



**Management of electronic information resources (EIRs) to enhance
their long-term links preservation and access in the University of
KwaZulu-Natal (UKZN) Pietermaritzburg (PMB) and Howard
College campus libraries**

by

George Firmin Kavishe

(B. Computer Science, PGDIS)

Submitted in partial fulfillment of the requirements for the degree of
Master of Information Studies (coursework), Information Studies
Programme,

School of Social Sciences, University of KwaZulu-Natal,
Pietermaritzburg, South Africa

2013

DECLARATION

I, George Firmin Kavishe, declare that;

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George Firmin Kavishe
(Name of student)

Athol Leach
(Name of supervisor)

.....

.....

Date:

Date:

DEDICATION

This thesis is dedicated to my father, Firmin Kavishe and in remembrance of my late mother Josephine Magori. Thank you for your love, support, care and the encouragement all through my life.

ABSTRACT

The purpose of this study was to examine the management of electronic information resources (EIRs) to enhance their long-term links preservation and access in the University of KwaZulu-Natal Pietermaritzburg (PMB) and Howard College campus libraries. The study investigated the strategies and policies used in managing EIRs, how the librarians overcome technological obsolescence, the information and communication technology (ICT) infrastructures used in the management of the EIRs and the competency of the librarians in electronic preservation.

The significance of this study lay in its addressing of the issue of long-term links preservation of and access to EIRs that has not been addressed by previous studies. There is rapid growth in the creation and dissemination of EIRs which has emphasized the digital environment's speed and ease of dissemination with little regard for its long-term preservation and access.

The study population was 33 and it comprised the subject librarians, metadata librarians and electronic resources librarian of PMB and Howard College campus libraries of the University of KwaZulu-Natal. Adopting a quantitative approach the research design was that of a survey and the research instrument was a self-administered questionnaire comprising both open and closed questions. A total of 28 librarians responded to the questionnaire giving a response rate of 84.8%. Data was analyzed using SPSS. Results were presented in the form of figures and tables. The study was underpinned by the Open Archival Information System (OAIS) Reference Model, which is being used widely in the digital preservation community.

The analysis of the findings revealed that there was an intermediate level of ICT knowledge and skill with regard to management of EIRs amongst the respondents and a need for training in EIRs management particularly with regards to metadata, migration, emulation, maintenances and bit preservation techniques. It was also revealed that the libraries were using the server's hard drive to store the EIRs. The results also showed that there were an arguably high number of respondents ten (35.7%) who indicated that their libraries did not have an EIRs management policy. For those respondents who said that their libraries do have a policy, the vast majority indicated that the policy did provide guidelines for acquiring materials in electronic form and for transforming materials from print to electronic form. Recommendations emerging from the conclusion were made and suggestions for further research put forward.

ACKNOWLEDGEMENT

I have come to recognize that my greatest fortune in life is the father Almighty God. All I have I owe to Him who art in Heaven.

The accomplishment of a research such as the one reported in this thesis could not have been accomplished without the help and support of other people. The work has been a challenging, motivating and pleasing experience for me because of the outstanding people with whom I had the opportunity to work and interrelate with and also because of the generous support I enjoyed from friends in the process of this research.

I am grateful to my supervisor, Mr. Athol Leach, for his guidance, encouragement and his time. Every meeting with him was an informative experience. He was always available to assist in whatever problems I experienced with the research. I would also like to thank the subject librarian Ms. Goitsehang Ncongwane for her support and encouragement and I would also like to thank my best friend Ms. Irene Shubi Isibika, who assisted me with so many things when I was stuck such as locating online information sources.

Thank you so much.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASCII	American Standard Code for Information Interchange
CCSDS	Consultative Committee for Space Data Systems
DVD	Digital Video Disk
EIRs	Electronic Information Resources
GB	Gigabyte
HTML	Hypertext Markup Language
ICT	Information and Communications Technology
ID	Identification Document
JPEG	Joint Photographic Expert Group
LAN	Local Area Network
MB	Megabyte
OCLC/RLG	Online Computer Library Center/Research Library Group
PC	Personal Computer
PDF	Portable Document Format
PMB	Pietermaritzburg
PhD	Doctoral Degree
R	South African Rand
SPSS	Statistical Package for Social Science
TB	Terabyte

TIFF	Tagged Image File Format
UKZN	University of KwaZulu-Natal
URL	Uniform Resource Locator
US	United States
XML	Extensible Markup Language

CHAPTER ONE

INTRODUCTION

The Chapter provides the background to the study and an outline of the statement of the problem. This is followed by the research questions, the rationale of the study as well as the study's scope and delimitations. Finally, the structure of the dissertation is briefly described. Included in this Chapter is an overview of electronic information resources (EIRs) management at the University of KwaZulu-Natal (UKZN) as well as a description of the libraries which are found on the two campuses under study.

1.1 Background to the study

Nsanzya (2003) indicated that developments in technologies since the 1990s have hugely changed how information is managed stored and accessed. Increasingly, libraries are moving their collections onto computer-generated platforms (Hodge 2002). The introduction of EIRs is part of these developments and such resources have fundamentally impacted on the library and its users. The arrival of e-resources has forced a change in library operational and organizational procedures (Yu and Breivold 2008). An EIR is a resource that can be written on magnetic or optical media (Wamukoya and Mutula 2005).

Styblińska (2006) argued that the need to manage and have widespread access to EIRs is now increasing very fast. Rapid changes in the formats for storing and in the technologies for use have threatened to reduce the lifetime of EIRs in the electronic age. Little attention has been given to the difficulties that are facing EIRs preservation. More specifically there is little attention in focusing on the longevity of the physical media on which the EIRs is meant to be stored (Styblińska 2006). It is seen that even under the best storage circumstances electronic information can be fragile and have a limited lifetime (Styblińska 2006).

Challenges in the practices of librarianship have also been stressed by Ngoepe and van der Walt (2009) who argued that rapid changes in technologies have created challenges in the

management and preservation of EIRs. Despite the advances in the use of information technologies in many collections, the management of EIRs for continuous access by library users is a major challenge for many libraries around the globe. The authors also point to the fragility of EIRs due to the high pace of technological change resulting in obsolescence. The management of EIRs is thus a challenging exercise that requires appropriate preparation and strategies (Ngoepe and van der Walt 2009).

Hodge (2002) indicated that wide use of links in e-publications has raised the question of whether these links and their contents should be preserved along with the original site. Most organizations preserve the Uniform Resource Locators (URL) or other identifiers for the links and not the content of the linked pages (Hodge 2002).

1.2 Statement of the problem

EIRs management is crucial within any organization but it is becoming increasingly challenging in terms of the long time frames over which information is required to be preserved (Paper 2008). This means that information contained in EIRs will only last for the period not exceeding the supported life of the application used to store them. This problem is not diminishing and in fact the challenge of long-term preservation of and access to EIRs is increasing (Paper 2008). Furthermore, Mloi and Mutula (2007) pinpointed that libraries in developing countries are faced with challenges in managing EIRs. These challenges include the aforementioned technological obsolescence, weakness or absence of policies and inadequate ICT skills in managing EIRs. Poor EIRs management is bound to result in information gaps (Wamukoya and Mutula 2005). Therefore, libraries must adopt long-term strategies to preserve EIRs (Bothmann and Holmberg 2010) and in doing so the effective management of EIRs is crucial.

Given the above, the problem which this study attempted to address was the management of EIRs in the UKZN Pietermaritzburg (PMB) and Howard College campus libraries to ensure their long-term links preservation and access.

1.3 Research questions

In terms of addressing the problem the following research question was posed:

How is the management of EIRs resources done in the UKZN PMB and Howard College campus libraries with the aim of enhancing their long-term links preservation and access?

To respond to the question above, various sub-questions were formulated and these were as follows:

- What methods do staff use to enhance continuous access of EIRs on the UKZN PMB and Howard College campus libraries?
- What level of ICT skills do staff have in metadata preservation and how often are they trained to meet the technological changes?
- What ICT infrastructures are used in metadata preservation?
- What strategies for metadata preservation are used in managing EIRs?

1.4 Scope and delimitations of the study

The study was confined to the management of EIRs in UKZN PMB and Howard College campus libraries (see below for a description of these libraries). Libraries of other UKZN campuses (Edgewood, Medical School and Westville) were not included in this study. While the ideal would have been to include all the libraries of UKZN this was too huge a task for the requirements of a short dissertation and, in addition, the time allocated to complete the research was limited. In this regard Bell (2003:28) indicated that there is “never sufficient time to do all the work that seems to be vital in order to do a thorough job”.

The study focused on the subject librarians, the metadata librarians and the electronic librarian. This population was chosen in terms of their expertise to provide relevant information on the matter being investigated. Furthermore, they would be the staff most involved in the EIRs management in their libraries.

Finally, for the purpose of this study, both born digital and digitized EIRs were focused on and these comprise e-books, e-journals, e-theses and databases. The born digital resources are the materials that were produced and managed in digital form whereas digitized resources are the digital items that were produced in printed form and then later converted into digital form through, for example, the scanning process (Erway 2010).

1.5 Rationale for the study

The results of this study could be useful to both UKZN and other university libraries in South Africa in the management of EIRs. The study could also be of importance in terms of either feeding into existing policy or providing a basis for a new policy with regard to EIRs management. Since libraries are arguably the main source of information for teaching and research in UKZN, the libraries have the responsibility of ensuring that the learning community has access to EIRs for learning, teaching and research purposes. Furthermore, there has been no formal investigations of this topic done at UKZN in the past (Ncongwane 2013), and it was anticipated that the study would fill in the gap.

1.6 Libraries of UKZN PMB and Howard College campuses

As noted above, the PMB and Howard College campuses have various libraries and these are described below. The PMB Campus comprises the Cecil Renaud Library (which is the main library), the Law Library and the Life Sciences Library. The Howard College Campus which is in Durban comprises the EG Malherbe Library (the main library), the Eleanor Bonna Music Library, the Architecture Library and the GMJ Sweeney Law Library (University of KwaZulu-Natal 2010).

Libraries on the PMB Campus:

1.6.1 The Cecil Renaud Library

The Cecil Renaud Library was named after Cecil Renaud, a library benefactor who, in 1990, contributed funds for the addition of the second floor to the library building. The Library is a four storey facility which comprises space for the substantial journal and book collection and a developing collection of EIRs. It is the main library of the PMB Campus. Since the concept of a research commons (see below) has yet to be provided at this Library, management devised a temporary solution to the lack of a research commons - a Multi-Media classroom is being used as a “Research Hub” (whereby a subject librarian is available to assist Masters and Doctoral students with their research) and this assistance includes accessing the EIRs (University of KwaZulu-Natal Library 2009).

1.6.2 The Law Library

The Law Library contains a collection of local and foreign law reports and journals in both print and e-format and it also serves the needs of the students and staff in the School of Law and Management Studies (University of KwaZulu-Natal 2010).

1.6.3 The Life Sciences Library

The Life Sciences Library caters for subjects in the School of Agriculture, Earth and Environmental Science (University of KwaZulu-Natal 2010).

Libraries on the Howard College Campus:

1.6.4 The EG Malherbe Library

The EG Malherbe Library is the main library of the Howard College Campus and it serves the needs of students and students in the Arts, Social Sciences, Development Disciplines and Engineering. The Library was called the EG Malherbe Library in 1988 after the former principal of the University (University of KwaZulu-Natal 2010). It has a LAN with high speed PCs with

adequate facilities to house 20 or more PCs for students to access the EIRs (University of KwaZulu-Natal Library, 2011).

1.6.5 The Eleanor Bonna Music Library

The Library was established in 1972 and it was named after the donor of the core collection. It is housed in the School of Music. Its collection comprises journals, tapes, books, microfilms, CDs, DVDs, CD-ROMs, and video cassettes (University of KwaZulu-Natal 2010).

1.6.6 The Barry Biermann Architecture Library

This Library was established in 1969 and named after architect Barry Biermann. The library serves the needs of the students and staff of the School of Architecture, Planning and Housing. It is a technical reference library comprising trade literature, slides and drawings (University of KwaZulu-Natal 2010).

1.6.7 The GMJ Sweeney Law Library

The Library was established in 1972 and it was named after a notable professor of law. It keeps the law collections and serves the needs of the students and staff of the School of Law (University of KwaZulu-Natal 2010).

Having provided some background to the libraries on the two campuses attention is turned to the management of EIRs. The section, however, begins with an historical overview of the University.

1.6.8 EIRs management at UKZN

The University of KwaZulu-Natal was formed in 2004 as an outcome of the union between the University of Durban-Westville and the University of Natal (University of KwaZulu-Natal 2010). The University of Durban-Westville was recognized in the 1960s as the University College for Indians on Salisbury Island in Durban Bay (University of KwaZulu-Natal 2010). Established in 1910 as the Natal University College in PMB, the Natal University was granted

independent University status in 1949 due to its rapid growth in numbers, its wide variety of courses and its successes in, and opportunities for, research (University of KwaZulu-Natal 2010). The two KwaZulu-Natal universities were amongst the first of South African institutions to unite in 2004 in agreement with the government's higher educational reform plans that were to see the number of higher educational institutions in South Africa abridged from 36 to 21 (University of KwaZulu-Natal 2010).

In 2012, UKZN sign up the Berlin Declaration on Open Access to Knowledge in Science and Humanities (University of KwaZulu-Natal Library 2012). The aim of the Declaration was to call for the results of research to be made extensively available on the Internet and to authorize the use of results in any way that extends scholarships and research (University of KwaZulu-Natal Library 2012). In the same year, there were new research commons facilities that were opened on Westville and Edgewood campuses. These research common facilities provide the users in the libraries access to the EIRs and to work on their research in a comfortable situation (University of KwaZulu-Natal Library 2012). This concept of research commons has brought together high-end technology, access to extensive EIRs and well-trained personnel with skills in managing EIRs. The research commons in the EG Malherbe Library was opened in 2008 and since then, It has been a runaway attainment in terms of enhancing access to the EIRs. There are two more facilities that are to be built on the Medical School and PMB Campus libraries (University of KwaZulu-Natal Library 2012).

In connection with their mission to support learning, teaching, and research and community engagement, the UKZN libraries have continued to develop their collections, with particular emphasis on automated collections. For the libraries to best work for a multi-campus patron base, the libraries transformed many of their print resources to e-format (University of KwaZulu-Natal Library 2009). For example, there is an on-going project concerning the digitization of doctoral theses that are held in all the UKZN campus libraries. By 2012, digitization of the doctoral theses in the Medical School Library had been completed and that of Westville Library was also almost completed. It was estimated that there were roughly 2,250 doctoral theses that were outstanding to be digitized (University of KwaZulu-Natal Library 2012).

The University of KwaZulu-Natal Library (2012) stated that although the acceptance of EIRs such as e-books has been fairly slow at the University, the libraries' e-books collection continues to grow. The UKZN Library annual reports are also showing that databases at the University are extensively used as sources of information. Due to the increased demands in using EIRs, several new EIRs were added to the UKZN Library collections in 2012 (University of KwaZulu-Natal Library 2012). The following were the new EIRs added:

- Health science and medical databases,
- Easy Data by Quantic,
- Fish, fisheries and aquatic biodiversity worldwide,
- International financial statistics,
- Sage research methods,
- Scopus and
- World data bank.

The increasing availability of information in e-format has meant that the role of academic libraries and librarians is changing. There has been a number of workshops organized in the UKZN libraries their aim being to influence librarians to explore the new technologies and improve their skills as information providers (University of KwaZulu-Natal Library 2010). Examples of such workshops include the Digital Library Workshop, Adobe Acrobat Workshop: preparing digital files, as well as those that covered Web 2.0 and other new technologies in use at UKZN libraries (University of KwaZulu-Natal Library 2010).

1.7 Definition of the main concepts of the study

1.7.1 Management

Yu and Breivold (2008) define management as “the management of information that is preserved on electronic media using electronic hardware, software and networks”. They say“ it includes the account of policies and strategies, the organization of these EIRs, requirements for information technology and access to the resources”

1.7.2 Preservation

According to Hedstrom (1998), preservation is the protection of information to endure value of access by present and future generation. Hedstrom (1998) went on and stated that preservation programmes include administration and technical components such as hiring of staff with expertise in preservation administration.

1.7.3 Access

Ensuring that the users are able to make use of electronic information which they are entitled to (Omollo 2011).

1.8 Structure of the dissertation

Chapter one – Introduction

The Chapter comprised the background to the study, statement of the problem, research questions, scope and delimitations and rationale for the study.

Chapter two – Literature review and theoretical framework

The Chapter will comprise a review of the relevant literature related to the study as well as a discussion of the theoretical framework which underpinned the study.

Chapter three – Research methodology

This Chapter raises the issue of the research methodology and the research methods employed, which includes the research design, population, sampling, data collection and data analysis.

Chapter four – Presentation of the results

This Chapter will present the research results obtained from the survey of the identified staff working at the UKZN PMB and Howard College campus libraries. Findings are presented in the form of tables and figures.

Chapter five – Discussion of the results

This Chapter will discuss and analyze the findings of the study as presented in the previous Chapter.

Chapter six – Conclusions and recommendations

This will be the concluding Chapter where major findings and conclusions will be presented. Recommendation emerging from these will be made and suggestions for further research will be provided.

1.9 Summary

In this introductory Chapter, the research problem, the aim of the research, including its rationale, scope and delimitations were articulated. The libraries on the two campuses under study were described as well as the situation concerning the management of EIRs at UKZN. The Chapter ended with a brief outline of the structure of the dissertation. In the next Chapter, the review of the literature and theoretical framework is presented.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

A literature review involves the identification and examination of literature related to one's research project. This includes identifying potentially relevant sources, an initial assessment of these sources, the exhaustive analysis of the selected sources and, finally, the building of an account integrating and explaining the sources (Lefuma 2004). The review of related literature includes the identification, locality and investigation of documents comprising information linked to the research problem (Hoskins 2002). According to Bell (2003:90) any investigation, whatever the scale, will involve reading what other researchers have written about your area of interest in order to gather information and gaps to support your arguments and write about your findings. The purpose of a literature review is to provide a theoretical background to the study, as well as to learn from what others have done (Lefuma 2004).

The literature in this study is reviewed from sources such as published books, journals, online unpublished and published articles and papers from conferences which deal with EIRs management.

Much has been written about the management of EIRs since the 1990s. Even though research initiatives have tried to contribute partial solutions to the challenges facing the long-term links preservation of EIRs, much more still has to be done (Ngoepe and van der Walt 2009).

The purpose of this study, therefore, was to investigate the management of EIRs in the UKZN PMB and Howard College campus libraries with the aim of providing long-term links preservation of, and continuous access to, these resources. With regards to the importance of electronic information management, this Chapter examines the issues of information and communication technologies (ICTs) infrastructure used in managing EIRs, the ICTs skills needed in managing EIRs and the strategies, policies and models used to manage these resources. The Chapter also looks into the management of EIRs, specifically metadata (this term will be defined and discussed in section 2.3.3) preservation skills required by the librarians to perform metadata preservation of EIRs. What are some of the metadata preservation knowledge

and skills librarians are required to have in order to preserve the links to EIRs? This is among the questions to be answered by this literature review.

2.2 Management of EIRs

For the purpose of this study management of EIRs comprises the use of proper metadata preservation strategies and policies as well as the application of the necessary metadata preservation methods and technologies to ensure the continual accessibility of these resources.

2.3 Requirements for managing EIRs

In order to manage EIRs in their different storage capabilities and in the formats that will make them available and usable, it is vital to articulate some basic necessities for this to occur (Hedstrom 1998). Libraries will not achieve their management mission if they do not fulfill the requirements of their users by managing EIRs in good storage, using metadata preservation strategies and in the formats which will enable users to access these resources (Hedstrom 1998).

2.3.1 Storage

Storage activities in digital libraries are based on two major understandings. The first is that digital storage media are inherently unreliable meaning that there will be loss of data due to manufacturing defects or media deterioration. The second one is that the storage media will finally become obsolete due to continuous change in technology (Harvey 2010:182). Therefore, one cannot say that there is a long-lived digital storage medium. Below are some of the storage methods that are used in storing EIRs. It is important for libraries to correctly store the EIRs because these ensure long-term access to information. Strategies such as backing up of information on different media will ensure this. This is done in case the original folder is corrupted or unavailable it is then quick to simply retrieve from the backup.

- **Magnetic storage media**

Lefuma (2004) states that recording in magnetic media has dominated computer storage technology since the 1950s. Magnetic media rely upon magnetism for recording and deleting the information. The computer retrieves information from storage when the information stored is active and then brings it into the Central Processing Unit (CPU). In the CPU the desired operation is done upon the EIRs and thereafter returned to the storage. Magnetic media comprises two categories: disk storage and tape storage.

Disk storage is a rigid platter coated with magnetic oxide that can be magnetized to store data. They come in different range of sizes like 40GB, 60GB and so on (Capron and Johnson 2002:165). There are different types of disk packs on the magnetic hard drives. Each disk in the pack has a top and a bottom surface on which data is recorded (Capron and Johnson 2002:174). The magnetic hard disk drive (HDD) plays a significant and very useful role in the electronic information processing system. Since the first hard disk drive was introduced in 1956, it has been the recipient of important additional technology modernisms which have extended its value (Grochowski 1998). Lilly (2012) indicated that modern hard disk drives are much more capacious than their predecessors. Maximum densities in HDDs are anticipated to increase more than twice over during the five-year period from 2011 to 2016. This tremendous growth is being driven by more demanding video and audio storage requirements (Lilly 2012). She continued by stating that there are new changes on the way, such as heat-assisted magnetic recording (HAMR) and if this takes off, the maximum capacity for 3.5-inch HDD could reach 30 terabytes (TB) to 60TB, while 2.5-inch HDDs could reach as high as 10TB to 20TB, all by 2016. HAMR is a method for enabling large increases in the storage density of HDDs (Kryder et al 2008).

Tape storage is a storage medium that is used primarily with large computer systems, although there are some personal computers which also use this form of secondary storage (Capron and Johnson 2002:17). The magnetic tape usually comes on a cartridge which is similar to the tape that is played on a tape recorder. These magnetic tape cartridges are inserted in a tape drive to read data or insert new data. The magnetic tape is always used for back up purposes (Capron and Johnson 2002:17). Magnetic tape is the most commonly used medium for offline information storage and backup protection (Lefuma 2004). In this type of storage, data is stored as extremely small magnetic spots.

- **Optical storage media**

Capron and Johnson (2002:185) indicated that optical disks are used to store data using laser beam technology. Optical disc technology has been one of the technological successes since the 1980s (Oppenheim 1993:1). Optical disks belong to three general families categorized according to their ability to read and write compact disks (CDs) and Digital video disks (DVDs) (CDs and DVDs are forms of optical storage). These categories are Read-Only-Memory, Write once and Erasable. Within each family, electronic information can be recorded in one of the two formats, analog or digital. Here analog and digital refer to the signal being used in recording electronic information. The analog signal is wave-like while digital refers to the on/off electrical pulses used in computer technology (Eaton, Macdonald and Saule 1989:3). Examples of Read-Only-Memory (ROM) are Compact Disk-Read Only Memory (CD-ROM), CD-Audio and CD-ROM/DVI (Digital Video Interactive).

CD-ROM is capable only of reading data from CDs and it is only used for data storage (Eaton, Macdonald and Saule 1989:5). The core advantages of CD-ROMs are that they are relatively low in cost and are widely available (Lefuma 2004). Compact Disk-audio (CD-audio) is designed for digital presentation of music. CD-ROM/DVI has the ability to show one hour of motion video from compressed electronic data preserved on a single standard CD-ROM disc. To operate this, a user will need a CD-ROM drive (Eaton, Macdonald and Saule 1989:5).

An example of Write once is Write Once, Read Many (WORM). Unlike the ROM technology, WORM allows local computer systems to write directly onto the disk and once the data has been written then the disk cannot be changed. It is also called DRAW (Direct-Read-After-Write) (Eaton, Macdonald and Saule 1989:7). The third family of optical disk is the erasable disks. These are the disks that allow the information stored in them to be modified, updated or deleted hence sometimes called Write-Many disks. Example includes the Compact Disk-Erasable Programmable Read Only Memory (CD-EEPROM) (Eaton, Macdonald and Saule 1989:8).

2.3.2 Preservation file formats

Selecting a stable file format is an essential preservation consideration. For each type of digital information one encounters such as text, image, sound, or video, there are low-level formats that are likely to go on supported now and for the foreseeable future (Hunter 2000:60). “For example,

word processing documents can be saved as an ASCII file”. This is a standard text that can be read using almost any software. The disadvantage of an ASCII file is that formatting is lost. Many organizations are turning to formats that are popular on the World Wide Web (WWW or Web) in the hope that these formats will last long/survive (Hunter 2000:60). There are three principal formats:

- HTML (Hypertext Markup Language)
- XML (Extensible Markup Language)
- PDF (Portable Document Format)

Hunter (2000:60) stated that HTML is the language that is used on the Web. Using HTML, one can display a page using various display browsers and readers. “The advantage of HTML is that it is widely available and has the potential for ongoing support” (Hunter 2000:60).

Hunter (2000:61) indicated that XML is a universal format for structured documents and data. Structured documents include spread sheets, address books and technical drawings. XML is license-free, platform-independent and well-supported (Hunter 2000:61). Many involved in electronic preservation see XML as their best hope for combining document content and descriptive information in one component that can be read by future software packages (Hunter 2000:61).

Adobe PDF is the open de facto standard for electronic document distribution globally. This is the type of format that keeps all of the fonts, formatting, colors and graphics of any source of document irrespective of the application and the platform used to generate it (Hunter 2000:61). Many organizations are adopting this particular format for submission and storage of EIRs (Hunter 2000:61). Any document, even scanned paper can be converted into PDF.

2.3.3 Metadata preservation strategies

Metadata is the structural information that describes, explains, locates, or makes it easier to retrieve, use or manage EIRs (Harvey 2010:71). Harvey (2010:75) identified the following features that comprise metadata:

- **Administrative metadata:** this relates to the use, management and encoding processes of EIRs over a period of time. This may include the subset of rights management metadata, technical metadata and preservation metadata.
- **Descriptive metadata:** this describes the work for the purpose of identification and location. This may include the title, name of the publisher and subject of the EIRs.
- **Technical metadata:** it is a form of administrative metadata that deals with the creation or storage encoding process or format of the EIRs.
- **Structural metadata:** this metadata feature indicates how complex EIRs are structured and provided to support their use.
- **Preservation metadata:** this metadata deals with the provenance of EIRs and their archival management.

Metadata that describes EIRs and indicates where they are located consists of descriptive and structural metadata (Harvey 2010:71). Descriptive metadata gives information which allows EIRs to be identified and linked with requests - for example, the name of the publisher or the title of the resource (Harvey 2010:75). Structural metadata describes and tries to show how the EIRs are organized. Therefore metadata enables EIRs in the collections to be identified and processed by the user (Harvey 2010:75). Metadata preservation is required in any collection because it supports and facilitates long-term preservation of EIRs (OCLC/RLG 2001). Metadata preservation is a strategy used to provide sufficient technical information about the EIRs and to support the two primary strategies for the preservation of EIRs. These are migration (transfer of EIRs from one generation to a subsequent generation) and emulation (developing techniques for imitating obsolete systems on future generations of computers) (Gelwa, Hastings and Hartman 2002). Generations refers to the different computer software and hardware that cannot be accessed by later software and hardware generations. Examples include the nonexistence of floppy disk drivers in computers that used to read data stored on floppy disks. Gelwa, Hastings and Hartman (2002) asserted that appropriately used metadata facilitates the long-term access to the EIRs.

2.3.4 Rights management

Issues of intellectual property rights and copyright have to be considered when managing electronic materials for long-term access. It is necessary, for example, to obtain permission from the owners of the information when preserving EIRs for long-term access before doing any reformatting (Deegan and Tanner 2006:23). Deegan and Tanner (2006:23) also suggested that solving management rights issues is vital in any electronic preservation program. Custodial organizations such as libraries and archives do not have physical custody of EIRs made available by the publishers. Therefore they will have to negotiate on the rights to this information for a specific period of time. For this study, it was assumed that the rights to the information preserved and accessed in the specific libraries had already been obtained from the respective information owners by the libraries' top management.

2.3.5 Access management

It is important to control the access to EIRs in order to uphold license agreements and prevent unauthorized use and the possibility of misuse of these EIRs (Grout et al. 2000). This is relevant to copyright and right management issues. For example, an EIR that has been cleared for public usage via the Internet will not require special access management, while one which has been cleared only for a specific group of users in mind would require one to provide access management to fulfill the license agreement.

By making EIRs management requirements explicit to the librarians, libraries will be able to address the challenging demands that face EIRs management.

2.4 Challenges in EIRs management

Ngoepe and van der Walt (2009) indicated that most information professionals acknowledged that electronic preservation is a global information management problem. They went further and stated that there are research projects that have been undertaken to address the challenges presented by EIRs management and gave an example of the Digital Preservation Test Bed Project which was conducted in October 2000, and whose goal was to build practical services

and tools in order to make certain the long-term access to electronic materials. The following are some of the challenges faced in providing access to the EIRs: lack of knowledge and adequately trained personnel in managing EIRs, technological obsolescence, weakness/absence of information technology policies and strategies in EIRs management and poor ICT infrastructure in EIRs management (Ngoepe and van der Walt 2009). Each of these challenges is elaborated on below.

2.4.1 ICTs skills in managing EIRs

Moloi and Mutula (2007) indicated that there is a constant need to upgrade ICTs staff skills in order for them to keep up with technological changes. Ngoepe and van der Walt (2009) on the other hand stated that most trainers in African countries lack expertise and are not equipped for the task of training people in the art of EIRs preservation as compared to countries outside Africa. Kanyengo (2006) argues that technical knowledge on EIRs is largely lacking among staff that are preserving these resources. Kanyengo (2006) went further by stressing that lack of knowledge leads to incomplete know-how on the equipment and software that are required for the management of EIRs. Therefore, information professionals must acquire new skills necessary to manage and provide access to EIRs.

EIRs are fairly new and have been changing in formats periodically due to rapid change in technologies - for example MS Word, PDF, HTML and XML formats; and if it is not the resource format that changes then it is the software requirement to be able to open and read the resource that changes. For example, if the resources are in PDF one will need a PDF reader; JPEG will require a JPEG reader, and a TIFF formatted resource will require a TIFF reader. This means that institutions are continually required to update/upgrade their systems so that they can meet the various software and hardware requirements. It is also clearly necessary that there should be constant and continuous learning by and training of the electronic information management staff in software and hardware skills and knowledge. This is because EIRs management and preservation methods are ever changing in order to be compatible with the changes in hardware and software.

Lefuma (2004) said that many libraries lack qualified and skilled information professionals. ICTs training should be relevant to local conditions and also be of high quality. This is because

without adequate ICTs training an EIRs management programme is guaranteed to fail (Lefuma 2004). Information professionals are supposed to have exposure to all areas of electronic information processing and handling. It is for this reason that there is need to develop schedules of service which will attract and retain the skilled librarians who are available in the field and also attract other professionals within the broader parameters of the information sciences (Lefuma 2004).

Asongwa and Ezema (2012) indicated that in developing countries there are few places where one can receive formal specialized education in management of EIRs. In addition, they pointed out that inadequate technical expertise is predominant in many African countries. There is a scarcity of personnel/human capital in that few information professionals with qualifications in computer science (computer engineers) work in libraries, resulting in the frequent break down of ICT facilities and the disturbance of digitized services leading to a lack of continuous access to EIRs. In many African nations, human resources with suitable skills, capabilities and attitudes are not readily obtainable to initiate, implement and sustain digitization projects, and most African states are still lagging behind in ICTs infrastructure which also affects the preservation of and access to EIRs. Asongwa and Ezema (2012) stated that African trainers (librarians) lack expertise and are ill-equipped to train others in electronic preservation and digitization which is also a challenge in managing EIRs to ensure long-term preservation and access.

Emmanuel and Sife (2008) indicated that frequent maintenance of ICT facilities in libraries is crucial for the sustainability of any ICT service. This is because it will ensure that the EIRs managed in the particular libraries are always available and are preserved for the long-term. Despite the fact that there are qualified technical personnel for managing and maintaining ICT facilities and networks that the library system runs, many libraries still have inadequately qualified ICT personnel (Emmanuel and Sife 2008). Most librarians in developing countries have low ICT skills and sometimes have technology phobia. Some libraries have managed to recruit and train their own ICT experts but in the end they have failed to retain them (Emmanuel and Sife 2008). This shows that deliberate approaches are required in terms of staffing and training librarians for sustainable management and maintenance of ICT services in libraries and to ensure that there is long-term preservation and continuous access of EIRs.

2.4.2 Obsolescence of information technology

The rapid rate of technological development has resulted in hardware and software lasting for short periods of time. Very often preserved and stored EIRs by one generation of software and hardware cannot be accessed by a later generation in a given (often short) period of time. For those EIRs that are still available, the chances of accessing and reading them in their original format are minimal and therefore most, if possible, have to be converted into updated readable formats (Ngoepe and van der Walt 2009). Nowadays, floppy disks are not read by the current computer generations. According to Ngoepe and van der Walt (2009) the Microsoft Company, for example, has changed its operating systems (OS) various times since 1995. In 1985 the operating system was Windows 1.01 and now, in 2013, the current operating systems are Windows 7 and Windows 8. This poses a challenge because the EIRs need to be migrated each time there is an update in order for them to remain accessible to the users.

Tonta (2004) indicated that information stored on old media needs to be transmitted to the new media on a regular basis so that it will not be unavailable due to the technological changes. Information available on various media such as microfiche and CD-ROM will only co-exist for a length of time if the right measures in terms of long-term preservation strategies are taken into consideration with these technological changes (Tonta 2004).

Styblińska (2006) in her study of the long-term preservation of some specific aspects of digital assets showed that information technology poses new dangers and problems. She argued that its functionality comes with complexity. Reading and understanding information in electronic form needs apparatus and software which are changing regularly and may not be available within a decade of their introduction. The mixture of these factors, according to Styblińska (2006) is both challenging and bothersome.

The issue of obsolescence has received a lot of press coverage over the years. For example, there are many accounts of media being incapable of being read due to obsolescence (Paper 2008). Paper (2008) categorized the technological obsolescence in three categories namely, media failure, lack of hardware to access media and lack of software to interpret the bits on the media. He gave, as an example of media failure, compact disc and DVD technology. This was not designed for long-term storage and the surface can be corroded in an unpredictable way. He also

stressed that hard drives in servers are also liable to failure hence information professionals are constantly worrying about “bit rot”. On the issue of lack of hardware to access media he commented that CDs and DVDs require particular hardware to read them and often, this hardware becomes unavailable very quickly. For example in optical media, the variation is growing. Compact disc formats now include CD-ROM, CDRW (650Mb), Video CD, CD-R (650Mb), Audio CD, CD-R (700Mb) and CD-RW (700Mb). With this variation it is not guaranteed that the drives of the future will be capable of reading all these variations.

2.4.3 Information technology policies and strategies

Lefuma (2004) argued that preservation policies give libraries the strategic directions they require to initiate measures which are necessary for the protection of EIRs. Despite the fact that these policies give planned directions in the management of electronic resources, Ogbebor (2011) stated that most African nations have no strategies on managing information which are either in print or in electronic format. Kanyengo (2006) pointed out that some countries in Africa are still struggling with enacting a library’s role and as a result most libraries operate within a no policy framework and gave an example of Zambia. Library policy frameworks will allow libraries to implement several preservation strategies which are in line with their operations as well as operate within the overall country policy framework (Ogbebor 2011).

These policy frameworks are vital because they can feed into broader global policies such as the New Partnership for Africa’s Development (NEPAD) initiative which provides a vision and the strategic framework for the preservation of electronic resources (Kanyengo 2006). Policy frameworks at a national level that support long-term preservation and continuous access of EIRs, will also improve the ICTs infrastructures (Ogbebor 2011) and this is beneficial for libraries in the long run.

In agreement with Ogbebor and Kanyengo above, Satish and Umesh (2005) indicated that most of the African libraries that manage EIRs have weak policies and strategies while some do not have them at all. These strategies may include migration, emulation, preserving original hardware and software to run outdated programs and creating hard copies of digital resources. Some of these strategies may meet some of the preservation goals (Satish and Umesh 2005).

Olatokun (2008) in his investigation on preservation and conservation practices and techniques in Nigerian university libraries also indicated that most African countries do not have national information policies. The absence of these policies means that in the event of a rapid change in technologies, information professionals would not be in a position to respond to the change with the urgency that is needed.

Whatever strategies or technique are adopted to preserve EIRs, they will be successful only if these EIRs are fully documented (metadata preservation). This is a strategic issue for long-term preservation organizations (Deegan and Tanner 2006:22).

2.4.4 ICTs infrastructure for EIRs preservation

Twitchell and Frame (2002) indicated that there is a necessity in today's situation to provide high performance, scalable and strong electronic information management systems (EIMS) to all businesses regardless of size. They went on to stress that a strong network infrastructure is crucial in providing reliable EIMS that have negligible interruptions for mission-critical operations. Stressing the same point Kanyengo (2006) pointed out that Africa's infrastructure is still lacking in terms of handling large-scale preservation of EIRs. The access to information technology facilities is a daily struggle for most libraries with the result that they just barely manage and maintain access to print resources let alone EIRs (Kanyengo 2006).

ICT infrastructures consist of the physical components of computing, wiring, switches, operating systems, servers and desktop machines. Computing infrastructures are vital for organizations. Lefuma (2004) emphasizes that a sound and reliable ICT infrastructure means rapid access to EIRs and facilitates the success of any future technology endeavors.

Asongwa and Ezema (2012) indicated that inadequate ICTs infrastructure characterized by, for example, frequent power outages create serious bottlenecks to EIRs preservation in Africa. This has the effect of damaging digital equipment and where there is a standby electric generator, the cost of running it is excessive. They continued by stating that most countries in Africa do not have an adequate and reliable power supply which consequently makes it impossible to maintain a conducive and sustainable technological environment suitable for EIRs preservation. In

addition, telecommunications infrastructures in most African nations are either not there or poorly established (Asongwa and Ezema 2012).

Since ICT infrastructure is viewed as the collection of computers, operating systems, software, communication hardware and links, which together form the platform for integrating and delivering information products and services to the organization and its customers as well as its suppliers as discussed above, it is therefore crucial that ICT infrastructure be present to support EIRs management in order to enhance long-term preservation as well as access to information.

2.5 Practices/approaches to the managing of EIRs

Debates on the best methods and approaches that should be used in preserving EIRs have been ongoing for many years now. The following are two of the most well-known theoretical solutions which have been proposed (and each will be elaborated on):

- Migration approach.
- Emulation approach.

2.5.1 Migration approach

Harvey (2010:211) pointed out that migration is the transferring of electronic materials from one technology to another or from one format to another while preserving their intellectual content as well as retaining the ability for users to retrieve and use them. She went on to state that migration focuses on the content or properties of digital materials and it usually attempts to maintain them over time by making them usable on new software and hardware. Stressing the same point, Deegan and Tanner (2006:18) indicated that migration involves change in the configuration of the original EIRs without changing their intellectual content information. This approach is necessary when there is a change in the hardware and software which means that the EIRs may no longer be accessed unless they are migrated to the newer hardware and software (Deegan and Tanner 2006:18). With regards to authenticity and integrity in relation to migration, Ngoepe and van der Walt (2009) defined migration as the process of moving electronic information from one system to another system while maintaining the information resources integrity, authenticity,

reliability and accessibility. Styblińska (2006) states that migration is the periodic transmitting of electronic materials from one media, format or one hardware/software configuration to another due to rapid change of technologies.

Deegan and Tanner (2006:18) pointed out that the rapid change of technologies means that EIRs will need to be moved regularly into new software and hardware platforms. They also indicated that migration is time critical meaning that it needs to be carried out as soon as the new formats are defined before the current format is obsolete. This means that if the new format generation is missed, the information will be difficult to recover (Deegan and Tanner 2006:20). The migration approach in electronic preservation needs to be relatively frequent because very few EIRs will survive more than six to seven years without some attention. As noted the purpose of migration is to preserve the EIRs in the long-term so that they retain the ability for users to retrieve (Styblińska 2006). The migration approach includes: refreshing, replication and transformation.

- **Refreshing**

The Consultative Committee for Space Data Systems (CCSDS) 650.0-B-1 (2002) stated that refreshment is the process in which one copies information from one storage device to another storage device. The bits of the electronic information are copied exactly as they are and no changes are made to the underlying EIRs. According to Deegan and Tanner (2006:18), this is done because digital storages have short lives therefore EIRs have to be moved periodically to new media to ensure their longevity. Lefuma (2004) said that refreshing has low risk of loss if performed and documented properly. For example if a CD-ROM disk has been having continuous bit errors, a decision has to be made to replace it with an exact copy. Once the equivalence between the two CD-ROMs has been checked, then the new CD-ROM replaces the old CD-ROM. When all the components on the new CD-ROM are unaltered then we term this process as refreshment CCSDS 650.0-B-1 (2002).

- **Replication**

CCSDS 650.0-B-1 (2002) defines replication as a process that does not change the stored content information. The bits used to create these EIRs are preserved in the same media or to a new storage media where information has been transferred to. The difference between refreshment and replication is that replication may or may not require changes to the storage mapping

infrastructure (CCSDS 650.0-B-1 2002). For example, information can be moved from a CD to a hard drive.

- **Transformation**

This is the process of creating new information content from the original information content. This happens in two principal ways: through migration and through generating a subset of the original information content (Harvey 2010:211).

Digital migrations that necessitate some changes to the content information are referred to as transformations. These changes will be made to some of the bits in the content data. In all cases the objective is to provide maximum information preservation (CCSDS 650.0-B-1 2002).

2.5.2 Emulation approach

If EIRs are complex in the sense that the file size is big then one needs to compress the file, it is highly likely that some of the bits might be lost during migration to the new storage or the new format. To avoid this loss, the information emulation technique is introduced. Emulation is the process of recreating a software or hardware environment that will be required to access resources (Ngoepe and van der Walt 2009). This technique involves creating programmes that are compatible with modern technologies, that is, software emulates the hardware components of older hardware or operating systems (Ngoepe and van der Walt 2009). This approach requires people to have detailed knowledge of every aspect of the original systems and necessary skills to do the function (Ngoepe and van der Walt 2009). Deegan and Tanner (2006:20) stated that emulation is made possible by storing sufficient metadata about current hardware and software.

Lefuma (2004) in her study indicated that emulation is using software that can pretend to be different software. This is accomplished by keeping information about the hardware and software requirements so that the system can be re-planned. A good example of the emulation approach is MS DOS emulation in the Windows operating system.

2.6 Global status of EIRs management

The review of the literature reveals that there are several projects that have been done to address the issue of EIRs in terms of preservation and access. The discussion below records the status of

EIRs management firstly, outside of Africa, secondly, within the continent and thirdly, within South Africa. The discussion will, where possible, underscore issues and findings which have emerged above.

2.6.1 Status of EIRs management outside Africa

Tonta (2005) in his investigation of the Internet and electronic information management done in Turkey indicated that continuous access to EIRs is only likely through preservation and storage. In his study he indicated that preservation and storing of EIRs is based on “copying.” This means that EIRs stored on old media need to be copied to the new media storage from time to time to avoid these resources from being inaccessible due to the obsolescence of technology. He suggested that in order to achieve continuous access and preservation back up, refreshment and access mechanisms are needed. Tonta (2005) also indicated that organizations that manage EIRs need sound information technologies support in order to integrate the contents with computer and communication technologies. The model that he used in his study was the ecological model for information management.

Weinberger (2000) investigated collection management guidance in Cambridge University. The study tried to answer how access to EIRs in the collections and how the compatibility of preservation standards of EIRs in the libraries can be ensured. The method used to collect data was the interview. The study concluded that guidelines depending on the current and future needs of the individual institutions should be provided. Weinberger (2000) suggested that these guidelines may help institutions to modify the existing collection management policies which will ensure preservation of EIRs. Weinberger (2000) further indicated that EIRs management policy which flags resources early in the acquisition process will ease the selection of these resources for preservation. He also stressed the importance of policy and strategies by arguing that there should be clear strategies and policy guidance because EIRs have become a significant part of most libraries and that obtaining and preserving them is expensive.

In her study of some specific aspects of the long-term preservation of digital assets done in Poland, Styblińska (2006) indicated that digital technologies pose threats and problems because the rapid change of technologies comes with complexity but at the same time new opportunities are created. She indicated that reading and understanding information in electronic form requires

one to have equipment and software which is changing constantly and may not be available within a decade of its introduction. This is a big challenge to the management of EIRs. The study also suggested the following approaches to digital preservation: The first is to preserve the original software which was used to store and access the information. The study termed it as the “technological preservation strategy” which involves the preservation of both the original operating system and hardware on which to run it. A second approach suggested was that one should ensure that the EIRs are re-encoded in new formats before the older formats become obsolete. Finally, Styblińska (2006) suggested that there should be a future powerful computer program system to emulate the older systems.

Bothmann and Holmberg (2010) in their study which examined strategic planning for EIRs management in Minnesota State University indicated that EIRs present a number of issues to the traditional library operations and workflow. Therefore, they suggested that these issues should be addressed in order to provide smooth management. Their study indicated the issue of technological obsolescence, lack of enough staff assigned to EIRs management duties and lack of knowledge in understanding of EIRs management. They suggested that organizations should identify all staff involved in the EIRs management workflow. The study also indicated there is a lack of policies in the management of EIRs. This is because the dedicated people see policy writing as both cumbersome and time consuming. On the same point, they noted that information professionals feel that policies may be too restrictive and make some management tasks more difficult. Bothmann and Holmberg (2010) suggested that despite being time consuming and cumbersome, policy and procedures development are essential for EIRs management pointing out, for example, that policy will help to eliminate publishers’ products that do not meet the desired standards.

Gelaw, Hastings and Hartman (2002) in their investigation of the metadata approach to preservation of digital resources at the University of North Texas noted that preserving digital resources is made challenging by the fact that EIRs can only be read by software. This would mean that in order to ensure long-term access to EIRs, one needs to preserve all the software, hardware, and operating systems on which the software can run. They also said that, with the current quick obsolescence of information technologies, such an approach may not be possible. Furthermore, insufficient media longevity is also an issue. Their study indicated that considering

the ever-growing worldwide Internet traffic, another issue is the mass of data and the necessity to compress it for effective preservation and transmission. However, compression sometimes leads to loss of data. It is also likely that frequent transmissions over years from one media to another media may cause information loss (Gelaw, Hastings and Hartman 2002).

2.6.2 Status of EIRs management within Africa

Kanyengo (2006) investigated the management of digital information resources in Africa focusing on the permanent access and storage of information resources which have been the foundation of libraries for centuries. The study used the Five Laws of Library Science as the theoretical framework and it revealed that most African countries had no information policies on the handling of information be it in print or electronic form. The study also indicated infrastructure and technical knowledge as among the issues that affect EIRs management on the continent. Stressing the issue of infrastructure, he pinpointed that Africa's infrastructure is still lacking in terms of managing large-scale preservation of EIRs. The study also showed that technical knowledge for the management of EIRs is largely lacking among the staff of library preservation departments. Accounting for this he pointed out that most library and information science schools offer preservation training at the theoretical level only. Kanyengo (2006) suggested that enabling policy frameworks at institutional level, governmental level as well as at the continental level will provide a solution for preservation of and access to EIRs. The study suggested several strategies that could help collections in ensuring long-term links preservation of EIRs. The strategies the study suggested were an enabling policy environment standardized archiving policies, and the training in modern methods of metadata preservation.

Emmanuel and Sife (2008) in their research investigating the challenges of managing ICTs for education at the Sokoine National Agricultural Library (SNAL) in Tanzania indicated that EIRs include full text materials such as electronic books, electronic journals, online article delivery services and free resources on the Internet, CD-ROMs, digital libraries and electronic databases. They noted that EIRs can be accessed through online networks from intermediary information providers or locally within the organization. Their research showed that the SNAL Library had about 580 databases, of which 52 were not working because of technical problems. They also found that preservation of EIRs such as electronic journals was even more challenging. This was

because there were no methods that were adopted for preserving EIRs such as metadata preservation methods.

Asongwa and Ezema (2012) conducted a study on the challenges of preservation of archives and records in the electronic age at the University of Nigeria and identified that digital preservation of resources is not without some limitations particularly in Africa where information technology is slowly being integrated into every sphere of library and information science operations. They mention some of the constraints namely, changes in software and hardware (one of the greatest challenges facing the long life of EIRs collections in developing countries is not only the storage media decline, but also the issue of rapidly changing storage devices), lack of technical expertise in handling EIRs, inadequate funding (digital preservation requires huge funding due to recurrent software and hardware upgrades), increasing cost of payment for electronic databases, and inadequate ICT infrastructures. They pointed out that repeated power outages constitute a serious bottleneck to digital preservation in Africa. In response to these challenges, they noted that there are additional approaches that information professionals may use to actively combat the loss of EIRs. These strategies include: migration which (as mentioned) is the transferring of EIRs to newer system environments, refreshing which, also as mentioned, is the transfer of EIRs between two types of the same storage medium so that there are no changes or alteration of the information, and finally, emulation and replication which is the creation of duplicate copies of one or more systems. They concluded that policies for digital preservation should be developed, there should be a continuous migration of EIRs, and metadata preservation should be given attention in academic libraries by professional librarians who have experience and skills in managing EIRs.

2.6.3 Status of EIRs management within South Africa

Peters (2002) in her research on preserving information resources for contemporary South African culture and scholarship, pointed out that digital preservation policies and practices are not currently well established in South African libraries and that only a few have assumed responsibility for preserving materials in an electronic form. She indicated that most institutions which began preserving digital resources by then could not access all of their digital materials because they lacked the operational expertise or the technical capacity to access some storage

media in their holdings. The results of her study showed that there are those who think that leadership on technological issues is simply a matter of establishing procedural guidelines. Others felt that the rapid rate of change and the sheer technological complexity of the digital environment render librarians weak in influencing technological development. Both of these perspectives, she argued, are misleading. Preservation in the area of digital technology should be a shared responsibility. Librarians should work with people involved in the Internet, the Web, multimedia and other technologies that serve a constituency far wider than the university library system. Peters (2002) suggested that there is a need for librarians to work together as a community to establish measures to build capacity and increase expertise in higher education. Although Peters' research was conducted over ten years ago, the issues she raised are still pertinent and this is because libraries are currently constantly getting involved in digital initiatives.

Groenewald and Breytenbach (2011) conducted research on the use of metadata and preservation methods for continuous access to digital data in Pretoria and indicated that information loss prevention starts with the creation of EIRs. However, they stated that methods to minimize the loss of EIRs are often overlooked. In their research, they suggested that metadata structures should be embedded in EIRs from the outset and this should be done as a starting point towards good preservation principles. The authors pointed out that negligence with regard to format specifications and standardization can cause huge electronic information losses in the future and suggested that there is a need for a study on a more simplified implementation of preservation strategies (Groenewald and Breytenbach 2011). They also indicated that storage and preservation of EIRs needs more attention in South Africa, meaning that awareness of metadata preservation methods should be created amongst librarians. Furthermore, they also said that training in the preservation of electronic content and the actual delivery of plans and policies need to receive more attention in the corporate environment especially with regard to electronic content stored on personal computers.

2.7 Model for EIRs management

Models are necessary to regulate the management of EIRs in their preservation, storage, maintenance and access. Standards and models are significant in any context in which information is to be managed (Harvey 2010:38). For digital preservation, standards and models are especially important. The following section will describe and investigate the application of the key conceptual model for digital preservation of EIRs.

2.7.1 Open Archival Information System (OAIS) Reference Model

This Model was originally developed for the space data community in the 1990s. Input was sought from other communities to ensure that its concepts and terms were commonly understood across different domains. It was widely adopted as the de facto standard and in 2003 it was formally adopted as the ISO standard for managing electronic materials in a digital archiving system (Harvey 2010:38). It provides a generic framework for building a digital collection and it is applicable to most actions in the library operations. This Model has three primary objectives. One is to provide terms of concepts correlated to preservation that can be easily understood and take on by people from a wide range of backgrounds such as librarians, archivists and information technology personnel. Second, it defines the information model: that is describing the types of information that are exchanged and managed within the OAIS. The last objective is that it defines a function model: that is, it defines the key functions needed in a digital collection and it provides information about the kinds of activities of each function (Harvey 2010:39).

The Model has been widely adopted as a starting point in electronic preservation by a number of institutions:

- Digital libraries (for example, Netherlands National Library)
- Traditional archives (for example, US National Archives)
- Scientific data centers (etc National Space Science Data Center)
- Commercial organizations (Aerospace Industries Association preservation working team).

2.7.1.1 OAIS environment

Figure 1 below which shows the environment surrounding an OAIS.

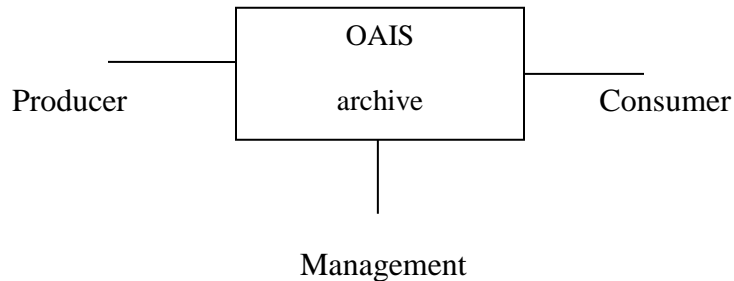


Figure 1: Environment Model of an OAIS (CCSDS 650.0-B-1 2002).

Outside the OAIS are the producer, the consumer and management.

Producer is the role played by those persons, or client systems, which provide the EIRs to the collection/library (CCSDS 650.0-B-1 2002).

Management is the role played by those who set overall OAIS policy as one component in a broader policy domain (CCSDS 650.0-B-1 2002).

Consumer is the role played by those persons, or client systems, that interact with OAIS services to find and acquire preserved EIRs of their interest from the library (CCSDS 650.0-B-1 2002).

This Model provides a framework for discussing the key areas that impact on digital preservation which are policies surrounding the archiving of EIRs, preservation formats, metadata preservation, planning (including issues of migration versus emulation), and long-term access to the EIRs' contents (CCSDS 650.0-B-1 2002).

2.7.1.2 OAIS structure

The Model has six functional entities and related interfaces which are:

- Ingest
- Archival storage

- Data management
- Administration
- Preservation planning
- Access.

- **Ingest**

Provides the services and functions to accept Submission Information Packages (SIPs) from the producers and it prepares the content for storage and management within the library (Harvey 2010:39).

- **Archival storage**

Provides the services and functions for the storage, maintenance and retrieval of Archival Information Packages (AIPs). This function ensures that the library context remains safe and it is stored accordingly (Harvey 2010:39).

- **Data management**

Provides services and functions for populating, maintaining and accessing both Descriptive Information (DI) which recognizes and documents library holdings and administrative data used to manage the library. The updating and support of access of information is done in this function (Harvey 2010:39).

- **Administration**

Provides the services and function for the overall operation of the library system, including: soliciting and negotiating submission agreements, maintaining configuration management of system hardware and software, and auditing submissions to ensure that they meet library standards. The functions provided manage day to day operations and coordinates other functions (Harvey 2010:39).

- **Preservation planning**

Provides the services and functions for observing the environment of the OAIS and providing recommendations to make sure that the information stored in the OAIS is always accessible to the designated user community over the long-term, even if the original computing environment

becomes obsolete. This function develops preservation strategies that ensure the EIRs are preserved with the current technology (Harvey 2010:39).

- **Access**

Provides services and functions that support consumers in establishing the existence, description, location and availability of information stored in the library and also permitting consumers to request and receive information products (Harvey 2010:39).

Graphic depiction of the functional entities of the Model is presented in Figure 2 below.

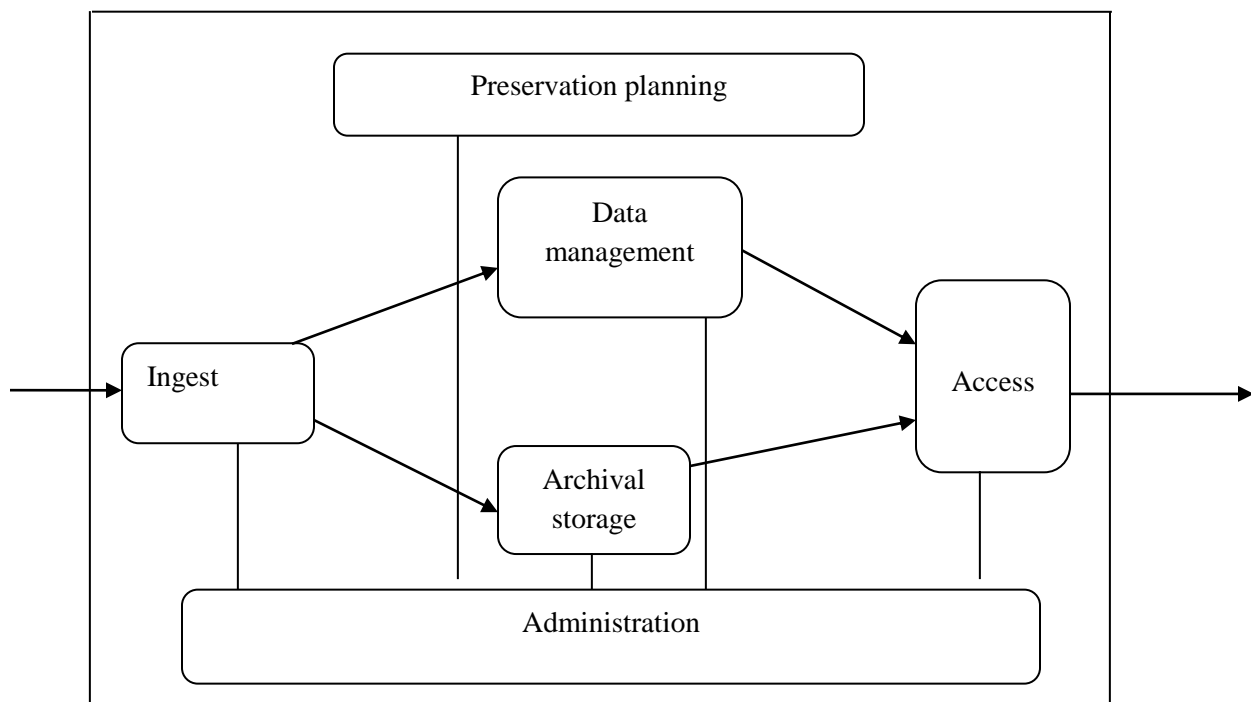


Figure 2: OAIS functional entities (Harvey 2010:40).

2.7.2 Functioning of the OAIS Reference Model

CCSDS 650.0-B-1 (2002) indicated that OAIS functioning can be categorized technically by both external and internal factors. The external factors include characteristics of the producer and the consumer communities while the internal factors include the characteristics on ingest archival storage, data management, preservation planning, administration and access function as presented in Figure 2 above.

2.7.2.1 Assessment of EIRs in the ingest function

Preservation begins outside the purview of the library with the producer or the publisher of the EIRs. This is where long-term storing and preservation must begin. Practices used when EIRs are produced will influence the ease with which the information can be digitally managed and preserved (Hodge 2002).

Key practices are developed by involving the producers of EIRs. First, the storing process is made more efficient when attention is paid to issues of consistency, format, standardization and metadata description before the digital material is considered for preservation (Hodge 2002). For this specific process to take place the librarians involved in this function must be sufficiently skilled in EIRs management or else they should utilize external expertise such as consultants for preservation of EIRs (Hodge 2002).

Another aspect of the publisher's involvement in preservation is the formation of metadata. The best practice is for metadata to be formed prior to incorporation into the library that is at the publisher's stage (Harvey 2010:40).

2.7.2.2 Metadata preservation in the data management function

Metadata is needed to preserve the EIRs for future users to find and access them. Metadata supports organization, preservation and long-term access of EIRs (CCSDS 650.0-B-1 2002). Management and preservation of EIRs requires special metadata elements to track the lineage of digital materials, that is, where they came from and how they have changed over time, their physical characteristics in detail, and to document their behavior in order to reproduce them on future technologies (CCSDS 650.0-B-1 2002).

Therefore, the data management function requires librarians to maintain databases of descriptive metadata by identifying and describing the preserved EIRs in support of the OAIS's finding aids. And this will be done properly only if the allocated librarians have got the required EIRs preservation skills. The function also requires librarians to manage the administrative data supporting the OAIS's internal system operations, such as system performance data or access statistics (Lavoie 2004). The principal functions of librarians in data management include

maintaining the databases for which they are accountable, performing requests on these databases, creating reports in reply to requests from other functional components inside the OAIS and conducting updates to the databases as new EIRs arrives, or existing EIRs are modified or deleted (Lavoie 2004). In managing these databases, the data management function supports search and retrieval of the OAIS's preserved content and administration of the OAIS's internal processes (Lavoie 2004). To be able to support all these processes, the assigned librarians require having metadata preservation skills as well as ICT skills in managing EIRs.

2.7.2.3 Formats for preservation in the archival storage function

Hodge (2002) stated that a major issue for preserving EIRs is the format(s) that should be used for archival storage because the format(s) of the EIRs always determine the methods to be used to preserve these EIRs. Questions to ask include: Should the EIRs be converted into a format more favorable to archiving? "Is the complexity of an interactive journal necessary or should it be simplified?" Should attention be given to the re-use of information and its enhancement or representation in more advanced access technologies in the future? "Should the goal be complete replication of the EIRs or should preservation provide a copy that is just good enough"? The answers to these questions in part differ by EIRs types. Most EIRs use image files (TIFF), PDF or HTML. TIFF is the most prevalent for those organizations that are involved with conversion of paper issues of resources (Hodge 2002).

Hodge (2002) indicated that for purely electronic documents, Adobe's PDF is the most prevalent format. It is used for both recognized publications and grey literature. Hodge (2002) indicated that there is also Portable Document Format-Archives (PDF/A) which is an ISO-standardized version of the Portable Document Format (PDF) specialized for the digital preservation of electronic documents. While PDF is increasingly accepted, worries remain for long-term preservation and it may not be accepted as a legal collection format, because it is a copyrighted format (Hodge 2002).

Archival storage offers the basic storage and backup of EIRs receiving them from the ingest function and providing them to the access function. Error checking and media replacement are part of archival storage. For repositories this might be a file store with a structure and backup

(CCSDS 650.0-B-1 2002). Hard drives, magnetic tapes, optical disks and compact disk- read only memory are the storage devices used in storing EIRs in this function.

Lavoie (2004) stated that archival storage is the portion of the archival system that is managed by the information professionals in order to manage the long-term storage and maintenance of EIRs assigned to the OAIS. More explicitly, the librarians with regards to archival storage function are accountable for ensuring that preserved information exists in an appropriate form of storage, for example, online, off-line and that the bit streams encompassing the preserved EIRs remain complete and render-able over the long-term (Lavoie 2004). To meet this obligation, the librarians who have ICT skills in EIRs management should occasionally perform procedures such as media refreshment or format migration. The librarians should also implement various safety mechanisms, such as error-checking procedures, to assess the outcome of preservation processes, as well as disaster recovery policies to diminish the effects of catastrophic events (Lavoie 2004). Finally, in the archival storage, librarians retrieve items from the OAIS's storage systems in support of access requests by users. Note that the archival storage function has no direct external interface-communication with archival storage is confined to the OAIS's internal high-level services (Lavoie 2004).

2.7.2.4 Migration and emulation strategies in the preservation planning function

“Preservation planning is the bridge between the decisions made about archival storage of the bits and bytes and issues of future access and user needs” (Hodge 2002). There is no common covenant on the explanation of long-term preservation, but some have described it as being long enough to be concerned about technological changes and changes in the user community. The OAIS Reference Model uses two strategies in EIRs preservation during preservation planning namely, migration and emulation. Migration, as noted in the section 2.5.1, is copying the EIRs stored and moving them to fresher hardware and software as the technology changes (Hodge 2002). Emulation, as mentioned, is a strategy that imitates the performance of old software and hardware on new hardware and software. This preservation strategy is considered as a substitute to migration (Hodge 2002). Librarians are required to have both migration and emulation skills. Migration strategy is seen as the more sustainable option if the organization is dealing with well-established commercial software such as Oracle or Microsoft Word (Hodge 2002).

During preservation planning, the librarians are responsible for determining the OAIS's preservation strategy, as well as recommending suitable revisions to this strategy in response to developing conditions in the OAIS environment (Lavoie 2004). With the preservation planning services, the librarians monitor the external environment for changes that could influence the OAIS's ability to manage and maintain access to the EIRs in its custody, such as innovations in storage and access technologies, or shifts in the scope or expectations of the users (Lavoie 2004). The librarians in the preservation planning function are required to develop approvals to bring up to date the OAIS's policies and procedures to house these changes. Through this, the librarians safeguard the libraries against frequently evolving technology. This is because planning preservation senses changes impacting on the OAIS's capability to meet its responsibilities, designs strategies for addressing these changes, and assists in the implementation of these strategies within the storage system (Lavoie 2004). Preservation planning therefore ensures that there is long-term preservation of and continuous access to EIRs.

2.7.2.5 Access mechanisms in the access function

While many digital preservation projects are worried about their capacity to provide long-term access to the EIRs as it happens today, others are interested in how they might actually improve access to current EIRs in the future (Hodge 2002). The access function manages the processes and services by which users trace, request, and receive delivery of EIRs that exist in the OAIS's archival storage (Lavoie 2004). Services provided by the librarians in the access function in support of the consumer include processing requests of the OAIS's holdings, forwarding the request to data management and presenting the response to the consumer as well as coordinating the retrieval and delivery of requested EIRs by forwarding the request to archival storage (Lavoie 2004). When the archival storage receives the requested EIRs, it performs any necessary transformations that must occur prior to delivery to the user. Access is also responsible for employing any security or access control mechanisms associated with the archived content (Lavoie 2004). The access function represents the OAIS's interface with its users; as such it is the primary mechanism by which the OAIS meets its responsibility to make its preserved EIRs available to the user community (Lavoie 2004).

In summary, the OAIS incorporates six high-level functional components which when taken together, establish the mechanisms by which the OAIS preserves EIRs over the long-term and makes it available to the users. An OAIS-type library will implement each of these services, in one form or another, in the progression of building a comprehensive library system. The OAIS Reference Model emphasizes best practices (Hodge 2002). The standards emphasize EIRs management responsibilities, metadata preservation strategies, control, and storage and access management (Hodge 2002). According to these requirements, the organizations have to follow codes and protocols, have to know what it has to do and then do it in accordance with the set policies and measures (Lavoie 2004). This will guarantee compliance with the maximum excellence of EIRs management (Lavoie 2004).

The data flow diagram for an OAIS Reference Model is presented in Figure 3 below

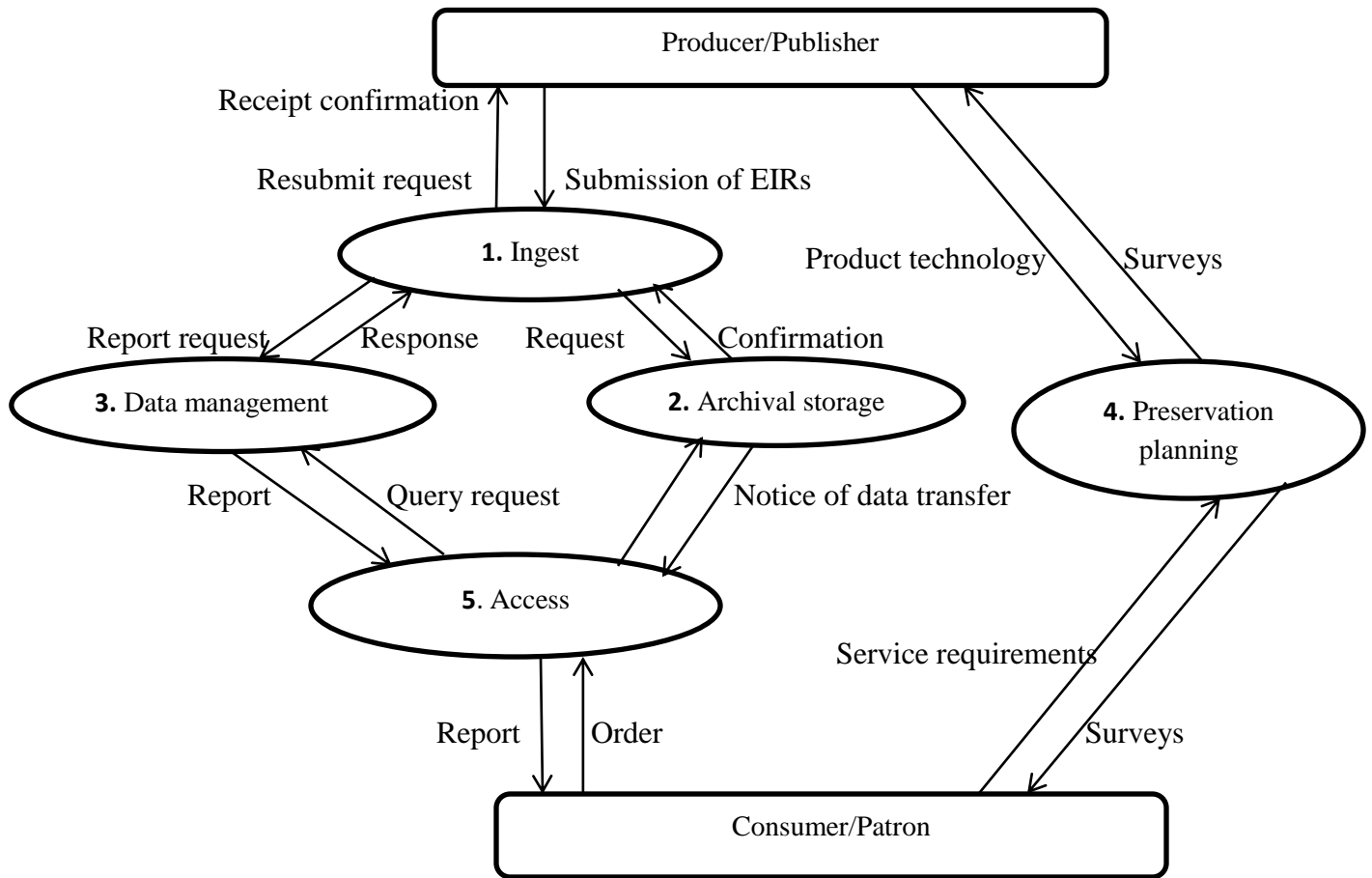


Figure 3: Data flow diagram for OAIS Reference Model (CCSDS 650.0-B-1 2002).

Figure 3 above shows the summary of how EIRs flow from the publisher when they are submitted to the time when the consumers order or request the information through the Access function.

2.8 Beyond the OAIS Reference Model

The OAIS Reference Model is a conceptualization of the environment, functional components, and information objects related with a system designed to effect the long-term preservation of EIRs (Lavoie 2004). This Model provides a starting point for implementation in the sense that it

illustrates the high-level responsibilities, services, and informational requirements that the implemented system must incorporate (Lavoie 2004).

A number of initiatives have used this Model as a conceptual foundation for more focused work in EIRs preservation. Major areas of study include but are not limited to developing “OAIS-compliant” storehouse architectures; starting OAIS-related standards; familiarizing the OAIS Reference Model to domain-specific implementations; fleshing out the metadata necessities of the OAIS information Model and developing approaches and procedures for encoding and replacing preserved EIRs (Lavoie 2004).

The Model aims at developing a framework to support business, social and organizational needs for preservation and management of EIRs. The Model addresses issues of metadata preservation, making EIRs accessible and sustaining environments in which EIRs can continue to function over time. The OAIS Reference Model clearly produces a framework for the management of EIRs in libraries and for this reason it has been extensively outlined. It is also the Model which underpins the present study.

2.9 Summary

This Chapter presented the theoretical framework for the study, namely, the OAIS Reference Model and its appropriateness was described. Several aspects of the subject of this study have been surveyed in this literature review. The aspects covered are storage, preservation file formats, metadata preservation strategies, access management, practices/approaches to the EIRs management and the ICT skills needed in EIRs management. The Chapter also reviewed the few studies which have been undertaken on the management of EIRs. Relevant and significant points recognized in the literature review will be drawn on in the discussion of the results of this study as contained in Chapter Five. The research methodology adopted is described in the next Chapter.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The purpose of the study was to investigate the management of electronic information resources (EIRs) to enhance their long-term links preservation and access in the University of KwaZulu-Natal (UKZN) Pietermaritzburg (PMB) and Howard College campus libraries. This Chapter discusses the research methodology used to achieve the above purpose.

3.2 Research paradigm

The term “paradigm” originated from the Greek term *paradeigma* which denotes “patterns” and was first used by Thomas Kuhn to mean a conceptual framework shared by a community of researchers that provides research/investigations with a suitable model for investigating problems and finding answers. Thomas (2010) argued that paradigm refers to the “research culture with the set of beliefs, values and assumptions that researchers have in common concerning the behavior and nature of their research”. He further indicated that research paradigm implies “a pattern, arrangement and context of scientific ideas, values and assumptions”. There are three research paradigms namely, positivism, post positivism and interpretivism (Neuman 2003:70).

3.2.1 Positivism

“Positivism is the oldest and most commonly used approach” (Neuman 2003:70). Positivism is associated with many explicit social theories. It is best known in relation to the structural-functional, rational choice and exchange theory framework (Neuman 2003:70). Positivist researchers prefer accurate quantitative data and frequently use experiments, surveys and statistics. They seek rigorous precise measures and objective research and they examine hypotheses by cautiously analyzing numbers from the measures (Neuman 2003:71). “Positivism assumes the presence of an objective, independent and stable actuality, which is obtainable for discovery and analysis” (Pickard 2007:6). Only visible phenomena are identified meaning that

“what is real is only which can be observed” (Pickard 2007:8). Positivist researchers trust that reality can be dissected into variables that present the theoretical ideas that underlie visible phenomena. This type of research generally starts with a hypothesis which is then tested empirically for confirmation through structured investigations (Pickard 2007:9). “This testing includes a complex statistical mechanism for establishing relationships between variables, and results in bold generalizations concerning the phenomena being studied” (Pickard 2007:9). According to Pickard (2007:9), the quantitative approach is used in positivist research.

3.2.2 Post positivism

Pickard (2007:9) suggests that the entire idea of positivism was an emulation of the natural science approach. “Post positivism was as much a response to the failure of positivism as it was to move in the developing changes in the basic axiom of natural science” (Pickard 2007:9). The approach taken by post positivism remains one of investigation and hypothesis testing and even though the method has been modified from that of the early positivists, they remain basically the same. Variables are recognized and manipulated, and the connection between these variables is then measured using statistical methods (Pickard 2007:11). “The aim of research within the post positivist tradition remains very similar to that of positivism” (Pickard 2007:11). Generalizations about the phenomena under study continue to be an outcome of the post positivist approach to empirical study. “Methodological dualism in the use of both qualitative approach and quantitative approach is accepted in post positivism paradigm” (Pickard 2007:9).

3.2.3 Interpretivism

According to Neuman (2003:76), there are a few varieties of interpretive social sciences and these are “ethnomethodology, hermeneutics, cognitive, constructionism, idealist phenomenological, subjective and qualitative sociology”. He goes on to say that “Interpretive researchers frequently use participant observation and field research.” These techniques need researchers to spend a lot of time in direct personal contact with the population being studied (Neuman 2003:76). Pickard (2007:12) indicated that “what we observe is not nature itself but nature exposed to our method of questioning.” Interpretivism pursues to understand the entire

context, “both at the macro and micro environmental level.” The qualitative approach is applied in this paradigm (Pickard 2007:12)

In terms of the above discussion, the research paradigm adopted for this study was positivism. The reason for this was that the researcher was interested in gathering information that can be objectively observed and classified and according to Pickard (2007:9), positivist approaches are dedicated to clarifying how things happened in order to foresee what comes next and being in a situation to control what happens.

3.3 Research approach

Research methodology comprises two approaches namely, qualitative and quantitative (Neuman 2003:139). The research approach is a strategy of investigation, which moves from the basic expectations to study design, and data gathering and “the most common classification of research approaches is the qualitative and quantitative approach” (Thomas 2010). These two terms refer to research methods, that is, the manner in which data are collected and analyzed (Thomas 2010).

3.3.1 Quantitative approach

Maree (2007:145) argued that the quantitative approach is a procedure that is methodical and objective in its techniques and it uses numerical data from only a particular subgroup of an organization in order to simplify the results that are being researched. Quantitative research approaches were initially established in the natural sciences to research natural phenomena (Thomas 2010). “This approach makes use of questionnaires, surveys and experiments to collect data that is studied and presented in numbers, which allows the data to be categorized by the use of statistical analysis” (Thomas 2010). Quantitative studies measure variables on a sample of subjects and define the link between variables using statistical effects such as correlations or frequencies. According to Neuman (2003:139), “almost all quantitative investigators rely on the positivist social science”.

3.3.2 Qualitative approach

Maree (2007:50) argued that people usually describe this approach as an approach that “tries to collect rich descriptive data in respect of a specific phenomenon or context with the aim of raising an understanding of what is being observed or studied”. It therefore focuses on how persons and groups view and understand the world and create meaning out of their experiences (Maree 2007:50). The qualitative approach as a research methodology is concerned with understanding the processes and the social and the cultural context which underlie various behavioral patterns (Maree 2007:50). “It is designed to help investigators understand people, the social and cultural background within which they live” (Thomas 2010). According to Neuman (2003:138), qualitative researchers frequently rely on interpretive social science.

The essential difference between the two approaches is that the qualitative approach involves methods that collect verbal or textual data, while quantitative approach deals with methods which collect numerical data that can be counted (Neuman 2003:140). Since the research paradigm chosen was positivism, the study used the quantitative approach. This is because the researcher was concerned with collecting statistical data.

3.4 Research design

Terre Blanche and Durrheim (2002:29) said that research design is a “strategic framework for action that works as a link between research questions and the implementation of the study”. In order to achieve the objectives of the research the researcher requires a wisely thought out strategy (Bless, Higson-Smith and Kagee 2006:71). The first step the researcher needs to do in terms of producing a good research design is to try to answer several important questions about the research. The questions relate to the focus of the study, the unit of analysis and the time length of the problem at hand (Bless, Higson-Smith and Kagee 2006:71).

3.4.1 Principles of research design

In developing a study design, the investigator needs to make a series of assessments, along four scopes (Terre Blanche and Durrheim 2002:33):

- The purpose of the study,
- The theoretical model informing the study,
- The background or condition within which the study is carried out and
- The study techniques engaged to gather and analyze data.

Several considerations that come from these four dimensions must be merged together in a coherent study design in a way that will maximize the validity of the results (Terre Blanche and Durrheim 2002:33). The strategic outline that connects the research question to the implementation of the study is established through reflecting on matters relevant to each of these four dimensions, to deliver a coherent direction for action which will give valid responses to the research questions (Terre Blanche and Durrheim 2002:33). There are two categories of research designs into which quantitative research designs can be classified. The categories comprise experimental designs and non-experimental designs (Maree 2007:149). The experimental designs are established to answer a particular kind of research question while the non-experimental designs are mainly used in descriptive research whereby the units that have been designated to take part in the study are measured on all the relevant variable at a particular time (Maree 2007:152). According to Maree (2007:152), the most widely used experimental research design is the pretest-posttest design while the survey is the mostly commonly used non-experimental research design. Since surveys are mainly done in order to obtain quantitative information (Maree 2007:152), the research design of the present study was the research survey.

3.4.2 Research survey

Research surveys are the most widely used data-collecting technique in sociology (Neuman 2003:264). The main objective of the research survey is to “gain information by questioning participants who are either representative of the study population or the entire study population which can then be analyzed and patterns extracted and comparisons made” (Bell 2003:13). Pickard (2007:100) indicated that “research surveys are used when the aim of the study is to define the population study or characteristics of that population (descriptive survey) or establish the relationship between particular variables within a research population (explanatory survey)”.

Neuman (2003:289) argues that survey is “one of the research designs which involve collecting data through asking questions using self-administered questionnaire or interviews”.

Advantages for using the survey in a study is that it tends to be relatively cheap, easy to carry out, has the ability to generate huge amounts of data in a relatively short period of time and can collect original data for describing a population that is too large to observe (Maree 2007:155). In terms of the present study, all these factors are important, hence the adoption of the survey as the research design.

3.5 Population of the study

According to Hoskins (2002:65), population refers to any cluster of objects, people or organizations that have at least one characteristic in common. Babbie and Mouton (2001:173) define population as any group of persons or objects that have at least one characteristic in common. Bless, Higson-Smith and Kagee (2006:98) define population as the “set of object or people which is the focus of the study and around which the researcher wants to establish some characteristics”.

In this study the population was the staff of the UKZN PMB and Howard College campus libraries and comprised subject librarians, metadata librarians and the e-resources librarian giving a total of 33 staff members at the seven libraries.

- Seven staff at the Cecil Renaud Library (PMB),
- One staff at the Law Library (PMB),
- Three staff at the Life Science Library (PMB),
- Nineteen staff at the EG Malherbe Library (Howard College),
- One staff at the Eleanor Bonna Music Library (Howard College),
- One staff at the Architecture Library and (Howard College) and
- One staff at the GMJ Sweeney Law Library (Howard College).

As noted in Chapter One the staff were identified on the basis that they were the best-suited in terms of being able to answer the questions posed.

3.5.1 Sampling

Bless, Higson-Smith and Kagee (2006:71) indicated that the subset of the entire population which is actually examined by a researcher and whose characteristics will be generalized to the whole population is called the sample. According to Pickard (2007:59), “sampling is done when it is not practical to include the whole research population in your study”. The method of sampling used plays a significant role in any study investigation (Pickard 2007:59). “It is of great importance that one should choose a technique that matches the research design” (Pickard 2007:66).

3.5.1.1 Census sampling

The census sampling technique includes information on characteristics of the whole population in a territory (Neuman 2003:64). Similarly, according to Bell (2003:13), “the census sampling aims to cover 100 per cent of the population”. Therefore given that the population in the present study was relatively small, the census sampling technique was used.

3.6 Data collection

Data for the study was collected using a self-administered questionnaire which was distributed to UKZN libraries staff. The questionnaire was considered the most appropriate instrument as it has the following advantages: relatively quick to collect information from a large sample size, cost effectiveness when compared to face-to-face interviews, easy to analyze data collected and the lack of interviewer bias (Bless, Higson-Smith and Kagee 2006:120).

Bless, Higson-Smith and Kagee (2006:120) point out that the questionnaire enables the researcher to use exactly the same type of technique with each and every respondent in the study. They note that questionnaires can be administered to respondents directly or can be mailed to them. In this study, the researcher emailed the questionnaires to the staff members at the libraries on both campuses. The questionnaire was adapted from previous studies. These studies are: *Digitization for libraries in Kenya* by Beatrice Adera Omollo (2011) and *Information and Communication Technologies (ICT) knowledge and skills of subject librarians at the University libraries of*

KwaZulu-Natal by Ruth Hoskins (2002). The questionnaire comprised six sections. Section A covered general information, section B to E covered the research questions and section F covered staff perceptions about library involvement in EIRs management.

3.6.1 Forms of questions in the data collection tool

Hoskins (2002:68) explained that survey questions may be forced choice or open-ended. These are also referred to as closed and open questions. Both types were used in the study.

3.6.1.1 Forced-choice (closed questions)

A closed question provides for a set of answers from which the participants have to choose one or sometimes more than one response (Maree 2007:160). “Benefits of the closed question are that they can be pre-coded and replies can easily be entered in a computer, complex questions are easily answered and also they are less time consuming and easier for the participants to complete” (Hoskins:2002:69). Maree (2007:164) points out that the disadvantages of these closed questions are that the answer the respondent wants to give may not be among the options provided, the answers provided are very simple and have got no details and lastly, the respondents can answer even if they have got no knowledge.

3.6.1.2 Open questions

Hoskins (2002:69) described open questions as “those that allow individuals to respond in any way they wish”. Maree (2007:161) points out the advantages of the open question namely, the respondents can give honest answers and in detail, complex questions can be adequately answered and the participants’ thinking process can be revealed. The disadvantages are that coding of answers may be difficult, statistical analysis is difficult, and participants may need time to think and write their answers (Maree 2007:161).

As noted, the data collection instrument in this study comprised both forms of questions, i.e. open and closed.

3.7 Data analysis

In this study the approach for data analysis was determined by the type of data collected. Once data has been collected and checked, the investigator should begin the process of analyzing the data (Bless, Higson-Smith and Kagee 2006:163). Data analysis in this study included both qualitative analysis and quantitative analysis (Babbie and Mouton 2001:411).

3.7.1 Quantitative analysis

Powell (1997:58) points out that the basic purpose of quantitative analysis is to summarize data in a manner that they provide answers to the research question. Before analyzing the raw data, each questionnaire is checked for missing data, ambiguity and errors. Terre Blanche and Durrheim (2002:96) note that statistical actions are used to analyze quantitative data. “Once the investigator has measured the significant variables, the observations on these variables are usually converted statistically to help the investigator describe the data more succinctly” (Terre Blanche and Durrheim 2002:96). In this study, quantitative analysis using SPSS was used to analyze and interpret the data obtained from the closed questions.

Pickard (2007:278) points out that SPSS has now turned out to be the standard analytical tool for most quantitative investigators and listed the following advantages of SPSS. It will:

- Decrease the time needed to analyze data,
- Decrease the errors involved in coding data,
- Carefully examine data with in-depth statistics and charts and
- Present outcomes clearly with flexible reports and charts.

3.7.2 Qualitative analysis

“Qualitative data analysis is typically based on an interpretative idea that is aimed at investigating meaningful and symbolic content of qualitative data” (Maree 2007:99). Maree (2007:100) goes on to say that “content analysis is a methodical approach to qualitative data analysis that recognizes and summarizes message content”. Content analysis is an approach for

investigating the content, or symbols which is enclosed in written documents or other communication mediums (Hoskins 2002). Content analysis was used to analyze the open questions in this study. Through this analysis, meaningful response groupings for responses to the open questions in the questionnaire were then generated and later coded allowing for computer input and processing of the responses.

3.8 Validity and reliability

Bell (2003:103) stated that whatever procedure for collecting data is selected, “it should always be inspected critically to evaluate to what extent it is expected to be reliable and valid”. “Reliability is the extent to which a procedure produces similar results under constant conditions on all occasions” (Bell 2003:103). According to Maree (2007:147) “reliability has to do with consistency or repeatability of a measure or an instrument e.g. a questionnaire”. High reliability is attained when the measure or instrument gives the same outputs if the investigation is repeated on the similar sample (Maree 2007:147). Neuman (2011:208) stated that “validity suggests truthfulness.” He went further and stressed that it is how well an idea “fits” with actual reality. “The absence of it means that the fit between the ideas we use to analyze the social world and what actually occurs in the lived social world is poor” (Neuman 2011:208). One of the most common means of ensuring validity is through performing a pre-test for the data collecting tool. Doing a pre-test one is able to eradicate vagueness and create the chances to maximize the validity as well as the reliability of the data collection tool (Neuman 2011:208).

3.8.1 Pretest for the research instrument

Powel (1997) stressed the importance of pre-testing a questionnaire by saying that “it gives the researcher a chance to detect questionnaire items that tend to be misunderstood by the respondents such as technical terms”. The pretest offers positive advantages in that it helps the researcher to refine the research instrument. It may also “permit an initial testing of the hypothesis by pointing out various types of problems not expected relating to research design and research methodology” (Powel 1997).

3.8.1.1 Population for the pretest

The research instrument was pre-tested on five subject librarians from the Westville Campus of UKZN. These subject librarians were chosen because they were all professional librarians who work at an academic institution and thus similar to the population under study.

The questionnaire was sent to the selected librarians through e-mail. The pre-test population was given one week from the date they received the questionnaire to complete the questionnaire. Out of the five subject librarians four participated. Based on the results from pre-test, no adjustments were done to the instrument as there were no problems identified.

3.9 Ethical considerations

Pickard (2004:72) indicated that the “keys to access to the field are almost always in the hands of many gatekeepers and this is both formal and informal.” In most cases these gatekeepers, before giving approval, will want to be informed about the investigation in which ways that will allow them to measure the risks that it will pose, both for themselves and for the people to which they control access.

In complying with the ethical requirements, permission to conduct the study was obtained from the Director of UKZN Libraries. A signed letter of consent was also obtained from each of the participants. This letter addressed the issues of confidentiality of the respondents and provided the respondents with the opportunity to opt out of the study at any time.

3.10 Summary

The research methodology used to collect data in the study has been discussed in this Chapter. The use of the quantitative approach was adopted. The population study, data collection instrument, its form and types of questions were described. The need to gain relevant information about the management of EIRs to enhance their long-term links preservation and access in the UKZN PMB and Howard College campus libraries led to the adoption of the survey design. The

issues of sampling, data analysis, reliability and validity, and ethical consideration were also described. In the following Chapter the findings are presented.

CHAPTER FOUR

PRESENTATION OF THE RESULTS

4.1 Introduction

The results of the survey of the population comprising subject librarians, metadata librarians and an electronic librarian which was conducted by means of a self-administered questionnaire, are reported in this Chapter. The aim behind each question that was asked is described and the outcomes are reported. Presentation of results of the study will be in line with, and respond to, the research questions. The results are presented in the form of tables and figures.

4.2 Response rate

Of the 33 questionnaires distributed, 28 were returned indicating a response rate of 84.8%. This is considered a very good response rate. According to Livingston and Wislar (2012), a response rate less than 60% is considered poor. This percentage, and all subsequent percentages, have been rounded off to one decimal place.

4.3 Results

The results are reported under broad headings for each of the six sections of the questionnaire. Section A of the questionnaire looks at the general information of the study population. Sections B to E examine the population's ability to manage EIRs, ICT infrastructure used in the libraries in managing EIRs, and strategies and storage methods used in preserving EIRs in the given libraries. Section F examines the population's perception of their library's involvement in EIRs management. The symbol 'N' in this Chapter indicates the number of respondents that were asked a particular question.

4.3.1 Section A - General information

The information in this section deals with the demographics of the study population.

4.3.1.1 PMB and Howard College campus libraries

Question 1 was asked to determine at which libraries the respondents were working and Figure 4 reflects the findings.

N=28

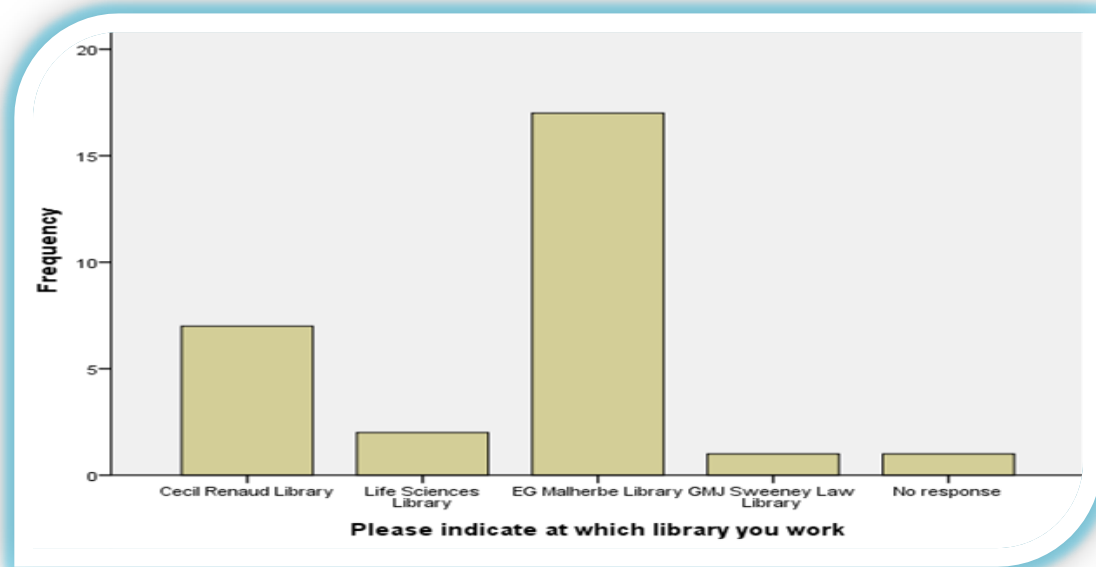


Figure 4: Libraries at which respondents worked

Of the respondents who responded to the question, 17 (60.7%) worked in the EG Malherbe Library. Seven (25.0%) of the respondents indicated they work at the Cecil Renaud Library, two (7.1%) at the Life Sciences Library, and one (3.6%) at the GMJ Sweeney Library. The Eleanor Bonna Music Library and the Architecture Library were thus not represented (see 3.5).

4.3.1.2 Professional qualification

Question 2 was asked to determine the education and training levels of the respondents. The respondents could give more than one response.

Table 1

Professional qualifications

N=28

Professional qualification	Responses	
	N	Percentage
Bachelor of Library Science Honours (BBibl (Hons.))	9	32.1%
Bachelor of Library Science (BBibl)	5	17.9%
Higher Diploma in Library Science(HDLIS)	4	14.3%
Master of Library Science (MBibl)	3	10.7%
Advanced University Diploma in Library and Information Studies (AUDIS)	2	7.1%
Master of Information Studies (MIS)	2	7.1%
Bachelor of Technology (BTECH)	2	7.1%
Master in Library and Information Studies (MLIS)	1	3.6%
National Diploma in Library Science (NDLIS)	1	3.6%
Master of Education (MED)	1	3.6%
No response	11	39.3%
Total	*41	146.4%

*Multiple responses received

The most held qualification was the BBibl (Hons.) with nine (32.1%), this was approximately a third of the respondents. Six (21.4%) respondents stated that they obtained an MLIS, MBIBL or an MIS. Those who indicated BBibl were five (17.9%). Those who had an HDLIS, AUDIS and NDLIS were seven (25.0%) which is slightly higher than those who indicated they had masters. The Table also shows two (7.1%) respondents had a BTECH and one (3.6%) having a MED.

4.3.1.3 Year of qualification

The respondents obtained their professional qualifications between the years 1986 and 2012 as reflected in Table 2. This covers a 26 year range.

Table 2

Year(s) in which respondents obtained their professional library qualifications

N=28

Years	Responses	
	N	Percentage
1995-1997	3	10.7%
2004-2006	3	10.7%
1989-1991	2	7.1%
1992-1993	2	7.1%
2007-2009	2	7.1%
2010-2012	2	7.1%
2001-2003	1	3.6%
No response	17	60.7%
Total	*32	114.3%

*Multiple responses received

Table 2 shows that the years between 2001 and 2012 was the period most of the respondents who answered the question obtained their library qualifications with eight (28.6%) indicating so. Seven (25%) respondents obtained their qualification between 1989 and 1997. A majority of respondents (60.7%), surprisingly, did not answer the question.

4.3.1.4 Gender and age

Table 3

Gender and age cross tabulation

N=28

Gender	Age			Total
	30-39	40-49	50+	
Female	5	7	4	16
Male	2	7	2	11
No response	0	0	1	1
Total	7	14	7	28

Out of 28 respondents, 21 (75.0%) were between the ages of 30-49 years and seven (25.0%) were 50 years or older. The majority in both age groups were female. There was one respondent who indicated 50+ years but did not respond to the gender question. There were the same number of male and female respondents between the age of 40 and 49, namely seven (25.0%) each thus comprising 50% of the population.

4.3.1.5 Main duties or task performed by the respondents

Table 4

Main duties/tasks

N=28

Main duties/tasks	Responses	
	N	Percentage
User education	11	39.3%
Cataloguing	9	32.1%
Collection organization	7	25.0%
Reference services and information retrieval	6	21.4%
Classification and assigning subject headings	5	17.9%
Management	3	10.7%
Collection development	3	10.7%
Maintaining the library database	2	7.1%
Purchase of EIRs	2	7.1%
Heading subject librarians	1	3.6%
Liaising with vendors of EIRs	1	3.6%
No response	8	28.6%
Total	*58	207.1%

*Multiple responses received

Very few of the tasks given by respondents were “strictly” ICT related, in fact maintaining of the library database and purchase of EIRs which was done by four (14.3%) of the respondents and liaising with vendors of EIRs, which was done by one (3.6%) were ICT related. Compared with the other duties listed by respondents these were thus performed to a small degree. Most of the tasks related to the normal duties of librarians with user education notching the highest at 11 (39.3%), followed by cataloguing nine (32.1%). The rest of the duties were performed by 25% or

less of the respondents and one (3.6%) respondent indicated heading subject librarians as the main duty.

4.3.1.6 Library budget

Question 6 asked whether the library manages its own budget and if 'Yes' the respondents were asked to indicate how much of the budget is devoted to the management of EIRs.

N=28

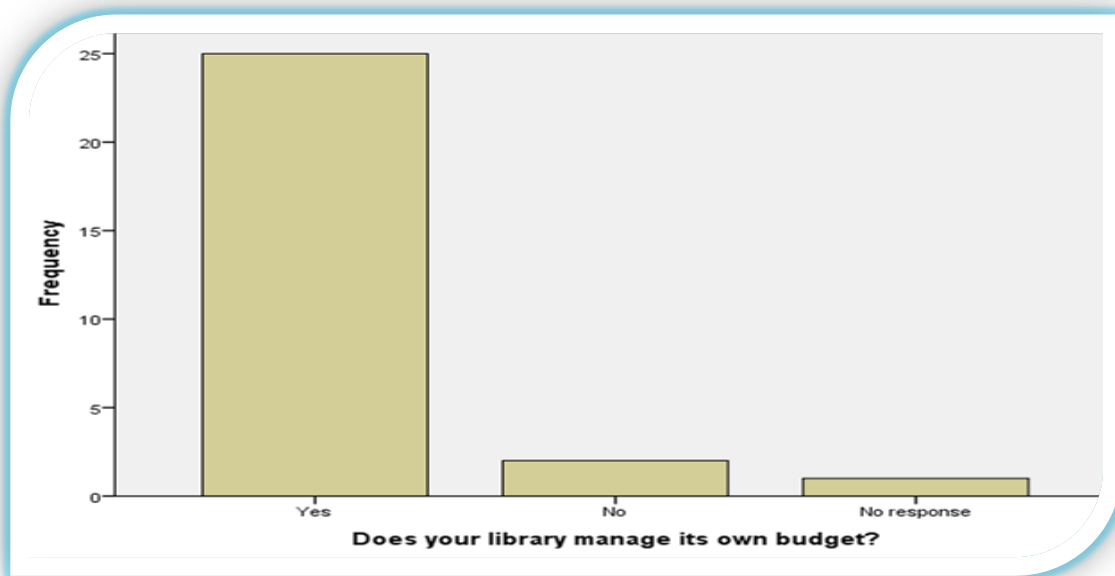


Figure 5: Library budget

Table 5
Budget devoted to the EIRs management
N=25

Budget devoted	Response	
	N	Percentage
Don't know	13	52.0%
R500 000 – 999 000	5	20.0%
R1 000 000+	4	16.0%
R100 000– 249 000	3	12.0%
Total	25	100.0%

Of the 27 respondents who responded, the vast majority, 25 (89.3%) said ‘Yes’ the library manages its own budget while two (7.1%) said ‘No’. Of the 25 respondents who said ‘Yes’, 13 (52.0%) indicated that they did not know how much of the budget is devoted to the management of EIRs, five (20.0%) indicated R500 000 - R999 000, four (16.0%) said R1000 000+ without specifying the exact figure and three (12.0%) indicated R100 000 - R249 000.

4.3.1.7 Budget devoted to the management of EIRs

Question 7, which was asked of all respondents, queried if the budget devoted to the management of EIRs was sufficient. Twenty (71.4%) respondents said ‘No’ the amount was insufficient (the 20 included those respondents who indicated that they did not know the amount of funds that was devoted to the management of EIRs). Six (21.4%) respondents did not respond to the question and two (7.1%) indicated ‘Yes’ the budget is sufficient for the management of EIRs.

4.3.2 Section B - Continuous access to EIRs

The information in this section deals with the ways used to ensure that there is continuous access to EIRs in the libraries in which the respondents worked.

4.3.2.1 Standby generator

Question 8 asked if the library where the respondent worked had a standby generator in case of power failure. The respondents' responses are reflected in Table 6.

Table 6

Standby generator

N=28

Place of work	Does the library have a standby generator:		Total
	YES	NO	
EGM Malherbe Library	15	2	17
Cecil Renaud Library	1	6	7
Life Sciences Library	1	1	2
GMJ Sweeney Law Library	0	1	1
Place of work not specified	0	1	1
Total	17	11	28

Seventeen (60.7%) stated that their library did have a standby generator in case of power failure while 11 (39.3%) indicated that their library does not have a standby generator. One respondent did not indicate his/her place of work but stated that there was no standby generator.

4.3.2.2 How continuous access to EIRs is ensured

Question 9 was asked to indicate the ways that librarians ensured there was continuous access to EIRs when there is power failure and no standby generator. Of the 11 respondents who answered that their libraries do not have a standby generator, nine (81.8%) indicated that there was no service when there was a power failure and two (18.2%) did not respond to the question.

4.3.2.3 Web browser

Question 10 was asked if the library where the respondents worked ensures that the Web browser used by the patrons inside the library was always up to date. All 28 (100%) respondents indicated that their libraries do ensure that the Web browser used by the patrons was always up to date.

4.3.2.4 Availability of EIRs for patrons' use

Figure 6 reflects the responses to question 11, which was asked to show how EIRs in respondents' libraries were made available for patrons' use.

N=28

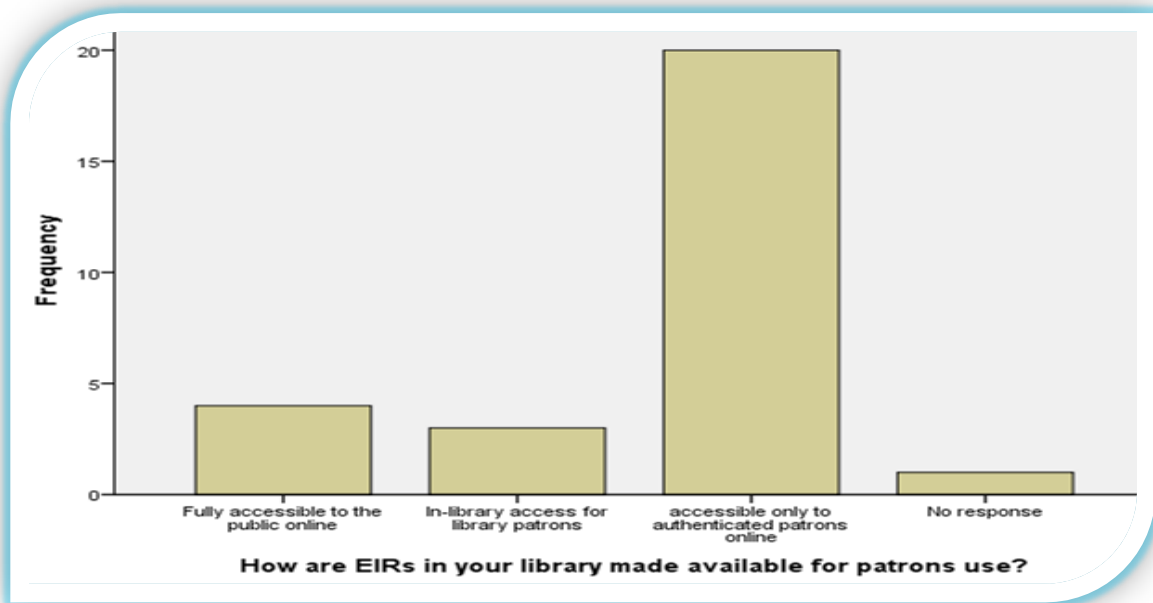


Figure 6: Availability of EIRs

Out of the 28 respondents, 20 (71.4%) indicated that EIRs are made available only to the authenticated patrons online via Web databases, four (14.3%) answered that EIRs are made fully

accessible to the public online, three (10.7%) said that EIRs are made available to the patrons in the library only.

4.3.2.5 Accessibility of EIRs

Question 12 was asked if the EIRs are accessible via Web database or in-house only. Table 7 reflects the responses that respondents gave.

Table 7

Accessibility of EIRs

N= 28

Accessible via	Responses	
	Frequency	Percentage
Web database	26	92.9%
In-house only	1	3.6%
No response	1	3.6%
Total	28	100.0%

Twenty six (92.9%) indicated that EIRs in their libraries are accessible online via Web databases while only one (3.6%) answered in-house only.

4.3.2.6 Maintenance of the EIRs links (much dependent on the supplier)

Question 13 was asked to determine if the library where respondents work ensures that the links of the EIRs are always up/available for continuous access. Out of the 28 respondents, 25 (89.3%) answered 'Yes' and three (10.7%) indicated 'No'.

Those who answered 'Yes' were asked to provide details on how their libraries ensure this. Figure 7 shows how the respondents answered the question.

N= 25

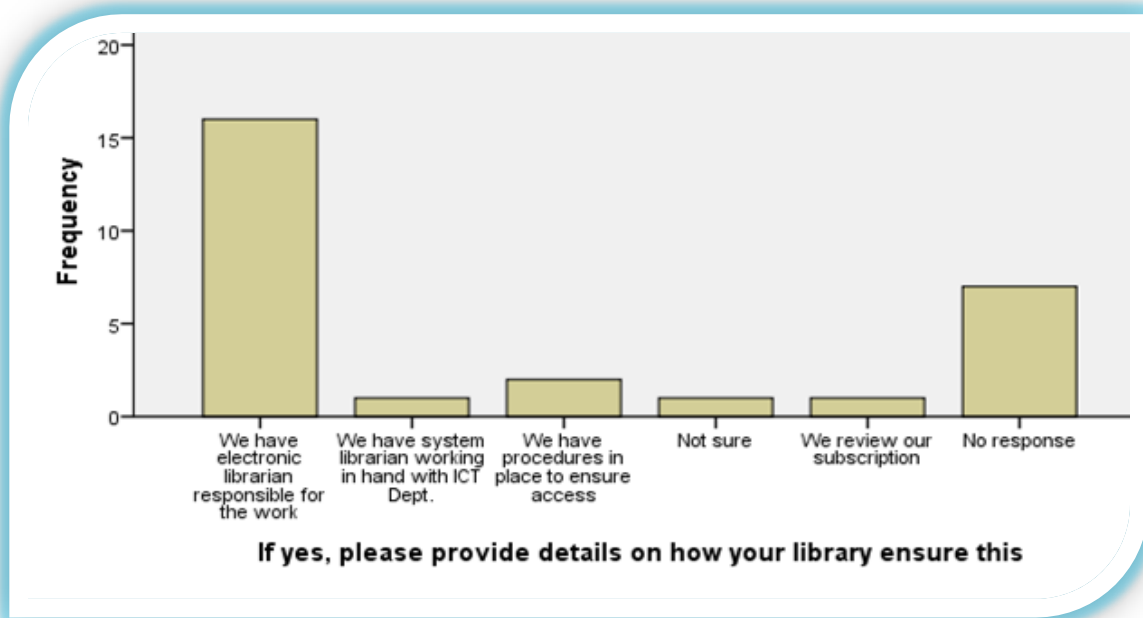


Figure 7: EIRs maintenance

Out of the 25 respondents who answered ‘Yes’, 17 (68.0%) indicated that there is an electronic librarian/system librarian responsible for maintaining the links of the EIRs in the library who is working hand in hand with the ICT Department, and three (12.0%) indicated that their libraries have procedures in place to ensure access (but gave no further detail). One (4%) respondent stated that they review their subscriptions and a further respondent was not sure how his/her library ensures EIRs links to be always available for the patrons.

4.3.2.7 Maintenance of links and time taken for a problem to be resolved

Question 14 was directed at the three respondents who said that their library did not ensure that the links to the EIRs were always available for continuous access (question 13 above). Respondents were asked who maintained the links and indicate how long it takes for the problem to be resolved. As reflected in Table 8 below, of the two respondents who replied to the question, one (33.3%) indicated that their library makes use of the ICT Department and/or vendors and that it usually takes a couple hours to several days to resolve the problem. The second respondent

stated that their library makes use of the University Computer Science Department and their response is usually as soon as possible depending on the nature of the problem.

Table 8

Maintenance of the EIRs links

N=3

Who carries the maintenance and how long it takes the company/person to resolve the problem:	Responses	
	Frequency	Percentage
ICT Dept. and/or vendors and it usually takes a couple hours to several days	1	33.3%
University Computer Science Department and it is usually as soon as possible	1	33.3%
No response	1	33.3%
Total	3	100.0%

4.3.3 Section C - ICT skills and training of staff in the EIRs management

This section deals with the ICT skills of the respondents and their training in the management of digital information resources.

4.3.3.1 ICT skills in EIRs management

Question 15 was asked to determine whether the respondents see themselves as sufficiently skilled in managing EIRs. Table 9 reflects the responses.

Table 9

Skills in EIRs management

N=28

Do you consider yourself sufficiently skilled in EIRs management:	Responses	
	Frequency	Percentage
Yes	16	57.1%
No	12	42.9%
Total	28	100.0%

A small majority, 16 (57.1%) indicated that they do consider themselves sufficiently skilled in EIRs management while the remaining 12 (42.9%) considered themselves as not being sufficiently skilled.

4.3.3.2 Frequency of training

Question 16 asked the 16 respondents who considered themselves sufficiently skilled in the management of EIRs how often they received training from the library to meet technological changes. Figure 8 below reflects the responses to the question.

N= 16

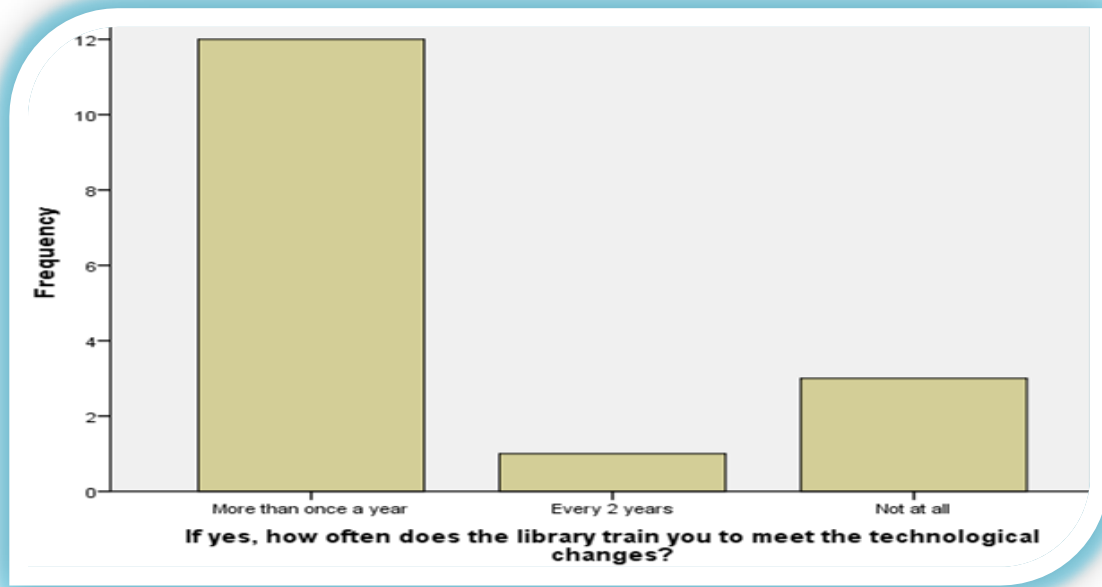


Figure 8: Technical changes

Out of 16 respondents, 12 (75.0%) answered that they get trained more than once a year to meet the technological changes; three (18.8%) indicated they are not trained at all to meet technological changes while one (6.3%) answered once every two years.

4.3.3.3 Techniques

Question 17 directed at all respondents was asked to determine the techniques they thought they needed training in. More than one response could be provided and the results are reflected in Table 10 below.

Table 10

Techniques in which training is needed

N=28

Techniques	Responses	
	N	Percentage
Training in metadata techniques	19	67.9%
Training in migration techniques	18	64.3%
Training in emulation techniques	18	64.3%
Training in maintenance techniques	18	64.3%
Training in bit preservation techniques	18	64.3%
No response	1	3.6%
Total	*92	328.7%

*Multiple responses received

Of the 28 respondents, 19 (67.8%) indicated that they needed training in metadata techniques while just under 65.0% (18) stated that they needed training in migration, emulation, maintenances and bit preservation techniques.

4.3.3.4 Level of knowledge in EIRs management

Question 18 asked respondents what they considered to be the level of knowledge available among staff in their libraries for EIRs management activities. Figure 9 shows the responses.

N= 28

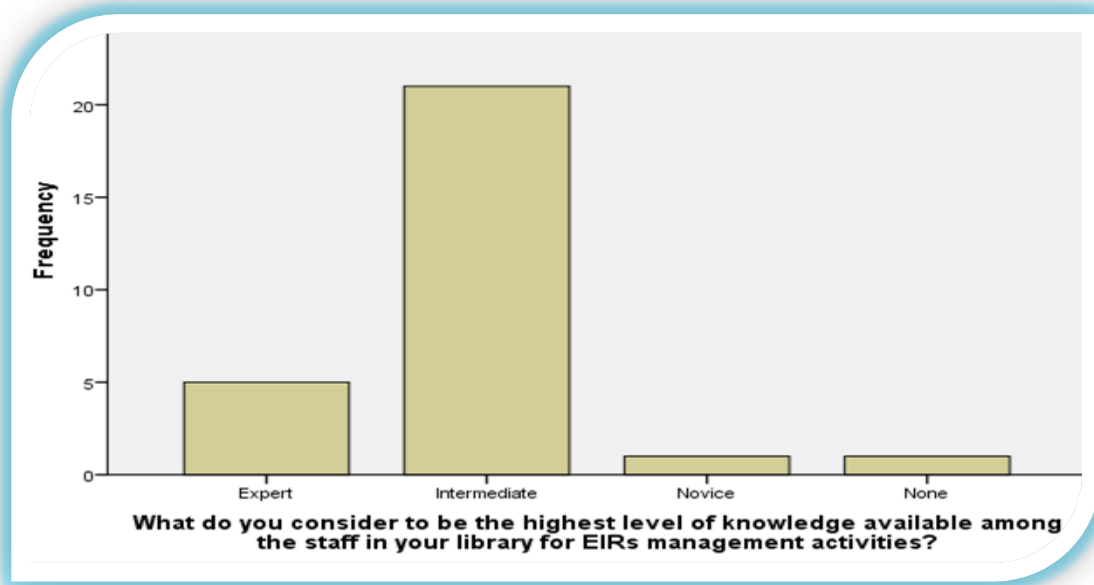


Figure 9: Level of knowledge in EIRs management

Twenty one (75.0%) answered that the level of knowledge available among the staff in their libraries for EIRs management activities is intermediate, five (17.9%) said the level is expert and of the remaining two respondents, one said the level is novice and the other pointed to the level of knowledge being non-existent.

4.3.3.5 Consultation of experts

Question 19 was asked to establish if the respondents' library was currently utilizing external expertise such as consultants for EIRs management. As reflected in Table 11 below, of the 28 respondents, 15 (53.6%) said 'Yes' their libraries utilize external expertise while 13 (46.4%) answered in the negative

Table 11

Utilization of external expertise

N= 28

Does your library utilize external expertise:	Responses	
	Frequency	Percentage
Yes	15	53.6%
No	13	46.4%
Total	28	100.0%

4.3.4 Section D - ICT infrastructure

The information in this sections deals with ICT infrastructure used in the management of EIRs by the respondents.

4.3.4.1 Number of computers available for patrons

Question 20 was asked to determine how many computers respondents' libraries have for patrons to access EIRs. Figure 10 below reflects the responses.

N=28

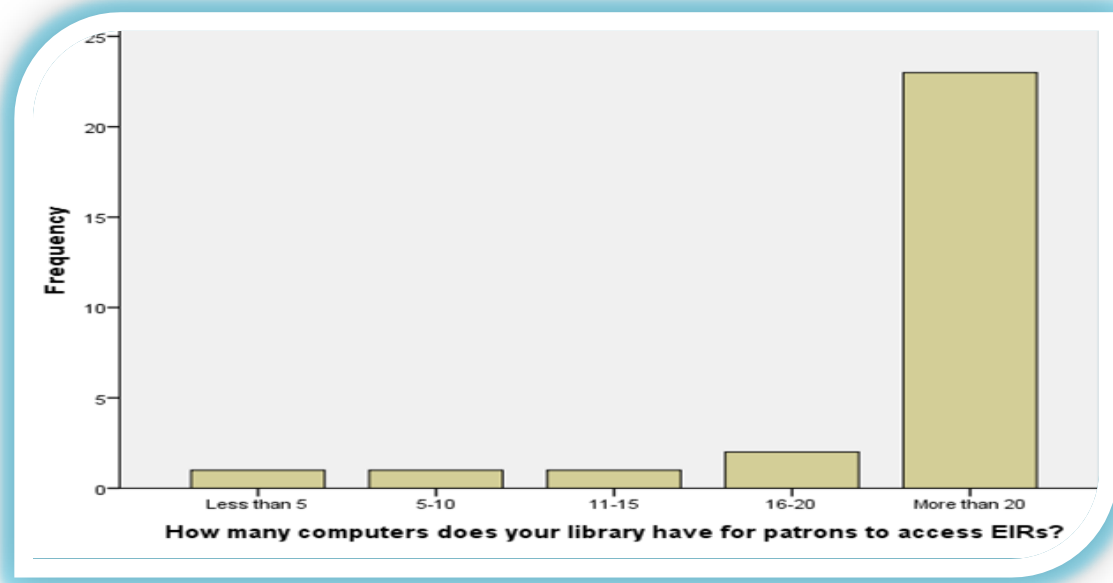


Figure 10: Number of computers available for patrons

The vast majority of respondents, 23 (82.1%) answered that their libraries have more than 20 computers for patrons to access EIRs. At the other extreme one (3.6%) respondent indicated that his/her library has less than 5 computers.

4.3.4.2 Devices for storage

Question 21 was asked to establish the devices used by the respondent's library in storing EIRs both born digital and those digitized. These devices are reflected in Table 12.

Table 12

Storage devices

N=28

Storage devices	Responses	
	N	Percentage
Server's hard drive	21	75.0%
Don't know	4	14.3%
Compaq Disk-Read Only Memory (CD-ROM)	2	7.1%
Optical disk (Re-writable)	2	7.1%
No response	2	7.1%
Total	*31	110.6%

*Multiple responses received

Twenty one (75.0%) respondents answered their server's hard drive as the device used to store EIRs in their libraries. Four (14.3%) respondents said they did not know and CD-ROM and Optical disk (Re-writable) were each mentioned by two (7.1%) respondents.

4.3.5 Section E – Strategies for EIRs management

The information in this sections deals with strategies used in the management of EIRs by the respondents' libraries.

4.3.5.1 Metadata preservation (for UKZN e-theses)

Question 22 was asked to determine the strategies of metadata preservation that are covered by the respondent's library in terms of preserving the UKZN e-theses that are both born digital and digitized.

Table 13

Metadata preservation strategies for UKZN e-theses

N= 28

Strategies used:	Responses	
	N	Percentage
Don't know	15	53.5%
Migration	11	39.3%
Emulation strategy	1	3.6%
Maintenance strategy	1	3.6%
Total	28	100.0%

Fifteen (53.5%), which is the majority of respondents, indicated that they don't know which strategies are used in their libraries as metadata preservation for electronic theses. Of the respondents who did know, 11 (39.3%) specified that migration is the strategy that is used. The remainder (one each) indicated emulation and maintenance strategies.

4.3.5.2 Metadata preservation strategies for e-books, e-journals and databases

Question 23 was asked to establish the strategies of metadata preservation that are covered in terms of links preservation of EIRs which are very much dependent on the supplier. While the respondents were able to provide more than one response if necessary, none did so.

Table 14

Metadata preservation strategies for e-books, e-journal and databases

N=28

Strategies used:	Responses	
	N	Percentage
Don't know	16	57.1%
Maintenance strategy	10	35.7%
Emulation strategy	2	7.1%
Total	28	100.0%

Once again a majority of respondents 16 (57.1%) indicated that they did not know the strategies used. Ten (35.7%) specified maintenance as the metadata preservation strategy covered by their libraries in terms of links preservation of EIRs such as e-journals, e-books and databases. Less than 10.0% (2) respondents stated that emulation was the strategy used in their libraries.

4.3.5.3 EIRs management policy

Question 24 was asked to establish if the library where respondents work have an EIRs management policy or regulation. Figure 11 reflects the answers of the respondents.

N=28

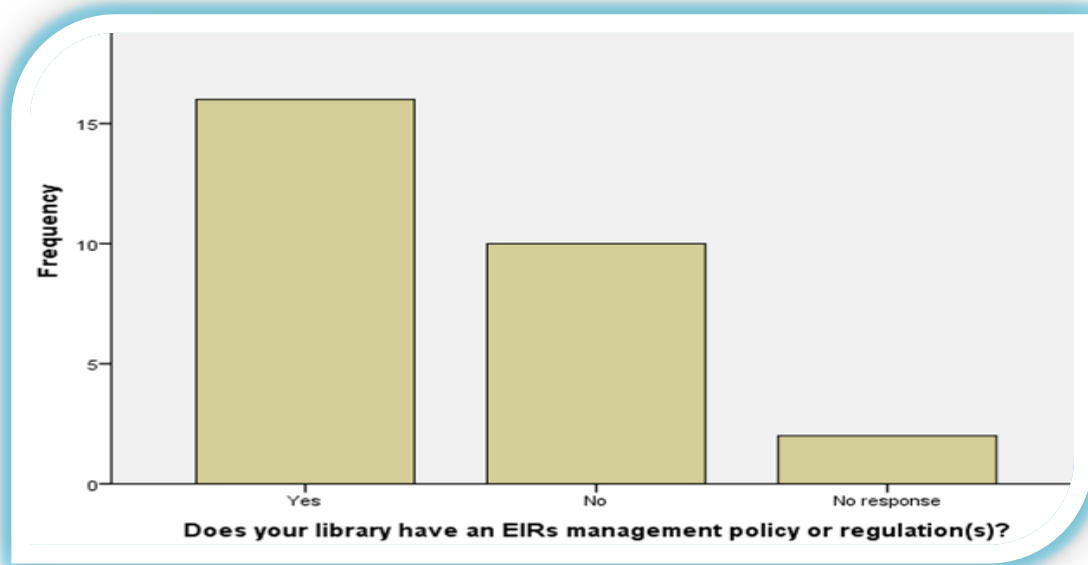


Figure 11: EIRs management policy or regulation

Sixteen (57.1%) respondents stated ‘Yes’ that their libraries have an EIR management policy or regulation while 10 (35.7%) said ‘No’.

4.3.5.4. Policy or regulation guidelines

Question 25 asked those respondents who said ‘Yes’ in question 24 what the policy or regulation provided guidelines for. The results to the question are reflected in Table 15 below.

Table 15
Policy guidelines
N= 16

Does the policy provide guidelines for:	Responses	
	N	Percentage
Acquiring materials in digital form	15	93.8%
Converting materials from print to digital form	13	81.3%
Storage	4	25.0%
Total	*32	200.1%

*Multiple responses received

Of the 16 respondents, 15 (93.8%) stated that their libraries have a policy that provides guidelines for acquiring materials in digital form, 13 (81.3%) said the policy provides guidelines for digitization and four (25.0%) referred to guidelines for storage.

4.3.5.5 Policy or regulation meeting libraries' current needs

Question 26 asked the 16 respondents above how well the policy or regulation met their libraries' current needs. Figure 12 represents the answers for the question.

N= 16

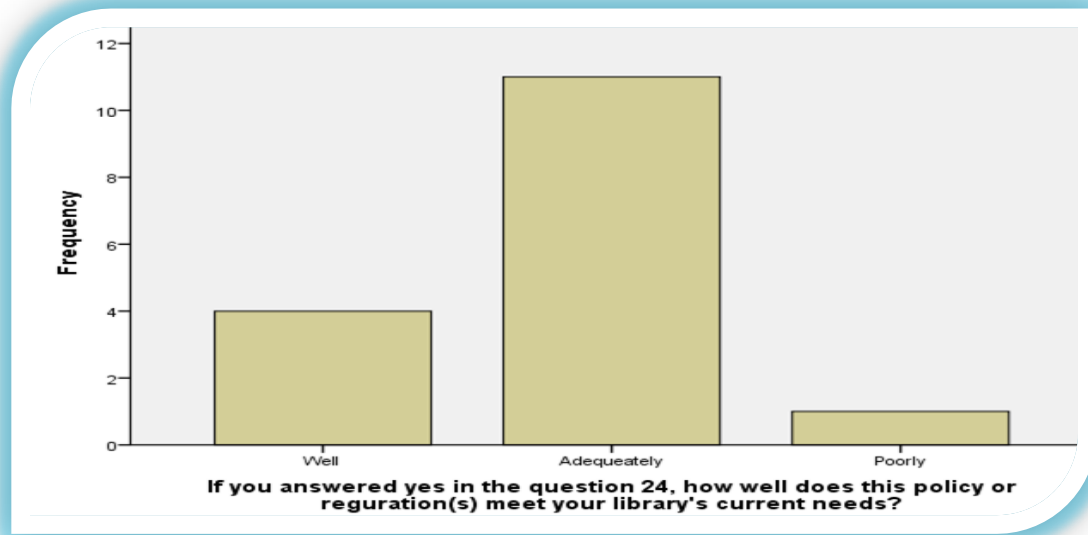


Figure 12: Policy with the current library's needs

Of the 16 respondents who said their libraries have an EIRs management policy or regulation, 11 (68.8%) pointed out that the policy or regulation adequately meets their current libraries' needs, four (25.0%) indicated well, and one (6.3%) said poorly.

4.3.6 Section F – Perceptions of library's involvement in EIRs management

The information in this section deals with respondents' perceptions of their libraries' involvement in EIRs management activities.

4.3.6.1 Level of library's involvement in EIRs management activities

Question 27 asked respondents to rate their agreement or disagreement with various statements reflecting their libraries' level of involvement in EIRs management activities. Table 16 reflects the responses.

Table 16

Level of library's involvement in EIRs management activities

N=28

My library's level of involvement in EIRs management activities has been limited by:	Responses						Total
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	No response	
Concerns about technology obsolescence	3	4	16	1	2	2	28
Insufficient policy or plans for preservation	0	2	17	4	2	3	28
Lack of staff with digital preservation expertise	1	3	9	3	11	1	28
Insufficient EIRs for preservation	3	7	9	5	2	2	28

An overall observation is the quite high number of neutral responses with over 50% of respondents in two instances providing neutral responses. Seven (25.0%) disagreed with the statement that their libraries' level of involvement in EIR management activities had been limited by concerns about technology obsolescence, while three (10.7%) agreed. In terms of their libraries having insufficient policy or plans for preservation, six (21.4%) agreed and two (7.1%) disagreed. Fourteen (50.0%) agreed that lack of staff with digital preservation expertise limited their library's level of involvement in EIRs management activities. In terms of their library's involvement in EIRs management with regards to insufficient electronic resources for preservation, 10 (35.7%) disagreed and seven (25.0%) agreed.

4.3.6.2 Other factors limiting libraries' involvement in EIRs management activities

Question 28 asked respondents to indicate if there were other factors which have limited their libraries' involvement in EIRs management activities and if there were, they should briefly describe the factors. Figure13 shows how respondents answered the question.

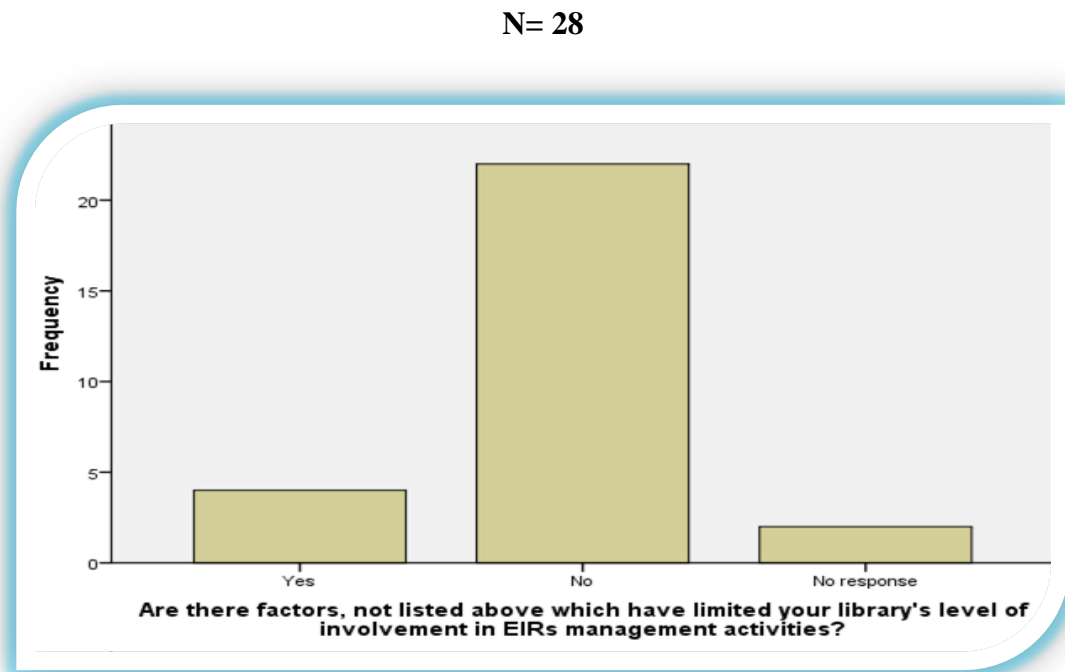


Figure 13: Other factors limiting libraries' involvement in EIRs management activities

Twenty two (78.6%) answered 'No' and four (14.3%) said 'Yes' in terms of there been other factors that limited their libraries' level of involvement in EIRs management activities.

Of the four respondents who indicated 'Yes', two (50%) pointed to insufficient funds being a factor and the remaining two (50.0%) stated that more electronic resources librarians should be employed.

4.3.6.3 Further comments

Question 29 was asked to determine if respondents had any further comments regarding the overall management of EIRs in their libraries. Table 17 indicates how respondents answered the question.

Table 17
Further comment
N=28

Do you have any further comment:	Responses	
	N	Percentage
Yes	4	14.3%
No	24	85.7%
Total	28	100.0%

Twenty four (85.7%) indicated that they did not have further comment while four (14.3%) indicated that they had. Two (50%) (possibly the same two in question 28 above) of the four respondents stated that more electronic resources librarians are needed, one (25%) pointed to the need for the establishment of a separate department to manage EIRs and the final respondent stated that patrons need to be strongly influenced to use EIRs.

4.4 Summary

This Chapter reported on the results of the survey of the population comprising subject librarians, metadata librarians and an electronic librarian which was conducted by means of a self-administered questionnaire. In reporting the results, the aim behind each question that was asked was described. Presentation of the results was in line with, and responded to, the research questions as listed at the beginning of the Chapter. Finally, the findings were presented in the form of tables and figures. In the following Chapter, these findings are discussed.

CHAPTER FIVE

DISCUSSION OF THE RESULTS

5.1 Introduction

In this Chapter the findings of the study are considered in the light of the research problem and the purpose of the study. The purpose of this study was to investigate the management of EIRs to enhance their long-term links preservation and access in the UKZN PMB and Howard College campus libraries. The order of the discussion in this Chapter follows that of the order of the research questions of the study.

The results for each of the six sections of the questionnaire are therefore discussed in light of the purpose and research questions of the study. The results that are interpreted in this Chapter relate only to the respondents who responded to the questionnaire. However, in view of the high response rate (84.8%) obtained the results could be generalized to the whole study population.

5.2 Background information on respondents

This section explores the findings relating to respondents' demographic information.

5.2.1 Area of work

As from Figure 5 in Chapter Four, seven (25.0%) respondents indicated working in the Cecil Renaud Library on the PMB Campus. Seventeen (60.7%) specified working in the EG Malherbe Library (Howard College Campus), two (7.1%) worked in the Life Sciences Library (also on the PMB Campus) and one (3.6%) at the GMJ Sweeney Library (Howard College Campus).

5.2.2 Gender and age

Out of 28 respondents, 16 (57.1%) indicated that they were female and 11 (39.3%) indicated that they were male. Twenty one (75.0%) of the respondents were between the ages of 30-49 years and seven (25.0%) were 50 years or older. There were the same number of male and female

respondents between the age of 40 and 49, namely seven (25.0%) each. The findings show majority of the respondents were female and it seems that the libraries have, in the main, middle-aged employees. To what extent age will have influenced respondents' answers is not known but there is the possibility that the fairly high proportion of middle-aged respondents were not as technologically "literate" as their younger counterparts and this could have had a bearing on their answers provided.

5.2.3 Professional qualifications and year of qualification

When asked to list their professional library qualification/s 17 of the respondents did so and these ranged from the Post-graduate Diploma, to a Master Degree. Of the respondents, seven (25.0%) had obtained their professional qualifications in or between 1989 and 1997. Eight (28.6%) of the respondents had obtained their library qualifications from 2001 to 2012. Seventeen (60.7%) did not indicate the year they obtained their library qualification. In terms of access to further education and training in the form of a higher degree plus the access to ICT skilling such an opportunity represents, of the respondents 32.1% had an Honors Degree, two (7.1%) had a Bachelor of Technology Degree, while 28.6% had a Master's Degree.

5.2.4 Main duties performed by the respondents

In order to recognize the ways in which respondents are preserving and ensuring continuous access to EIRs one must examine the main duties performed by the respondents. In the scope of their work, the main tasks performed by most of the respondents included: 11 (39.3%) user education, nine (32.1%) cataloguing, seven (25.0%) collection organization, six (21.4%) reference services and information retrieval, five (17.9%) classification or assigning subject headings, three (10.7%) management and collection development, two (7.1%) maintaining the library database and purchase of EIRs, one (3.6%) heading subject librarians and liaising with vendors of EIRs.

This results are partly in keeping with the literature that suggests information professionals are supposed to have exposure to all areas of electronic information processing and handling (Lefuma 2004). However, in this study only 14.2% of the respondents considered maintaining the library database and purchase of EIRs as part of their main duties and tasks. There is thus a

strong focus on user education as part of the main duties of these respondents as opposed to preservation and ensuring continuous access to EIRs. While user education can rightly be considered a core function of the university library the seemingly lack of attention paid to the EIRs management is of concern.

5.2.5 Library budget

Respondents were asked whether their libraries managed their own budgets and if so how much of that budget were devoted to the management of EIRs. They were then asked if the amount was sufficient. The majority of respondents 25 (89.3%) indicated their libraries have their own budgets and of these respondents, five (20.0%) indicated an amount of R500 000 – R999 000, four (16.0%) said R1 000 000+ without specifying the exact figure and three (12.0%) indicated R100 000 – 249 000. A small majority 13 (52.0%) said that they did not know how much of the budget is devoted to the management of EIRs. When asked if the amount was sufficient 20 (71.4%) answered in the negative. Only two (7.1%) indicated that the budget is sufficient and the rest did not respond to the question. This high percentage, (71.4%), reflects that the budget devoted for EIRs management is not sufficient.

5.3 Research question 1: What methods do staff use to enhance continuous access to EIRs on the UKZN PMB and Howard College campus libraries?

This section explores the findings relating to the methods the respondents use to enhance continuous access to EIRs in their libraries.

5.3.1 Standby generator

In order to recognize the ways in which respondents are ensuring continuous access to EIRs one must examine if the library has a standby generator in case of power failure. The responses provided indicate that 11 (39.3%) answered that their libraries do not have a standby generator in case of power failure while 17 (60.7%) said their libraries have a standby generator. This is partly in keeping with the literature that points to an inadequate ICTs infrastructure characterized

by, for example, frequent power outages which create serious bottlenecks to EIRs access and preservation in Africa (Asongwa and Ezema 2012).

In this study 60.7%, which is more than a half the respondents, indicated that their libraries have a standby generator in case of power failure. Out of the 60.7%, the vast majority, 53.6% indicated that EGM Malherbe Library has a standby generator. These results show that only one out of the four libraries has a standby generator. This might make sense because it is the main library of the Howard College Campus. Surprisingly, it was not the same with the Cecil Renaud Library which is the main library on PMB Campus whereby only one out of the seven respondents incorrectly indicated that the Library has a standby generator in case of power failure.

These findings can be connected with the literature that suggests most countries in Africa do not have sufficient and dependable power supply which as a result makes it difficult to maintain a favorable and maintainable technological environment appropriate for EIRs preservation (Asongwa and Ezema 2012). Therefore, the only solution is to have a standby generator. The fact that the Cecil Renaud Library, the Life Sciences Library and the GMJ Sweeney Law Library do not have standby generators could be due to the initial cost of a standby generator as well as its running costs in the event of a power failure, which is in line with the literature (Asongwa and Ezema 2012). One can assume that the issue of lack of funds is the main reason for the given libraries not having a standby generator.

5.3.2 Web browser

Occasionally, libraries might have older versions of browsers installed on patrons PCs, while the databases are designed for the newer versions. In this case libraries should try as much as possible to ensure that the Web browser used by the patrons inside the library is always up to date. The respondents were asked if their libraries ensure the Web browsers used by the patrons inside their libraries are up to date and all 28 (100.0%) respondents indicated that their libraries do ensure this. The importance of updating has been emphasized in the literature review by Tonta (2004) who stressed the importance of updating software from older versions to new versions when necessary so as to prevent inaccessibility due to the obsolescence of technology.

The results show that inaccessibility to EIRs that can be caused due to old versions of Web browsers is prevented in the libraries under study.

5.3.3 How are EIRs in the library made available for patrons use?

In Section 2.3.5 of the literature review, Grout et al. (2000) indicated that it is important to control the access to EIRs in order to prevent their unauthorized use and the possibility of their misuse. They added that EIRs that have been cleared for public usage via the Internet will not require special access management while those EIRs that have been cleared only for specific groups of users in mind would require one to provide access management. In terms of the present study 20 (71.4%), which is almost three quarters of the total respondents, indicated that EIRs are made available only to the authenticated patrons, four (14.3%) answered that EIRs are made fully accessible to the public online, three (10.7%) said that EIRs are made available to the patrons only in terms of in-library access.

A majority of respondents do appear to know what is going on in their libraries in terms of making EIRs available to their patrons, indicated that the libraries are using an ID login and password system for patrons to access electronic information from their server. This means that libraries will be able to control unauthorized users from accessing EIRs. Controlling the number of users avoids patrons getting frustrated with the length of time taken to retrieve information from the server. Thus given that patrons are accessing the EIRs through ID login and password means that the libraries (which are working hand in hand with the ICT Department) can control the number of users thereby helping in resolving the issue of low bandwidth and access. When there are too many users accessing information from the same server, there is a high chance of low bandwidth (few data transfer in bits per seconds) leading to 503 Service Unavailable Errors (which means the server is too busy due to a huge increase in traffic by users).

It was concerning to see that quite a number of respondents did not know what was really happening in their libraries in terms of providing EIRs access to patrons since a total of seven (25.0%) indicated that either EIRs are made fully accessible to the public online or are made available to the patrons only in terms of in-library access.

5.3.4 In your library, are EIRs accessible via a Web database or in-house only?

In order to establish the ways which patrons could use to access information resources, it was important to identify if patrons could only access the EIRs when they were inside the libraries or even when off campus. From the responses, it was evident that patrons can access EIRs anywhere and at any time as long as they are authorized and they have access to the Internet. This was seen from the vast majority 26 (92.2%) of respondents who indicated that EIRs are accessible online via Web databases while one (3.6%) stated in-house only.

5.3.5 Maintenance of the EIRs links (much dependent on the supplier)

Twenty five (89.3%) respondents specified that their libraries do ensure that the links of the EIRs are always up/available for continuous access. When asked how this was ensured by their libraries, 17 (68%) of the 25 respondents said it was done by the electronic/system librarian who worked hand in hand with the ICT Department. Three (12.0%) said that their library has procedures in place to ensure continuous access and there was one who indicated that he/she was not sure. This high percentage (89.3%) indicates, as was to be expected, that there is continuous access to EIRs for patrons use. Therefore, these findings show that there is a good relationship between the libraries and the ICT Department of the University in terms of working together to ensure the links of the EIRs are up/available for continuous access.

The results, however, also show that while there is a good relationship between the libraries and the ICT Department, all the libraries depend on one electronic/system librarian to do the links maintenance.

5.3.6 How long it takes a problem to be resolved

The three respondents who answered in the negative to their library ensuring continuous access were asked who carried out the maintenance of the links and how long it took to resolve the problem of the links being down. Two of the three respondents replied as follows:

- One said that the library makes use of ICT Department and vendors and it usually takes a couple of hours to several days to resolve the problem.

- One said that the library makes use of the University Computer Science Department and the response is usually as soon as possible depending on the nature of the problem.

Evidently, the above situations do result in time delays and, as a consequence, continuous access to EIRs by patrons is compromised.

5.4 Research question 2: What level of ICT skills do staff have in metadata preservation and how often are they trained to meet the technological changes?

Moloi and Mutula (2007) argued that there is a constant need to upgrade ICTs staff skills in order for them to keep up with technological changes. Due to these persistent changes in information technologies, it would be difficult for librarians to provide appropriate services without any ongoing professional development and, specifically in terms of the present study, staying aware of trends in the ICT field in relation to EIRs management activities. As a consequence computer literacy, in its many and varied forms, has become a vital competency for librarians in any position.

5.4.1 Do you consider yourself to be sufficiently skilled in EIRs management?

When asked whether they considered themselves as being sufficiently skilled in the management of EIRs only 16 (57.1%) respondents indicated that they do consider themselves sufficiently skilled in doing so. Accordingly, a significant 42.1% of respondents did not consider themselves sufficiently skilled. While 17 of the respondents in the present study did indicate having a professional library qualification it is probable that the training they received at the time and subsequently did not include EIRs management. In terms of the literature, Lefuma (2004) argued that many libraries lack qualified and skilled information professionals and that ICT training should be relevant to local conditions and also be of high quality. This is because without adequate ICT training an EIRs management programme is guaranteed to fail. Information professionals are assumed to have exposure to all areas of electronic information processing and handling, particularly those involved in the management of EIRs. It is for this reason that there is a need to develop schedules of service which will attract and retain the skilled librarians who are available in the field and also attract other professionals within the broader parameters of the information sciences (Lefuma 2004).

It is recognized in the literature that there is a need for librarians who are well trained in information technology and especially in the EIRs management activities (Asongwa and Ezema 2012). This is because, although computer literacy is an important competency for librarians in any position, Asongwa and Ezema (2012) argued that in developing countries there are few places where one can receive formal specialized education in preservation of EIRs. In addition, they pointed out that inadequate technical expertise is prevalent in many African countries. There is a shortage of personnel/human capital in that few librarians with computer science qualifications (computer engineers) work in libraries, resulting in frequent break down of ICT facilities and disruption of digitized services leading to a lack of continuous access to EIRs.

In question 27 the respondents were asked to indicate their level of agreement with various statements which may have limited their libraries' involvement in EIRs management activities. One statement referred to a "Lack of staff with digital preservation/technological expertise". While nine respondents remained neutral, 14 (or half) either agreed or strongly agreed with the statement thus again pointing to the need for training. This is also in line with the finding which showed that there is only one electronic resources/system librarian whose work is solely concerned with the management of EIRs including the preservation of links for all the given libraries. This is also supported by the results which showed that only five (17.8%) of the respondents said that the highest level of knowledge available in their libraries is expert. This can be connected with the literature that points to technical knowledge on EIRs being largely lacking among staff that are preserving these resources (Kanyengo 2006). Kanyengo (2006) went further by stressing that lack of knowledge leads to incomplete know-how on the equipment and software that are required for the management of EIRs.

However, Ngoepe and van der Walt (2009) stated that most trainers in African countries lack expertise and are not equipped for the task of training people in the art of EIRs preservation as compared to countries outside Africa. On the same point, respondents were asked to comment if they had further comments regarding the overall management of EIRs in their library. Two (50.0%) respondents out of the four who commented, indicated that more librarians who are sufficiently skilled in EIRs management should be employed.

In connection with the theoretical framework, the data management function of the OAIS Reference Model requires librarians to maintain databases of descriptive metadata by identifying

and describing the preserved EIRs in support of the OASIS's finding aids. This might be done properly only if the allocated librarians are ICT literate and have the required EIRs preservation skills and knowledge. The data management function also requires the ICT skilled librarians in EIRs management to manage the administrative data supporting the OASIS's internal system operations, such as system performance data or access statistics (Lavoie 2004).

5.4.2 How often are you trained to meet technological changes?

In order to establish how up to date the respondents are in facing the technological changes, respondents were asked to indicate how often they were trained in ICT in relation to EIRs management. The question was specifically asked of those who consider themselves sufficiently skilled in managing EIRs in their libraries. Out of the sixteen respondents, 12 (75.0%) indicated that they get trained more than once a year, one (6.3%) received training every two years and, surprisingly, three (18.7%) respondents pointed out that they were not trained at all to meet technological changes. Ongoing training is necessary if respondents are to keep up with changing technology. The findings thus depict that it is only 12 respondents out of the 28 who undergo training more than once a year to keep in touch with technological developments. This is only 42.9% of the total percentage which is low when one considers the rapid rate of technological development.

Emmanuel and Sife (2008) pointed out that most librarians in developing countries have low ICT skills and sometimes have technology phobia. They went further and stressed that some libraries have managed to recruit and train their own ICT experts but in the end have failed to retain them. This shows that deliberate approaches are required in terms of staffing and training librarians for sustainable management and maintenance of ICT services in libraries and to ensure that there is long-term preservation of and continuous access to EIRs. Therefore, librarians must acquire new skills necessary to manage and provide access to EIRs whenever technology changes and libraries should try to retain their librarians once they have been trained.

5.4.3 Preservation techniques needed training in

The findings revealed a general need for training in various preservation techniques. For example, of the 28 respondents, 19 (67.9%) indicated a need for training in metadata techniques

while 18 (64.3%) needed training in migration, emulation, maintenances and bit preservation techniques. Kanyengo (2006) in his study said that technical knowledge for the management of EIRs is largely lacking among the staff of library preservation departments. Accounting for this he pointed out that most library and information science schools offer preservation training at the theoretical level only.

In similar vein Okoye and Ugwuanyi (2012) suggested that there is a need for staff to be given exposure to the management of EIRs irrespective of the staff's rank or age. They also indicated that librarians need to acquire skills to manage applications and apply new techniques of analysis for dealing with EIRs. Without doubt, the present study points to a definite need for further training amongst respondents in what can be considered a crucial area of EIRs management, namely, preservation. This can also be linked with the theoretical framework: librarians are required to have skills in preservation techniques such as migration and emulation in the preservation planning function of the OAIS Reference Model (Hodge 2002). This is because through these preservation techniques, the librarians safeguard the libraries against frequently evolving technology as the preservation planning function senses changes impacting on the OAIS's capability to meet its responsibilities (Lavoie 2004).

5.4.4 Highest level of knowledge available among the respondents in their libraries for EIRs management activities

Out of the 28 respondents, only five (17.9%) said that the highest level of knowledge available in their library was expert while three quarters of the respondents, 21 (75.0%) stated that the level of knowledge available among the staff in their libraries for EIRs management activities was intermediate, one (3.6%) indicating the level as novice and the final respondent suggesting that there was no knowledge at all. These results do perhaps reflect the fact that the majority of the main duties performed by the respondents are not ICT related. Since only 17.9% of respondents pointed out that the level of knowledge in their libraries among the staff for EIRs management activities is expert, one can see that this is a very low percentage. This is perhaps not surprising given that only a small majority 16 (57.1%) of respondents considered themselves sufficiently skilled in EIRs management and the remainder considered themselves as unskilled (see 5.4.1).

The results discussed above do show that there is a need for the improvement of the skills level with regard to EIRs management in the libraries in which the respondents worked.

5.4.5 Utilization of external expertise

The respondents were asked to state if their libraries currently utilize external expertise for the management of EIRs. The results showed that 15 (53.6%) of the respondents said their libraries utilize external expertise while the remaining 13 (46.4%) said their libraries do not. The latter is surprising given that the level of knowledge available among the majority of staff in managing EIRs is intermediate and below as indicated earlier. Asongwa and Ezema (2012), as mentioned, stated that African trainers (librarians) lack expertise and are ill-equipped to train others in electronic preservation and digitization which is also a challenge in managing EIRs to ensure long-term preservation and access. Therefore, this may necessitate libraries to utilize external expertise to fill the gap left by these ill-equipped librarians. Peters (2002) stressed that librarians should work with people (external expertise) who are involved in the Internet, the Web, multimedia and other technologies that serve a constituency far wider than the university library system. This would assist in establishing measures to build capacity and increase expertise in terms of EIRs management in the academic libraries.

Keeping with the theoretical framework, to assess the EIRs in the ingest function of the OAIS Reference Model, the librarians involved in the function must be sufficiently skilled in EIRs management or else they should utilize external expertise such as consultants for preservation of EIRs. This is because by limiting the format and layout of EIRs, preservation is made easier (Hodge 2002). And this can only be done in the ingest function of the OAIS Reference Model by the librarians who are skilled in EIRs management.

5.5 Research question 3: What ICT infrastructures are used in the metadata preservation?

This section explores the findings relating to the ICT infrastructures used by the respondents in digital preservation. Twitchell and Frame (2002) indicated that there is a necessity in today's situation to provide high performance, scalable and strong electronic information management systems (EIMS) to all businesses regardless of size. They went on to stress that a strong network

infrastructure is crucial in providing reliable EIMS that have minimal downtime for mission-critical operations. To add to the same point, Lefuma (2004) emphasized that it is crucial that ICT infrastructures are present in an organization to support EIRs management in order to enhance long-term preservation of EIRs.

5.5.1 Number of computers available for patrons

The librarians were asked to state the number of computers available for patrons to use when accessing EIRs inside their libraries. The results showed that most of the libraries have sufficient computers available for patrons to use. Twenty three (82.1%) answered that their libraries have more than 20 computers for patrons to access EIRs while four (14.3%) said their libraries have between five and 20 computers and only one (3.6%) respondent indicated his/her library has less than five computers. Linking with the literature, since ICT infrastructure can be viewed as collection of computers, Asongwa and Ezema (2012) indicated that inadequate technology infrastructure creates serious bottlenecks to EIRs preservation in Africa. In the given libraries in the present study, the issue of EIRs preservation and in particular access, due to an insufficient number of computers, is not a problem.

5.5.2 Storage devices

When asked what storage devices were being used 21 (75.0%) respondents indicated their libraries were using the server's hard drive as the device to store EIRs and CD-ROM and Optical disk (Re-writable) were each mentioned by two (7.1%) respondents. The findings showed that the EIRs stored are made available online because three quarters of the respondents stated that the server's hard drive is the storage device used. As mentioned above, respondents were asked to rate their level of agreement with various statements which may have limited their libraries involvement in EIR management activities (see Table 16). One such statement is applicable to this discussion, namely "insufficient electronic resources for preservation." While there were once more a high number of respondents remaining neutral (nine), 10 (35.7%) respondents either disagreed or strongly disagreed that it was not a factor that limits EIRs management activities in their libraries. This suggests that there are enough storage devices for digital preservation.

Furthermore, the results also showed that respondents did not only indicate the server's hard drive but also CD-ROM and Optical disk (Re-writable) as storage devices used by the libraries.

5.6 Research question 4: What strategies for metadata preservation are used in EIRs management?

Lefuma (2004) argued that preservation policies give libraries the strategic directions they require to initiate measures which are necessary for the protection of EIRs. This section will discuss the results relating to the policies and strategies used in preserving EIRs in respondents' libraries.

5.6.1 Metadata preservation strategies

In terms of the preservation of UKZN electronic theses, 11 (39.3%) respondents specified that migration was the strategy used and emulation and maintenance strategies were mentioned by one (3.6%) respondent each. Interestingly a majority of respondents, 15 (53.5%) stated that they did not know. With regard to the EIRs which are very much dependent on the supplier namely, databases, e-books and e-journals 10 (35.7%) specified maintenance as the metadata preservation strategy covered by their libraries in terms of links preservation while only two (7.1%) stated emulation strategy. Again, a majority 16 (57.1%) of respondents stated that they did not know what is going on in their libraries in terms of links preservation of the EIRs. This could be a problem because librarians who are involved in EIRs management should be aware of the metadata strategies that are used in their libraries. This can be connected with the literature which suggests that awareness of metadata preservation methods should be created amongst librarians (Groenewald and Breytenbach 2011).

5.6.2 EIRs management policy or regulation

Kanyengo (2006) pointed out that policy frameworks are very vital because they can feed into broader global policies such as the New Partnership for Africa's Development (NEPAD) initiative which provides a vision and the strategic framework for the preservation of electronic resources. From the findings, the majority of the respondents, 16 (57.1%) stated that their

libraries have an EIRs management policy or regulation(s). The vast majority of those 16 respondents said that the EIRs management policy provides guidelines for digitization (13 or 83.1%) and acquiring materials in digital form (15 or 93.8%). Of the same 16 respondents who indicated that their libraries have an EIRs management policy or regulation, 14 (87.5%) said that it met their library's current needs. This shows that the EIRs management policy or regulation present in these libraries is strong. Surprisingly, however, when the respondents were also asked about the statement "Concerning insufficient policy or plans for preservation" in question 27, the majority were neutral, six (21.4%) agreed and only two (7.1%) disagreed that their libraries have insufficient policy or plans for the preservation of EIRs. Given the results concerning EIRs management policy or regulation(s) one would assume that more respondents would have agreed with the statement.

5.7 Summary

This Chapter comprised a discussion of the findings as contained in Chapter Four. The basis for the discussion was provided by the research questions underpinning the study which revolved around staff's knowledge and understanding of issues concerning the management of electronic information resources at libraries on the Pietermaritzburg and Howard College campuses of the University of KwaZulu-Natal. In the next Chapter, the final one, the major findings of the study are highlighted and conclusions and recommendations relating to these are presented. It is to this Chapter that the study now turns.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The purpose of this study was to investigate the management of electronic information resources in order to enhance their long-term links preservation and access in the University of KwaZulu-Natal Pietermaritzburg and Howard College campus libraries. In this Chapter, conclusions and recommendations are made in reply to the analysis of data and discussion of results covered in Chapters four and five respectively. To begin with, the research questions which underpinned this study will be revisited and a brief summary of the study so far, given.

6.2 Revisiting the research questions

- What methods do staff use to enhance continuous access of EIRs on the UKZN PMB and Howard College campus libraries?
- What level of ICT skills do staff have in metadata preservation and how often are they trained to meet the technological changes?
- What ICT infrastructures are used in metadata preservation?
- What strategies for metadata preservation are used in managing EIRs?

6.3 Summary of the study

Chapter one provided a background to the study, in which the problem statement underpinning this research was presented. The research questions, the rationale of the study as well as the scope and delimitations of the study were also presented.

Chapter two involved the theoretical framework used by the study and the literature review relating to the management of electronic information resources. The theoretical framework was based on the Open Archival Information System Reference Model. In the literature review, the concept of long-term preservation of electronic information resources and an overview of the role of librarians in managing electronic information resources were discussed. Other areas of

discussion focused on the long-term preservation strategies, staff knowledge and skills in preserving electronic information resources as well as the infrastructures used in the preservation of electronic information resources in libraries.

Chapter three described the research design and the research method used in the study. The approach the researcher used was quantitative and data were collected using a self-administered questionnaire. The reasons for the approach and instrument used were provided. A census sampling method was adopted and an excellent response rate of 28 was achieved. In order for the researcher to ensure reliability and validity of the study, a pre-test was done.

In Chapter four, the results of the survey of the 28 respondents were presented. The results were presented in the form of tables and figures.

Chapter five discussed the results of the study as presented in the previous Chapter. The research questions provided the structure on which the discussion was based.

6.4 Major findings and conclusions

The major findings and conclusions are guided by the research questions of the study. The survey of the 28 respondents who were employed in the libraries of the Pietermaritzburg and Howard College campuses of University of KwaZulu-Natal resulted in several significant findings and subsequent conclusions. As was done with the discussion (Chapter five) the research questions serves as useful “pegs” on which to present the findings and conclusions relating to the findings.

6.4.1 What methods do staff use to enhance continuous access to EIRs on the UKZN PMB and Howard College campus libraries?

The findings revealed that more than half the respondents indicated that their libraries have a standby generator in case of power failure. What was interesting was that there were two respondents from EGM Malherbe Library who said ‘No’ when they should have said ‘Yes’. Also there were two respondents from the Cecil Renaud Library and Life Sciences Library who said ‘Yes’ their libraries do have a standby generator but should have said ‘No’. This clearly

shows that they either misunderstood the question or, of more concern, did not know what was going on in their libraries. The study also revealed that the libraries are making sure that the Web browsers used by the patrons inside their libraries are always up to date. Therefore chances of inaccessibility to electronic information resources due to outdated Web browsers are minimal.

The study established that the libraries are using the identification login and password system. Patrons have to login using their student identification or staff identification numbers and their passwords in order for them to access the electronic information resources from the libraries. This is vital because through this system, the given libraries are able to monitor and control the unauthorized users from accessing the servers who might cause 503 Service Unavailable Errors. The study also revealed that there were some respondents who did not know what was really happening in their libraries in terms of providing access of the electronic information resources to their patrons.

Twenty six (92.2%) of the respondents indicated that electronic information resources were accessible online via databases. While there was one respondent who said in-house only instead of via databases, these results portray that patrons could access the electronic information resources from anywhere and anytime as long as they were authorized and they had access to the Internet. The results also showed that the libraries do maintain the links of the EIRs especially those that are much dependent on the suppliers with almost 90.0% of the respondents stating that this was the case. In addition, the findings revealed that all the libraries depend on only one electronic librarian to do the links maintenance as the majority of the respondents indicated that there is an electronic librarian/system librarian working hand in hand with the information and communication technology Department.

From the above major findings it can be concluded that the lack of back-up generators in three of the libraries (Cecil Renaud, Life Sciences and GMJ Sweeney Law) represented is a concern in terms of ensuring continuous access to electronic information resources. In the event of power failures (and these do occur) the electronic information resources are, in effect, inaccessible to patrons. Also from the above one can conclude that there was a need for employing more electronic/system librarians. It is evident that all the libraries were depending on only one electronic librarian to maintain the links of the electronic information resources. This is risky

because when he or she is on leave/sick, it means there is no one to back up the position to maintain the electronic information resources for continuous access.

6.4.2 What level of ICT skills do staff have in metadata preservation and how often are they trained to meet the technological changes?

The findings revealed that just over 40.0% of the respondents did not consider themselves sufficiently skilled in electronic information resources management. This result is perhaps understandable when it is evident that the majority of the main duties performed by the respondents were not information and communication technology related. For those respondents who indicated that they do consider themselves skilled, only 75.0% said that they get trained more than once a year to meet the technological changes. What is surprising was that three respondents indicated that they were not trained at all to meet technological changes while one said they were trained once every two years. This latter respondent indicated that he/she does consider himself/herself sufficiently skilled for electronic information resources management.

The study also showed that the respondents needed trainings in metadata, migration, emulation maintenance and bit preservation techniques. It is evident that the libraries where respondents work, lack expertise in electronic information resources management – only a few (17.9%) of the respondents said the highest level of knowledge in electronic information resources management available in their library was expert. It is perhaps not surprising given the fact that the libraries were lacking (internal) experts in electronic information resources management, that 13 respondents indicated that their libraries did utilize external experts for electronic information resources management activities.

It can be concluded that there is a shortage of personnel/human capital with computer science qualifications (computer engineers) working in the libraries represented. This may exacerbate the situation when there is a disruption of digitized services thereby leading to a lack of continuous access to electronic information resources. With regard to skills, it can be concluded that a majority of the respondents are in need of training in electronic information resources preservation techniques. Linking in, and perhaps partly accounting for the lack of skills with

regard to electronic information resources management, is that the budget devoted for such management is, according to the respondents, not sufficient. This is not surprising as South African libraries, like most libraries around the world, are constrained by finances in terms of meeting all library needs and to provide adequate services for their users. Adequate funding, amongst other things and in terms of this study, is needed for the training of staff involved in electronic information resources management.

6.4.3 What ICT infrastructures are used in the metadata preservation?

The findings showed that most of the libraries have sufficient computers available for patrons to use. The majority of the respondents indicated that their libraries have more than 20 computers for patrons to access electronic information resources. It was also evident given the majority of responses in this regard that the library server's hard drive was the device used for storing the electronic information resources in the libraries. Surprisingly, and pointing again to the lack of skills and knowledge concerning the management of electronic information resources, there were four respondents who indicated that they did not know what the storage devices used were.

Although respondents were not asked whether they thought the number of computers available for use was sufficient, it can be concluded that the libraries have enough computers available for patrons to use. As was indicated earlier, usage of the electronic information resources was not restricted to in-house use only as those users with Internet access could access the Web databases from locations other than the libraries by using their own computers or using the computer local area networks available on the two campuses. This of course would assist in easing or avoiding any potential congestion with regard to computer usage in the libraries. Using the server's hard drive as a storage device is indicative of the libraries' attempts to make the electronic information resources available online as much as possible. Patrons only needed to have the requisite privileges to access the server for them to have access to the electronic information resources on the server's hard drive.

6.4.4 What strategies for metadata preservation are used in EIRs management?

The results revealed that a majority of respondents were not aware of what metadata strategies were being used in their libraries to preserve the electronic information resources with regard to

both University of KwaZulu-Natal e-theses and the electronic information resources that much depended on the supplier such as e-books and e-journals. With regards to an electronic information resources management policy, a majority of the respondents stated that their libraries did have such a policy. The results also showed that there were an arguably high number of respondents (10) who indicated that their libraries did not have an electronic information resources management policy. For those respondents who said that their libraries do have a policy, the vast majority indicated that the policy did provide guidelines for acquiring materials in digital form and for converting materials from print to digital form. Four respondents indicated that the policy provided guidelines for storage. It was also evident that the electronic information resources management policy or regulation met the libraries' current needs as only one of the 16 respondents to whom this question was directed responded in the negative.

It can therefore be concluded that there are a majority of respondents who did not know what was going on in their libraries in terms of links preservation due perhaps to their not being involved in the links preservation of the electronic information resources. However, this might be a problem because even librarians who are not directly involved in electronic information resources management should be aware of the metadata strategies that are used in their libraries as well as the policy that is guiding them in doing so (there were only a few who seemed to know what guidelines the electronic information resources management policy provided). The issue of training of staff is again pertinent here.

6.5 Recommendations

The recommendations below are based on the findings of the study and the conclusions reached. It is anticipated that the recommendations relating to staff training and development will contribute in improving the information and communication technology knowledge and skill of the librarians in the management of electronic information resources on the Pietermaritzburg and Howard College campuses of the University of KwaZulu-Natal.

- **Staff training and development**

It is evident that majority of the staff working in these libraries do not consider themselves sufficiently skilled in managing electronic information resources. Therefore there is a need for

training and skills development in information and communication technology with regards to electronic information resources management for all the staff involved in such management. In particular, metadata techniques, migration techniques, emulation techniques, maintenance techniques and bit preservation techniques need to be emphasized in such training. This should not be overlooked as complete obsolescence of the technology that exists needs to be avoided.

It was found that only a few staff got training more than once a year while others are not trained at all. It is thus recommended that in order to keep pace with technological changes staff training should take place at least once a year.

The library director, managers and supervisors should be aware of the entailment of the staff training and development legislation in South Africa, particularly the Skills Development Act, 1998. Putting this legislation into account there should be no reasons, such as lack of funds, to prevent the staff from getting information and communication technology training that relates to electronic information resources management.

A needs analysis should be done to establish individual and organizational strengths and weaknesses in terms of information and communication technology knowledge and skills with regards to management of electronic information resources in each of the University of KwaZulu-Natal libraries. This should be done periodically.

- **Budget**

It is evident that the given libraries have insufficient funds set aside for electronic information resources management. While acknowledging the financial constraints which libraries are working under it is nonetheless recommended that library management give urgent attention to the funding of electronic information resources management activities including staff training. For example, there is a need for backup generators, with the exception of EGM Malherbe Library, to be installed in all libraries and, in particular the Cecil Renaud Library which is the main library on the Pietermaritzburg Campus.

- **Human resources**

All the libraries represented in this study depend on only one electronic librarian to maintain the links of the electronic information resources. This is risky because when he or she is on leave/sick it means there is no one to back up the position. Therefore, the chances for electronic

information resources being inaccessible are high due to links being down/not available. In addition, given the increasing importance of electronic information resources in terms of the resource base of the libraries, it is thus recommended that consideration be given to employing additional electronic/systems librarians. Again, financial constraints are recognized in putting forward this recommendation.

6.6 Recommendations for further research

- A similar study should be done at the libraries of University of KwaZulu-Natal not included in this study in order to determine how these other libraries are dealing with electronic information resources management activities.
- An evaluation of electronic information resources services provided by the libraries from the perspectives of both academic staff and students could be done. Findings could well re-enforce those of the present study and give weight to the recommendations made above.
- Determining the information and communication technology staff training and development needs in relation to electronic information resources management could be the focus of a study which could give weight and further insight into the recommendation regarding staff training above.

6.7 Summary

The Chapter provided an overview of the entire study. Conclusions about the findings were discussed as well as the recommendations to improve the electronic information resources management together with recommendations for further researches were provided.

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APPENDICES

Appendix 1: Cover letter to the respondents

17th September 2013

Dear Respondent,

My name is George F Kavishe a master's student at the UKZN carrying out a research on: “**Management of electronic information resources (EIRs) to enhance their long-term links preservation and access in the University of KwaZulu-Natal (UKZN) Pietermaritzburg (PMB) and Howard College campus libraries.**”

The purpose of this questionnaire is to assess your knowledge and understanding of digital preservation in UKZN PMB and Howard College libraries. Please note, however, that this is not a formal test. Please try to answer the questions as best as you can. If you do not know or are unsure of an answer, it is not a problem – please simply indicate this on the questionnaire or you are welcome to leave it out. I would like to remind you that there is no right or wrong answer in completing this questionnaire.

Any information that is obtained in connection with this study and that which will be identified by you will remain confidential. Disclosure of information will only be done with your permission. Please note that your name will not be included in the report and your participation in answering the questions is completely voluntary. You have the right to withdraw at any time in the process.

You are kindly asked to answer all questions to the best of your ability.

Please complete the questionnaire by not later than 30th September 2013. I will physically come and collect the answered questionnaires from you.

Thank you.

Yours sincerely,

George FirminKavishe.

Masters student

UKZN Pietermaritzburg campus

Spuna43@yahoo.com / 212556842@stu.ukzn.ac.za

Supervisor:

Mr Athol Leach

Telephone: 031 260 5098

Leach@ukzn.ac.za

HHSREC:

Ms P. Ximba

Telephone: 031 260 3587

ximbap@ukzn.ac.za

Appendix 2: Informed consent form

Title of study:

“Management of electronic information resources (EIRs) to enhance their long-term links preservation and access in the University of KwaZulu-Natal (UKZN) Pietermaritzburg (PMB) and Howard College campus libraries”

I,, hereby consent to participate in the study as outlined in the document about the study/ as explained to me by the researcher.

I acknowledge that I have been informed about why the questionnaire/interview is being administered to me. I am aware that participation in the study is voluntary and I may refuse to participate or withdraw from the study at any stage and for any reason without any form of disadvantage.

I.....acknowledge that I understand the contents of this form and freely consent to participating in the study.

Participant

Signed:

Date:.....

Researcher

Signed:

Date:

Appendix 3: Questionnaire

Please note that electronic information resources for the purposes of this study refer to e-journals, e-theses, e-books and databases

- 1.) Please complete this questionnaire as honestly as possible.
- 2.) Please answer all the sections in the questionnaire.
- 3.) To ensure anonymity, you are not required to write your name on the questionnaire.
- 4.) Please tick the square bracket(s) representing your choice (s) or answer(s) to each question and/or write your answers in the space provided. Should you need more space to write your answer(s) use the back of the questionnaire, but please make sure that you indicate the number of the relevant question.

SECTION A

General information

1.) Please indicate at which library you work.

- | | | | |
|---------------------------------|-------|--------------------------|-------|
| The Cecil Renaud Library | [] | The Law Library | [] |
| The Life Science Library | [] | The EG Malherbe Library | [] |
| The Eleanor Bonna Music Library | [] | The Architecture Library | [] |
| The GMJ Sweeney Law Library | [] | | |

2.) Please list your professional library qualification(s) and the year(s) in which you obtained it or them.

.....
.....
.....

3.) Gender

- Female [] Male []

4.) Age

- 20 - 29 years [] 30 - 39 years [] 40 - 49 years [] 50+ years []

5.) Please list what you consider to be the three main duties or tasks of your work.

.....

.....
.....
6.) Does your library manage its own budget?

Yes [] No []

If “Yes” how much of the budget is devoted to the management of electronic information resources?

Don’t know [] R 10, 000 – R 49, 000 []

R 50, 000 - R99, 000 [] R 100, 000 – R 249, 000 []

R 250, 000 – R 499, 000 [] R 500, 000 – R 999, 000 []

More than – R 1, 000, 000 [], please specify the figure.....

7.) Do you consider the amount sufficient?

Yes [] No []

SECTION B

Continuous access to electronic information resources

8.) Does your library have a standby generator in case of power failure?

Yes [] No []

9.) If “No” how is continuous access to online resources from your library in the case of a power failure ensured?

.....
10.) Occasionally, libraries might have older versions of browsers installed on public PCs, while the databases are designed for the newer versions. Does your library ensure that the Web browser used by the patrons inside the library is always up to date?

Yes [] No []

11.)How are electronic information resources in your library made available for patrons use? (Please tick only one option)

Fully accessible to the public online [] In-library access for library patrons []

Accessible only to authenticated patrons online [] Not accessible to patrons []
Other []

If “Other” please explain how your electronic information resources are made available for patrons use:

.....
.....

12.) In your library, are electronic information resources accessible via a Web database or in-house only?

Web databases [] In-house only []

13.) Does your library ensure that the links of electronic information resources such as databases, e-journals and e-books which are very much dependent on the supplier are always up/ available for continuous access?

Yes [] No []

If “Yes” please provide details on how your library ensures this:

.....
.....
.....

14.) If “No” who carries out the maintenances of the links when the links to electronic information resources are down? Please also indicate how long it takes the company/person to respond and resolve the problem once they have been informed.

.....
.....
.....

SECTION C

ICT skills and training of staff in the management of electronic information resources

15.) Do you consider yourself to be sufficiently skilled in electronic information resources management?

Yes [] No []

16.) If “Yes” how often does the library train you to meet the technological changes?

More than once a year [] Every 2 years [] Every 3 years []

Every 4 years or more [] Not at all []

17.) Irrespective of your answer to question 15 above, what techniques below do you think you need training in? (*Migration is the transferring of electronic materials from one technology to another or from one format to another and emulation is the technique involved in creating programs that are compatible with modern technologies*) (Please tick those that are applicable)

Techniques	
Migration techniques	<input type="checkbox"/>
Emulation techniques	<input type="checkbox"/>
Maintenance techniques	<input type="checkbox"/>
Metadata preservation techniques	<input type="checkbox"/>
Bit preservation techniques	<input type="checkbox"/>

Other (please specify):

18.) What do you consider to be the highest level of knowledge available among the staff in your library for electronic information resources management activities?

Expert [] Intermediate [] Novice [] None []

19.) Does your library currently utilize external expertise (e.g. consultants) for management of electronic information resources?

Yes [] No []

SECTION D

Information and Communication Technology (ICT) infrastructure used in management of electronic information resources

20.) How many computers does your library have for patrons to access electronic information resources?

Less than 5 [] 5-10 [] 11-15 []
 16-20 [] More than 20 []

21.) Which of the following devices does your library use to store electronic information resources which it has received in digital form and those that it has digitized? (Please tick all the applicable options).

Server's hard drive [] Magnetic tape (open reel) []

Magnetic tape (cassette or cartridge) [] Compact Disk-Read Only Memory []

Optical Disk (Re-writable) [] Write-Once-Read-Many optical disk []

Don't know [] Other []

If "Other" please specify

SECTION E

Strategies and storage methods for managing electronic information resources

22.) Which of the following strategies of metadata preservation are covered by your library in terms of preserving the UKZN e-theses that are both born digital and digitized(Please tick those that are applicable).

Emulation [] Migration [] Maintenance [] Don't know []
Other []

If "Other" please specify

23.) Which of the following strategies of metadata preservation are covered by your library in terms of links preservation of the electronic information resources such as the databases, e- books and e-journals which are very much dependent on the supplier? (Please tick those that are applicable).

Emulation [] Migration [] Maintenance [] Don't know []
Other []

If "Other" please specify

24.) Does your library have an electronic information resources management policy or regulation/s?

Yes [] No []

25.) If "Yes" does the policy or regulations provide guidelines for: (Please tick all that apply)

Acquiring materials in digital form [] Storage []

Converting materials from print to digital form []

26.) If you answered "Yes" in the question 24, how well does this policy or regulation/s meet your library's current needs?

Well []

Adequately []

Poorly []

SECTION F

Perceptions of library’s involvement in electronic information resources management

27.) My library’s level of involvement in electronic information resources management activities has been limited by: (Please tick the appropriate options)

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Concerns about technology obsolescence					
Insufficient policy or plans for preservation					
Lack of staff with digital preservation/ technological expertise					
Insufficient electronic resources for preservation					

28.) Are there factors, not listed above, which have limited your library’s level of involvement in electronic information resources management activities?

Yes [] No []

If “Yes” please briefly describe three factors:

.....

.....

.....

29.) Do you have any further comments, regarding the overall management of electronic information resources in your library?

Yes [] No []

If "Yes", please comment:

.....

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.....

.....

Thank you very much for your participation!!!!!!