possessed by staff in managing IRs digital content

1. Do you have staff with the requisite skills and knowledge on the preservation of digital content for the IR to ensure long-term access?

2. What training and skills development opportunities do you have in place for staff dealing with IR digital preservation?

3. How often do staff dealing with IRs digital preservation get trained or attend workshops regarding long-term digital preservation?

4. How adequate do you regard digital preservation skills among librarians and other staff involved in dealing with IR digital preservation activities?

5. Do you think librarians should be trained in managing electronic resources (digital preservation)? If yes, how do you suggest this can be done?

6. What skills and qualifications would you consider important if you were hiring a new digital preservation staff to conduct IR digital preservation?

Challenges experienced in IRs long-term preservation practices

1. What aspects of the IR would you like to improve on?

2. Is there anything else you would like to share regarding this topic/study?

Thank you for your valuable time

APPENDIX G: INTERVIEW GUIDE (NUST FACULTY-LIBRARIANS)

My name is Sylvia Umana, and I am studying towards a Masters of Arts in Library and Information Science. I am conducting a study on "Digital preservation of Institutional Repositories in Namibian academic libraries". Thus, I have chosen you to participate in this study because you form part of your institutional repository to ensure its long-term access to its users. Kindly consider a voluntary participation to share your in-depth knowledge by responding to the questions in the interview guide below regarding your institutional repository. The information provided will be treated with confidentiality as no names will be revealed at all. If acceptable, a cellphone maybe used to capture the responses. The information you are providing is solely for educational purposes.

Background Information

1. Is there a dedicated digital preservation department dealing with IR activities within your library/institution? If yes, can you please state the name of the department?

Current preservation strategies of digital content in IRs

1. I understand that you are a stakeholder in developing the IR content, what is your role regarding the IR?

2. Do you manage digital content deposited into the IR in anyway? If yes, how do you do this? If no, why is this the case?

3. Do you consider the long-term preservation of digital documents to be an intrinsic task of libraries? If yes, can you please elaborate your answer?
   Possible probing questions
   1.If no, why do you not consider the long-term preservation of digital documents to be an intrinsic task of libraries?
   2.In your opinion, who should take over this task?

4. How important do you consider the long-term preservation of digital documents in the IR?

Preservation policies regulating IRs

1. What guidelines are in place to acquire IR information from the writers/authors?

2. Is there a specific format for content to be acquired for the IR? If yes, what is the required format?

3. Is there a policy in place governing IR? What does it cover in terms of long-term access?

Management Support received by staff towards digital preservation of IRs

1. Is there any dedicated and adequate budgetary allocation for digital preservation activities for the IR?

2. Is your unit consulted by management on issues concerning the development of the IR?

3. How is the long-term preservation of digital documents in the IR financed at your library?

Challenges experienced in IRs long-term preservation practices

1. What challenges do you experience regarding acquiring and processing digital content for the IR?

2. What areas regarding the IR that you would like to improve on?

3. Is there anything else you would like to share regarding this topic/study?

Thank you for your valuable time

APPENDIX H: INTERVIEW GUIDE (UNAM FACULTIES-RESEARCH UNIT)

My name is Sylvia Umana, and I am studying towards a Masters of Arts in Library and Information Science. I am conducting a study on "Digital preservation of Institutional Repositories in Namibian academic libraries". Thus, I have chosen you to participate in this study because you form part of your institutional repository to ensure its long-term access to its users. Kindly consider a voluntary participation to share your in-depth knowledge by responding to the questions in the interview guide below regarding your institutional repository. The information provided will be treated with confidentiality as no names will be revealed. If acceptable, a cellphone maybe used to capture the responses. The information you are providing is solely for educational purposes.

Preservation policies regulating IRs

1. What are the policies and guidelines in place that assist you to submit information for the Institutional Repository (IR)?
2. What is the format required to submit content for the IR?

Support received by staff towards digital preservation of IRs

1. Is your faculty/unit consulted by the library on issues concerning the development of the IR?
2. How often do you deposit or handover information for the IR?
3. What motivates you to submit information for the IR?

Skills required or possessed by staff in managing IRs digital content

1. In your opinion, how well do you think the IR is managed?

Challenges experienced in IRs long-term preservation practices

1. What challenges do you experience regarding processes in submitting content for the IR?
2. What areas regarding the IR would you like to improve on?
3. Is there anything you would like to add regarding this topic/study?

Thank you for your valuable time

APPENDIX I: OBSERVATION CHECK-LIST

The check-list observes the digital preservation principles covered in the IR policy (if

applicable)

Content of play	Observed		Comments
	Yes	No	
Access and Use	*		Output is distributed worldwide
Accessioning and Ingest	*		States that digital copies of content will be collected, organized, managed, stored and preserved
Audit	*		
Content format preservation		*	
Collaboration		*	
Content Scope	*		Scholarly, educational or research-oriented items
Glossary/Terms	*		
Mandates		*	
Metadata and Documentation	*		States that Dublin core metadata schema is used
Policy/Strategy review timeframe	*		The policy will be reviewed every three years from the date of its' approval
Preservation strategy: refreshing,		*	
Preservation strategy: migration	*		Briefly stated
Preservation strategy: emulation		*	
Preservation strategy: technology preservation	*		-System monitoring, testing and debugging duties -Monitoring and upgrading utility programs and middleware -Compiling migration strategies to ensure long-term access to assets by users

Preservation planning		*	
Rights and Restriction management	*		
Roles and Responsibilities security	*		A shared responsibility between library and ICT department; with unique responsibilities
Management selection/appraisal		*	
Staff training type and frequency		*	
Sustainability planning		*	
Disaster and emergency measures		*	