eResearch Support: An Exploratory Study of Private University Libraries in Nairobi County, Kenya

By

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DECLARATION

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ABSTRACT

This exploratory study was carried out in Nairobi County, Kenya to investigate the role of private university libraries in supporting eResearch. The study used a multiple-case study design involving six private chartered universities that included Africa International University, Africa Nazarene University, the Catholic University of Eastern Africa, Daystar University, Pan Africa Christian University, and the United States International University. The following research questions were addressed: How do the organisation structures of the university libraries support eResearch? What positions in the organisation structure and competencies are available for coordinating eResearch? How is curation, analysis, and provenance (Metadata) of both basic data and information produced by research achieved? What problems of data management, organisation, dissemination, and preservation exist and how can they be addressed? What procedures, tools, and policies are used to promote eResearch? What is the inclination of library and academic staff towards eResearch?

The study was underpinned by two theoretical frameworks namely: The Purdue University Libraries (PUL) model and the eResearch Capability Model (eRCM) respectively. A pragmatic paradigm was adopted, which provided a basis for the use of mixed methods encompassing qualitative and quantitative approaches. The unit of analysis consisted of PhD students, Faculty, University Librarians, Reference Librarians, and Institutional Repository Managers. PhD students and Faculty are the most active group in research in the universities. Librarians on the other hand, are involved in providing eResearch support. Self-administered questionnaires were used to collect data from 306 PhD students, 462 Faculty members, 13 Reference Librarians, and 7 IR Managers, while interviews were used to collect data from the University Librarians.

Quantitative data were analysed using SPSS version 21 to generate descriptive and inferential statistics, while qualitative data were analysed using content analysis. Validity was enhanced through deriving questions from the set objectives, reviewing and adopting methodologies from previous studies and application of a multiple-case design to enhance generalisabilty of the results. Reliability was ascertained through pre-testing of the survey questionnaires and subjecting it to Cronbach's Alpha where a coefficient Alpha of 0.895 was achieved indicating a high reliability. The study complied with research ethical protocols of the UKZN and permission

was sought and granted from all the universities that were surveyed. Consent was also obtained from respondents prior to involving them in the study.

The findings of the study showed that the university libraries had stringent organisational structures, conventional library set ups, and lacked roles specifically designated to facilitate eResearch support. The findings also revealed that the libraries generally did not have staff with competencies to provide eResearch support. Therefore, research data management service was not provided by the university libraries. Several challenges in relation to data management were identified which included the lack of strategies and policies to guide data management support, the lack of integrated and realigned eResearch policies, the research process was fragmented, meaningful collaborative support towards eResearch within the universities and externally had not been established, and there were limited ICT policies and infrastructures. Finally, the findings revealed a general positive attitude and willingness towards eResearch from the librarians and the researchers at large but the eResearch environment was yet to be institutionalised.

The study proffers among other recommendations a review of the libraries' organisational structures to facilitate eResearch; an advancement of librarians' competencies through formal and informal structures to empower them to effectively support eResearch; libraries should assist researchers to create data management plans; there is a need for libraries to institutionalise RDM as a core library service; there is a need for an elaborate ICT policy to ensure appropriate tools are available to enable eResearch; the need to create awareness and advocacy about eResearch among stakeholders, and the libraries must carry out needs analysis to understand the stakeholders needs properly in order to create a conducive environment for eResearch.

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"No one can whistle a symphony. It takes a whole orchestra to play it" – H.E. Luccock

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DEDICATION

"*Mum, have you finished writing your chapter, can we play house*?"

To a young girl, for having to learn and use scholarly terminologies in our conversations at a tender age, as no dictionary provided me with child-friendly synonyms. The one person, whose "interruptions" of my academic journey felt like the much needed pauses that fuelled my sanity.

Evita, you are simply awesome!

- *Mum*.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AAU	Association of African Universities
AIBN	Australian Institute for Bioengineering and Nanotechnology
AIU	Africa International University
ANDS	Australian National Data Service
ANU	Africa Nazarene University
APCs	Article Processing Charges
CHE	Commission for Higher Education
COP	Community of Practice
CPD	Continuing Professional Development
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
CUE	Commission of University Education
CUEA	Catholic University of Eastern Africa
DCC	Digital Curation Centre
DDI	Data Documentation Initiative
DERM	Department of Environment and Resource Management
DIRISA	Data-Intensive Research Infrastructure for South Africa
DMPs	Data Management Plans
DOAR	Directory of Open Access Repositories
DOI	Diffusion of Innovations
DOI	Digital Object Identifier
ECU	Edith Cowan University
e-IERG	e-Infrastructure Reflection Group
EIFL	Electronic Information for Libraries
ERA	Excellence in Research for Australia
eRCM	eResearch Capability Model

eRIC	eResearch Infrastructure and Communication
ETA	Enhanced Technology Acceptance
EU	European Union
GB	Gigabyte
GDP	Gross Domestic Product
HEIs	Higher Education Institutions
HPC	High Performance Computer
IBM	International Business machines
IBM SPSS	International Business machines Statistical Package for the Social Sciences
ICTs	Information and Communication Technologies
IDCT	Information and Distributed Computing Technologies
IL	Information Literacy
INASP	International Network for the Availability of Scientific Publications
IPR	Intellectual Property Rights
IR	Institutional Repository
IT	Information Technology
JISC	Joint Information Systems Committee
KAG	Kenya Assemblies of God
KCA	Kenya College of Accountancy
KENET	Kenya Education Network
KLA	Kenya Library Association
KLISC	Kenya Library and Information Services Consortium
LIASA	Library and Information Association of South Africa
LMS	Library Management System
LOYA	Library of the Year Awards
MIT	Massachusetts Institute of Technology
M.IT	Master's in Information Technology

MS	Microsoft
NeCTAR	National eResearch Collaboration Tools and Resources
NeDICC	Network of Data and Information Curation Communities
NGOs	Non-Governmental Organisations
NREN	National Research and Education Networks
NRF	National Research Foundation
NSF	National Science Foundation
OA	Open Access
OPAC	Online Public Access Catalogue
OpenDOAR	Open Directory of Open Access repositories
ORCID	Open Researcher and Contributor ID
OST	Office of Science and Technology
PAC	Pan Africa University
PC	Personal Computers
PDF	Portable Document Format
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
PUL	Purdue University Libraries
QUT	Queensland University of Technology
RDM	Research Data Management
RDA	Research Data Australia
RDS	Research Data Services
R&D	Research and Development
RFID	Radio Frequency Identification
RIN	Research Information Network
RLUK	Research Libraries UK
RSS	Really Simple Syndication

SA	South Africa
SADA	South African Data Archive
SANParks	South African National Park
SARIS	South African Research Information Services
SCT	Social Cognitive Theory
SDI	Selective Dissemination of Information
SPSS	Statistical Package for the Social Sciences
SSRN	Social Science Research Network
STEM	Science, Technology, Engineering, and Math
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
TUC	Tangaza University College
UCT	University of Cape Town
UIUC	University of Illinois at Urbana – Champaign
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-Habitat	Unite Nations Human Settlements Programme
UNISA	University of South Africa
UNSW	University of New South Wales
UON	University of Nairobi
UP	University of Pretoria
URL	Uniform Resource Locator
USA	United States of America
USIU	United States International University

UTAUT	Unified Theory of Acceptance and Use Theory
VREs	Virtual Research Environments
VUW	Victoria University of Wellington
Wits	Witwatersrand

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The revolution in new information and communication technologies (ICTs) including advanced electronic networks, cloud and grid computing, big data, collaboratories among others have presented novel ways and methods of conducting research involving huge data sets (Fernihough, 2011:1; Thomas, 2011:37). This paradigm shift of conducting research electronically is being referred to as eResearch. eResearch has been popularised since 2000 (Appelbe & Bannon, 2007:83) and has assumed many labels such as cyber-infrastructure in the United States America (USA), e-Science in the United Kingdom (UK), e-infrastructure/the *grid* in the European Union (EU) and eResearch in Australia (Tavakol, 2012:141; Schroeder, 2007:3; Borgman, 2006:359; O'Brien, 2005:64). Tavakol (2012:141) attributes these differences in terminologies to etymologies rather than distinct concepts.

eResearch by definition, therefore, refers to "the development of, and the support for, advanced information and computational technologies to enhance all phases of research processes" (Luce, 2008:43). Karume and Omieno (2011:636) assert that eResearch involves the process of conducting research in virtual communities that cut across academic and industries by using specially designed online technical facilities and services which facilitate the sharing, federation and exploitation of global scientific facilities supported by technical framework among virtual community research members regardless of their locality.

Jankowski (2009:7) is of the view that eResearch is not necessarily predicated on the application of "high-speed computers for processing large datasets", but rather, the integration of a wide range of "new media and electronic networks in the research process". Fernihough (2011:2) is of the view that eResearch facilitates the application of ICT infrastructure to enhance research and scholarly collaborations among researchers particularly on a global and national scale, thus altering "the ways in which scientists carry out their work, the tools and workflows they use, the types of problems they address, and the communications resulting from their research" (Luce, 2008:42). Appelbe and Bannon (2007:84) argue that though there is a common belief that eResearch is about using information technology (IT) tools to support research projects, it is not

just about the use of IT, but rather, reliance on IT and organisational changes such as online collaboration "made possible by the internet and data and computational grids" to achieve research outcomes.

Sargent (2006:v) posits that due to the increased interactions emanating from research collaboration across disciplines, eResearch increases efficiency and effectiveness of research output. Further benefits resulting from eResearch include: opportunities to develop new areas of valuable research; opportunity for researchers to harness the capacity of ICT such as high capacity distributed computing and storage capacity (O'brien, 2005:66); enhanced access to shared data and document repositories, tools, and services (Borgman, 2006:359); an opportunity to advance social sciences and the humanities through innovations and new discoveries (Luce, 2008:43).

1.1.1 Overview of some Global eResearch Initiatives

Considering its significant impact to the society, eResearch has attracted the interest of nations, organisations, educational institutions, and individual researchers across the globe. Chiware and Mathe (2015:2) state that global scientific research outputs have been on the rise driven by economic and social benefits derived from research and due to enhanced collaborations among scientists across borders and disciplines. Consequently, there has been increased funding from national governments and funding agencies. This funding is not only meant to support IT infrastructures but also human and organisational resources such as the "training and retraining of scholars, the management and operation of the technical facilities that make up the IT environment and the scholarly tools that are integrated with it, and the performance of data curation and preservation." Ribes and Lee (2010:231) assert that significant effort in terms of funding and technological development for eResearch has been witnessed especially in the USA and Europe.

In Europe, the pan-European research network evolved in 1993 under EuropaNET connecting 18 countries with the aim of augmenting research collaborations. The EuropaNET was enabled through the National Research and Education Networks (NRENs) consortium. This project evolved over the years and covers 34 countries thus propelling Europe to the centre of global research networks (Karume & Omieno, 2011:634).

In 2001, the UK officially launched an e-Science program (Lynch, 2008:1) which became instrumental in leading the world into the creation of a "coordinated, multidisciplinary research and development programme using an emerging set of technologies that were set to enable large-scale collaboration and resource sharing". The program, however, "focused on handling the data deluge that was enabled by new parallel and high-throughput experimental practices". Grid computing technologies proved to be significant drivers in the e-Science infrastructure as it enabled the distribution of "data and computational resources [that were] combined in 'virtual organisations' in order to process the large data volumes, models and simulations".

The ARCHER project funded by the Australian Government's Department of Education, Science and Technology in 2006 aimed at addressing eResearch concerns that had emerged at the time which included "high levels of data produced by researchers, challenges in collaborations due to increased data quantities, need for online publishing, security and privacy in eResearch, and a need to streamline eResearch workflows" (Androulakis, Buckle, Atkinson, Groenewegen, Nicholas, Treloar & Beitz, 2009:23). The program provided infrastructure to researchers that enabled the collection, storage and management of data; software for data and information management; a customisable and adaptable web portal for collaborations; secure standards for storing, accessing, and analysing research results and tools for sharing datasets and information (Androulakis *et al*., 2009:31).

eResearch Infrastructure and Communication (eRIC) is a joint project that facilitates "integrated communication and data management infrastructure for accompanying the complete lifecycle of knowledge generation and transfer" (Mitscherling, 2014). eRIC is a joint effort by information specialists the world over. In Germany, South Africa and Thailand, academic and research libraries are jointly working with systems developers, IT specialists and researchers in the development of software platforms that support research data management (RDM) using the eRIC infrastructure with each institution having ownership on the development of the platform, but ideas can be shared across the board (Chiware & Mathe, 2015:4).

Apart from technologies and collaborations, open science (or e-science) has been advocated for largely on the global front. The need for putting out research enhances the sharing and re-use of

research output. Hall, De Roure and Shadbolt (2009:993) assert that researchers anticipate "to find any recent publication on the Web either directly from the publisher or via the author's website or appropriate open access repository"; a shift that has changed research culture driving developments towards the creation of integrated research repositories "that can be analysed to present a comprehensive picture of the latest state of the art in the various research fields, including detailed citation analyses."

Research funding bodies and non-governmental organisations (NGOs) alike have advocated for open science. Science Commons, for instance, advocates for e-science on the level of research policy. Groups like the e-Infrastructure Reflection Group (e-IERG) which consists of national representatives of EU governments similarly aim to inform policy and advocate for open science. Furthermore, they argue that Intellectual Property Rights (IPR) is against research interests (Schroeder, 2007:3). Another area of focus has been on RDM whereby, funding agencies and national governments are pushing researchers to preserve and make data open and publicly accessible for re-use. Chiware and Mathe (2015:2) highlighted the National Science Foundation (NSF) in the United States of America (USA), the Australian National Data Service (ANDS) in Australia, and the e-Science Core Programme in the UK as some of the bodies that have pushed for national legislations for responsible research conduct and their policies have provided guidelines to institutions on how to enforce RDM.

1.1.2 eResearch Initiatives in the African Context

Narrowing down to Africa, eResearch has also taken root albeit not at the level of first world countries. Tavakol (2012:139) claims that the gap in African research and science would have deepened and widened were it not for the widespread introduction of IT into higher education research and science, which has presented new possibilities in terms of avenues that can be explored and put in practice. Karume and Omiemo (2011:632) assert that improved connectivity in African tertiary education will enhance research output to achieve parity with the rest of the world. However, they state that this equivalence can only be achieved through intensive collaborative activities, a situation that is being enhanced through the emergence of large-scale e-infrastructure projects in Africa.

Karume and Omieno (2011:632) define e-infrastructure as the "integration of technology and organizations that support research undertaken through distributed regional, national, and global collaborations enabled by the Internet. It comprises of grid computing software, which can provide researchers with shared access to large data collections, advanced ICT tools for data analysis, large-scale computing resources, and high-performance visualisation, among other examples. It embraces: networks, grids, data centres and collaborative environments, and can include supporting operations centres, service registries, single sign-on, certificate authorities, training, and help-desk services."

Examples of e-infrastructure projects that have provided an opportunity for the growth of eResearch in Africa include the UNESCO-HP and HP Catalyst. These projects were set up to enhance eResearch in Africa: the UNESCO-HP Brain Gain which was meant to address the issue of brain drain which impacts on education and development in developing countries. The project used Information and Distributed Computing Technologies (IDCT) to enable students from various countries to interact with experts in Diaspora by making each participating university a digital hub. Through this project, equipment, cloud computing technologies, training and support, as well as funding, were provided to the institutions. The UNESCO-HP initiated 17 Brain Gains in 21 Higher Education Institutions (HEIs) in 15 African countries: Algeria, Burkina Faso, Cameroon, Cote d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Morocco, Nigeria, Senegal, Tunisia, South Africa, Uganda, Zimbabwe (Karume & Omieno, 2011:637).

The HP Catalyst on the other hand, was meant to explore approaches in Science, Technology, Engineering, and Math (STEM) education through the combination of technology and expertise through an established network of leading educators, education institutions, and key stakeholders in four HEIs in Egypt, Kenya, Nigeria, and South Africa. The focus of these two projects was to enhance eResearch through enhanced collaborations among researchers in HEIs. Considering the challenge of sustainability after the funding phase, Karume and Omieno (2011:637) proposed that the involved institutions must work together to ensure training of the researchers on the use of the technologies and how to use them.

Compared to other countries in Africa, South Africa (SA) has taken leadership in the development and implementation of eResearch. This is evident in the initiatives that have taken place both at the national and institutional level. Van Deventer and Pienaar (2008) report that the South African government published a national research and development strategy for SA in 2002 that invited stakeholders concerned with research and its impact on the lives of South Africans. A call that resulted in the establishment of South African Research Information Services (SARIS) whose purpose is to provide a framework for eResearch services to South African researchers.

Chiware and Mathe (2015:2) report that in SA, there are several "national initiatives working towards formulating and implementing national frameworks on how academic and research institutions should develop and implement data management services". The National Research Foundation (NRF) is one of them. NRF is a government funding agency in SA that has also contributed immensely to the realisation of eResearch. This has been through the maintenance of the South African Data Archive (SADA) which has enhanced large-scale data sharing both locally and internationally and, maintenance of knowledge networking databases that facilitate access to research results, technology, and innovation in order to allow their utilisation. Chiware and Mathe (2015:3) state that in March 2015, the NRF "released a statement on open access for data retention, mandating that their funded research publications and supporting data be deposited in an accredited open access repository". This move necessitated that researchers must deposit their data and research outcome in a repository and this meant an increased need for libraries to be involved in the management of data repositories.

Some libraries in SA have taken up the initiative of supporting eResearch through the formulation of policies, infrastructure, training of library staff, holding awareness and advocacy campaigns with academic staff and researchers among others. Challenges that have been experienced include the availability of resources and infrastructures and limited skills among library staff (Chiware & Mathe, 2015:1). "Some funding agencies and research councils like the NRF and Council for Scientific and Industrial Research (CSIR) have been organising awareness and information-sharing workshops to build capacity among library professionals" (Chiware & Mathe, 2015:9). Chiware and Mathe (2015:3) report that some universities such as the University

of Cape Town (UCT), University of South Africa (UNISA), the University of Pretoria (UP), Stellenbosch and Witwatersrand (Wits) have made effort towards the realisation of RDM but critical challenges that require urgent attention are being experienced in the areas of leadership, policy and skills. Cape Peninsula University of Technology (CPUT) has been cited to be way ahead in the provision of RDM services. The university library has developed RDM services "on the premise that, within an eResearch environment, several components exist including: infrastructure development; information flow and management; communication with researchers; development of tools related to the full research lifecycle and the means to store, curate and retrieve data for further use; and the training of researchers" (Chiware & Mathe, 2015:4).

The impact of IT has also been felt in universities in Kenya with the majority of these universities striving to integrate technology in education and research in order to try and be at par with international practices. Government bodies such as the Commission of University Education (CUE) have played a critical role in the growth and development of universities and foreseeing the integration of quality standards in the services provided. CUE targets various aspects including the adoption of technology and has provided standards that university libraries should follow when being established, which includes installing of systems for data management, development and implementation of institutional repositories, and, provision of appropriate ICT to support information management among others (Commission for Higher Education[1], 2012:7). The Kenya Education Network (KENET) has also been instrumental in providing affordable internet bandwidth to universities in Kenya which has enhanced research activities (KENET, 2017).

Open access, which enhances research visibility, has also emerged in Kenya with university and research libraries making effort to build institutional repositories to make research output more accessible and visible. The Directory of Open Access Repositories, OpenDOAR indicates that there are 3342 repositories around the globe with only 25 listed from Kenya (OpenDOAR, 2017). The Kenya Library and Information Services Consortium (KLISC) in partnership with Electronic Information for Libraries (EIFL) and International Network for the Availability of

[1] The Commission for Higher Education (CHE) established under universities Act Cap 210B of 1985 was succeeded by the current Commission for University Education (CUE) established by an Act of Parliament, Universities Act, No. 42 of 2012 (CUE, 2017).

Scientific Publications (INASP) have played a critical role in conducting training workshops on open access (OA) to member institutions, which has led to about 30 institutions establishing Institutional Repositories (IRs) though at different levels of implementation (UNESCO, 2017). However, the progress has been slow due to barriers such as policy issues and quality control; lack of facilities/infrastructure; lack of technical expertise/inadequate funding; lack of commitments; sustainability and lack of sensitisation (UNESCO, 2017).

Essentially, eResearch is still at the infancy stage in the Kenyan context given that universities are currently still grappling with establishing and sustaining IRs. Compared to global initiatives, there is still a huge gap to be filled. Individual researchers in universities may be adopting technologies in their research process but with lack of support, the benefits of eResearch such as access to large data collections, advanced tools for data analysis, enhanced online collaborations, online publishing among others, may be far from being achieved. Looking at the global and South African examples, there seems to be a lot of initiatives to support eResearch, especially at the national level. However, this top-down approach, though vital, may not be sufficient to get the key stakeholders who are researchers into eResearch practices. This gap can be filled by academic libraries that have traditionally worked closely with researchers. This study, therefore, set out to understand how private university libraries in Kenya were supporting eResearch especially with regard to the implementation and management of data management systems and procedures, eResearch training programs, and eResearch ICT support and more.

1.1.3 University Landscape in Kenya

According to the latest published information by the Commission of University Education (CUE) on their website, Kenya has 30 public chartered universities; 18 private chartered universities; 5 public university constituent colleges; 5 private university constituent colleges; and, 13 institutions with a letter of interim authority (CUE, 2017b). The CUE is the statutory body responsible for monitoring and providing oversight of higher education institutions in Kenya.

A "charter" refers to a licence granted by the President under an Act provided in section 11(4) of the constitution of Kenya; "public university" refers to a university maintained or assisted out of public funds, while "private university" means a university established with funds other than public funds (National Council for Law Reporting, 2012:5). Thus, a public and a private

chartered university refer to universities that have been granted a licence by the president in accordance with provisions of an Act of parliament. The president grants a charter to a university upon determining that the institution meets the provision of the Act. Once a university is granted a charter, this information is published in the Kenya Gazette (National Council for Law Reporting, 2012:10) making the declaration an official government decision.

An institution with a letter of interim authority, on the other hand, means an institution has applied to be a university, and has been granted a letter under seal in a designated Form ACC/CHE 4 until it is suspended, revoked, or granted accreditation. The letter is granted by CUE upon determining that some merits have been met such as, no duplication has been made from existing universities (like no similar names); realistic plans are being followed by the applicant to achieve the objectives upon which the university will be set; and, the establishment of the university is in the interest of university education in Kenya (National Council for Law Reporting, 2012:10). The list of private chartered universities in Kenya is presented in Table 1.1.

Table 1.1: Private chartered universities in Kenya

	Private chartered university name	Year of establishment	Year of award of charter	Location of main campus (County)
1	Adventist University	-	-	Kajiado
2	University of Eastern Africa, Baraton	1989	1991	Nandi
3	Catholic University of Eastern Arica (CUEA)	1989	1992	Nairobi
4	Daystar University	1989	1994	Nairobi
5	Scott Christian University	1989	1997	Machakos
6	United States International University	1989	1999	Nairobi
7	St. Paul's University	1989	2007	Kiambu
8	Pan Africa Christian University	1989	2008	Nairobi
9	KAG – East University	1989	2016	Nairobi
10	Africa International University	1989	2011	Nairobi
11	Kenya Highlands Evangelical University	1989	2011	Kericho
12	Africa Nazarene University	1993	2002	Nairobi
13	Kenya Methodist University	1997	2006	Meru
14	Strathmore University	2002	2008	Nairobi
15	Kabarak University	2002	2008	Nakuru
16	Great Lakes University of Kisumu	2006	2012	Kisumu
17	KCA University	2007	2013	Nairobi
18	Mount Kenya University	2008	2011	Kiambu

(Source: Commission of University Education, 2017)

For any institutions to attain accreditation and become a university, the CUE must be satisfied that the institution concerned has adequate physical, human, library and financial resources, viable relevant academic programmes and sound structure of governance. "Accreditation of an institution in Kenya, therefore, demonstrates public acceptance and confirmation evidenced by award of a Charter, that a university meets and continues to meet the standards of academic excellence set by the commission" (CUE, 2017c).

1.1.4 University Libraries in Kenya

The establishment of university libraries in Kenya for both public and private universities is guided by the CUE standards and guidelines for university libraries in Kenya (Commission for Higher Education, 2012:7) in areas such as:

i) Policy formation that requires that these libraries should create visions and missions that support their parent institutions. A glance at the vision and missions available on the websites of university libraries in Kenya that are listed by the CUE (2017a) gives an indication that the libraries have a common intend to support research services, knowledge production, teaching and learning;

ii) Information resources which states that university libraries should provide varied up-to-date information resources to facilitate teaching, learning, and research and this includes the establishment and sustainability of institutional repositories;

iii) ICT resources whereby, the libraries are expected to develop ICT policies, establish ICT infrastructure that integrates with the university environment, install library systems that support data exchange using standard protocols and format, provide ICT hardware and software to facilitate information management needs, provide for digitisation and, provide competent staff to manage ICT infrastructure;

iv) Facilitate easy access to information by organising of information using recognised standards;

v) To ensure quality in service provision in order to facilitate teaching, learning and research;

vi) To provide appropriate library facilities in areas such as building, furniture, space, security among others;

vii) The libraries should ensure that they have appropriate, qualified and adequate staff to support library services and continuous training of these staff should be ensured;

viii) The library shall have an appropriate administrative structure to support its vision and mission and that of the institutions and;

ix) The university should provide an appropriate budget to support library services.

Another key area of development arising from the guidelines is in information literacy (IL) competency where the CUE requires that university libraries should work closely with the Faculty to provide instruction to library users to develop an information literacy policy; to design a curriculum that integrates the emerging needs of students and Faculty and shall also be responsible for training of IL (CHE, 2012:12). This endorsement provides the university libraries with room to create appropriate training programs that integrate emerging research issues. Frank and Pharo (2016:537) suggest further that data information literacy should include – "the skills needed to understand, use, manage, share, work with, and produce data." According to Ojiambo and Kasalu (2015:8), university libraries are centres of learning, teaching, research, and extension. Kavulya (2003:22) echoes the same view that the university library is directly responsible for the improvement of the quality of student output, maintaining and improving the standards of teaching, and facilitating research initiatives.

1.2 Statement of the Problem

In the face of technology advancements that offer opportunities to universities to enhance research practices, given their critical role in contributing to the research output of a country, Kenya's global research visibility is still wanting. Some effort has been made by various organisations in a bid to support eResearch endeavour. Government bodies in Kenya such as the CUE have provided standards to support ICT adoption in research and education in higher learning institutions in the country (CUE, 2017c). The KENET has provided affordable internet bandwidth to universities in Kenya in a bid to enhance research activities (KENET, 2017). The Kenya Library and Information Services Consortium (KLISC), has been instrumental in supporting the development and implementation of institutional repositories and training of librarians in order to enhance open access initiatives (UNESCO, 2017). Despite these efforts,

Kenyan universities are still lagging behind in terms of adopting and providing support to eResearch initiatives.

Generally, research and development (R&D) in Kenya has been stagnated by various factors that include (Nyerere, 2013:11-12 citing the Republic of Kenya, 2005): ineffective coordination between the various actors; poor harmonisation of research policies; limited research funding; de-linked R&D from development; limited appreciation for the role of R&D; limited research, especially applied research; inadequate mechanisms and arrangements for dissemination and utilisation of research findings; the absence of any up-to-date research bank of inventories and directories of what has been done or is being done; limited demand-driven and collaborative research between universities/research institutions and private sector/industries; weak institutional capacity in terms of human resources and equipment; and inadequate prioritisation of research vis-à-vis goals, aspirations and commitments.

Lu (2014:3) points out that countries with higher income levels are able to produce more world-class universities in ranking lists. Universities in countries with higher levels of Gross Domestic Product (GDP) for research and development such as the USA at 2.7% tend to perform well in research as evidenced in global rankings (the USA has 61 universities at the top 100 in the world in webometric rankings of 2017). This can be attributed to the support provided in areas such as research funding, appropriate infrastructure, national frameworks, capacity building, and skills development.

One has to agree with Thomas (2011:37) when he argues that "the merging of information and communication technologies (ICTs) with traditional research practices has created a new movement of eResearch, which generates new research methods emerging from increasing access to advanced networks, services and tools." Effective eResearch requires that technology is applied in all the phases of the research processes. Shaffer (2013:8) asserts that changes in scholarly publishing brought about by the revolution in ICTs offers new opportunities for researchers to share the products of their work in ways that weren't previously possible. According to Thomas (2011:46), it is now possible through ICT for researchers separated by time and space to engage in collaborative partnership in research projects and to share large data sets, as well as jointly generate scholarly output.

Pearce (2010:1191) recognises that "academic researchers have often utilised a wide range of information and communication technologies (ICTs) to collaborate with colleagues, carry out research, and communicate findings". Nevertheless, global research visibility for Kenya remains minimal as evidenced in web rankings such as the Webometrics rankings, with only four universities from Kenya appearing in the top 100 universities in Africa (Webometrics, 2017). Further, the extent of eResearch practices in the Kenyan universities also remains blurred. Academic libraries are better placed to spearhead eResearch in universities in Kenya. According to Carlson and Garritano (2010:8), "the changes in how research is done under the e-science paradigm will have an effect on how the library carries out its mission of supporting the research and information needs of the university". Thomas (2011:46) notes that academic libraries will be "compelled to rethink their workforce planning and service delivery models to incorporate these new practices".

In line with this, recent studies have underscored the need to deploy new information and communication media in the management of scholarly research. For instance, Moseti (2015) advocated for investment in institutional repositories, robust institutional support for research, the creation of an enabling research culture, and strong scholarly networks as crucial in promoting eResearch spaces. This study is therefore motivated by the need for evidence-based interventions in the spheres of policy framework, human resourcing, and infrastructure development to advance eResearch within universities in Kenya. The study, thus, investigates eResearch support in private university libraries in Nairobi County, Kenya.

1.3 Research Objectives

The specific objectives to be addressed include:

i. To examine the organisation structures available to support eResearch.
ii. To establish positions in the organisation structure and competencies for coordinating eResearch.
iii. To assess how curation, analysis and provenance (metadata) of both basic data and information produced by researchers are achieved to support eResearch.
iv. To find out the problems of data management, organisation, dissemination and preservation and how they can be addressed.
v. To determine the procedures, tools and policies for promoting eResearch.

vi. To explore the inclination of library and academic staff towards eResearch.

The research problems to be addressed relate to the broader issues of data science which involves the use of scientific methods of extracting insights from data; scholarly communications which involve means through which researchers create, share and publish research findings; digital repositories which are critical for the management and storage of data and information; and further advance open access of research findings. The areas to be studied have been derived from these broader issues which fall within the realm of eResearch and, impact on research processes as technology is adopted. Considering that the research focus was on the role of academic libraries, it was necessary to look at the capability of academic libraries in using technology to enhance eResearch.

1.4 Research Questions

The main research question this study sought to address was 'What is the role of private university libraries in Nairobi County, Kenya in supporting eResearch?' The following sub-questions drawn from theory and literature were addressed:

i. How do the organisation structures of the university libraries support eResearch?
ii. What positions in the organisation structure and competencies are available for coordinating eResearch?
iii. How is curation, analysis, and provenance (Metadata) of both basic data and information produced by research achieved?
iv. What problems of data management, organisation, dissemination, and preservation exist and how can they be addressed?
v. What procedures, tools, and policies are used to promote eResearch?
vi. What is the inclination of library and academic staff towards eResearch?

1.5 Significance of the Study

It is hoped that this study will contribute to the literature in eResearch in the African context by providing empirical evidence of the status of eResearch in selected private university libraries in Kenya. The study may serve to create more awareness about eResearch to librarians, researchers, and universities, and consequently may increase the application of technologies in research endeavours. The outcomes of this study may be of essence in the provision of guidelines that will enable libraries to have a greater focus and better-planned strategies in support of eResearch in

Kenyan universities. Furthermore, the study will inform the re-evaluation and re-strategising of policies to better enhance eResearch. University libraries will be greatly informed through this study, thus, enabled to evaluate their organisational structures and competencies in line with the new paradigms of research undertakings in academic institutions. The study should be useful in informing change of curriculum in information science schools to prepare emerging librarians better to face challenges and meet the constant changes in service delivery in libraries caused by evolving technologies, which impact education and research. The study should also be useful to prop up infrastructure developments in relation to eResearch initiatives not only at the university level, but also nationally.

1.6 Delimitations of the Study

This study had a focus on private universities in Kenya because of the evidential levels of ICT adoption and use in these institutions, thus, suggesting eResearch can be facilitated. Kavulya (2003:156) indicated that private universities are faster in adopting new technologies. Nganga reported on a study by CPS international that indicated Kenyan universities were ranked top in East Africa in ICT (Nganga, 2012). Examples of this include The Strathmore University which was ranked at the top in terms of IT adoption in Kenya by CPS International (Herbling, 2012). Strathmore University's IR also went live on the internet as an open access repository at a time when the majority of universities in Kenya were embarking on establishing IRs (Otando, 2012:4). As early as 2006, the United States International University (USIU) was accredited for pioneering e-learning and also had implemented Erudite, a library automation system which was later upgraded to Symphony Library Management System (LMS) in 2008 (Mwiria, 2007:172). Mwiria (2007:172) also reports about the Daystar University having invested in an ultra-modern broadcasting studio at the time. Another private university, the CUEA, has in recent times attracted attention as having the latest RFID technology implemented in the library and has consequently scooped the Library of the Year Awards (LOYA) thrice, twice at the first and once at the second position respectively. Essentially, the library, which is fully automated, has been credited with the integration of IT in its services (KLA, 2013). Two of the private universities libraries, CUEA and USIU, are also host to the KENET which is the NREN in Kenya (KENET, 2017). Given these examples, the researcher felt that private universities could have the potential to support the adoption and use of technologies in the research process.

This study was limited to private chartered universities in Nairobi County. Kenya has 47 counties according to Article 6(1) of the Kenyan constitution (National Council for Law Reporting, 2010:164-165). The Kenyan government operates on a devolved system that essentially entails the "transfer of fiscal, administrative, and political power from a highly centralised system of governance to a devolved system with two levels of governments – the national and the 47 county governments" (Government of Kenya, 2015: iii). Nairobi, one of the 47 counties, is the most single county that has a concentration of private universities with 9 out of the 18 private chartered universities in the country as reflected in Table 1.1. Nairobi also has an elaborate ICT infrastructure to support eResearch compared to other counties, which are largely rural-based. For instance, the KENET has set up a gateway for research e-infrastructures based in Nairobi. KENET also partners with the Kenya Library and Information Science Consortium (KLISC) and others to provide training for librarians (KENET, 2017). Nairobi County is also the capital of Kenya and is host to the Kenya national government as well as the regional headquarters of several international companies and organisations such as International Business Machines (IBM), United Nations Environment Programme (UNEP), United Nations Human Settlements Programme (UN-Habitat), and Cisco Systems among others that have contributed immensely to the growth and urbanisation of the County.

1.7 Preliminary Literature

A number of empirical studies have been conducted on eResearch in university settings around the world. The search strategy for the preliminary literature was focused on the role of academic libraries in supporting eResearch with the intent of finding literature that discusses holistic support for eResearch by academic libraries. Some e-journals and thesis were reviewed.

Tenopir, Sandusky, Allard and Birch (2014) conducted two separate studies on research data management in academic research libraries and perceptions of librarians with an aim of checking whether academic library directors in the USA and Canada and librarians had espoused research data services. The study found some misalignment between library policies on research data services (RDS) suggesting that provision of RDS were at the formative stages of development. They cited the need for awareness and training of the academic library community to enhance the development of these services.

Carlson and Kneale (2011) discussed the role of an embedded librarian in research, and highlighted that embedded librarians play a critical role by working closely with researchers throughout the research lifecycle rather than just getting involved in the final products. They highlighted lack of approaches to aid librarians in the processes of transitioning from a traditional to an embedded librarian and thus, provide guidance to aid this process.

Thomas (2011) in a case study of the role of the academic library in eResearch support at the Queensland University of Technology (QUT), found that the QUT had embarked on a project 'building eResearch support capabilities and capacity' which focused on understanding the QUT research needs and building effective eResearch support services with the library playing a key role. The key objectives of the project were to develop data management systems, and understand the researcher's needs. The outcome of the project consisted of an implementation of data management systems and procedures, the creation of eResearch training programs, and the creation of a research support website with updated information on new and emerging eResearch activities and technologies. The study recommended that academic libraries rethink their workforce plans and modes of service delivery to incorporate eResearch support effectively.

Genoni, Merrick and Willson (2006) investigated the use and impact of the internet in scholarly communication among academic staff and research students at the Curtin University in Western Australia. The study established that the respondents appreciated the application of internet in research, but indicated that it may not replace some traditional forms of scholarly communication. Moreover, the study established that the majority of the respondents still needed library services despite the ability to use the internet for scholarly communication. Librarians are, therefore, required to establish their new roles as members of the scholarly communities.

Carlson, Forsmire, Miller and Nelson (2011) reported on a study conducted at the Purdue University Libraries and Graduate School of Library and Information Science, at the University of Illinois, Urbana – Champaign (UIUC) to investigate research data needs and possible roles for librarians in facilitating data sharing and curation activities. Deficiencies in data management were identified in the areas of "metadata, standardizing documentation processes, maintaining relationships among data, ethics, quality assurance, basic database skills, and preservation" (Carlson *et al*., 2011:10-11). The study, thus, established there was a need for data literacy

education to enhance proper management of data and that the library has a critical role to play in training students and research Faculty about data management.

A study by Smith (2006) addressed eResearch needs of postgraduate students at higher education institutions within an increasing electronic research environment. A needs assessment was conducted to establish eResearch needs of postgraduate students at the University of Pretoria. The study established that postgraduate students in South Africa and throughout the world experience similar eResearch needs with regard to primary data sharing, transfer of data and computation, e-access, e-communication, e-training and e-publishing; and that understanding these specific needs would help academic libraries to create an appropriate electronic research environment.

African universities have witnessed low rankings in the world university rankings, which is based on scholarly research presence online. Studies such as Ezema (2013:324); Nwagu (2013:4); McKay (2011:251); Moahi (2009:1) and Mutula (2009:5) have indicated low international reach and visibility for African research output. McKay (2011:252) pointed out that, only "0.7% of all research findings come from Sub-Saharan Africa". Ezema (2011:474) proposed that institutional repositories present a chance for African countries to make their research visible globally, but pointing out Nigeria as an example, indicates that African countries have not positioned themselves appropriately in employing this method to disseminate research findings. However, South Africa (SA) has made some effort to enhance eResearch. Sithole (2016:67) notes that the past decade has witnessed SA investing in national cyberinfrastructure to enhance research and development for academic and research institutions. Nwagu (2013:6) asserts that SA stands out significantly in Africa as it has national statements about open access with the first conference on open access (OA) in Africa having been held in SA in 2005. Nwagu (2013:6) further states that all educational institutions in SA have OA initiatives. Chiware and Mathe (2015:3) on the other hand, reported that SA has made strides in RDM with academic and research libraries having introduced programs meant to facilitate the realisation of RDM services. Despite the effort made by SA towards eResearch, Nwagu (2013:8) states that, "its achievements from a continental perspective are dwarfed by the neglect of the movement in other countries". This suggests a need for other African countries like Kenya to develop and enhance eResearch initiatives so as to augment eResearch in the continent.

The preliminary literature presented above suggests that academic libraries are supporting scholarly communications and are calling for continuous eResearch skills development of researchers and research support staff, as well as the need for understanding researcher needs in order to effectively support eResearch. Moreover, it has been established that librarians need to work directly with researchers in the research process. It is evident that there is an increasing role of the library in eResearch, especially in developed countries. However, limited studies are available to provide evidence-based data on improving eResearch in university setups in developing countries such as Kenya. Besides, most emerging studies on eResearch seem inclined towards the role of the library in supporting data management practices in universities. Therefore, this study aims at building on existing research from a developing country perspective by looking at what other roles the library can play in eResearch guided by the eResearch Capability and the Purdue University Libraries models.

1.8 Theoretical Lens of the Study

Theories and models are useful in providing guidance on research design and the interpretation of research results (Kim & Crowston, 2011:3). Theories and models commonly used to underpin eResearch studies include among others: Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), Enhanced Technology Acceptance (ETA), Unified Theory of Acceptance and Use Theory (UTAUT), Diffusion of Innovations Theory (DOT), Social Cognitive Theory (SCT), eResearch Capability Model and, The Purdue University Libraries Model. This study was underpinned by the eResearch Capability model and, the Purdue University Libraries model.

The eResearch Capability Model was developed by a working group at the Victoria University of Wellington Australia. It provides a wide range of elements to be studied that are of great interest to an academic library involved or planning eResearch activities in an academic institution. This study focused on the six elements of the model namely: data; policy; processes; support; collaborations; and, tools in order to respond to the questions relating to data management systems, research processes and challenges related to RDM. The Purdue University Libraries model, on the other hand, was developed by the Purdue university libraries in their attempt to re-look the organisational structure and librarians' roles to determine their relevance in supporting eResearch. The Purdue University Libraries model was useful for this study as it sought to

investigate libraries organisational structures and librarians skills and competencies in supporting eResearch (See Table 1.2).

Table 1.2: Mapping research questions to sources of variables

	Research question	**Source**	**Key variables from the model**
1	How does the organisation structures of the university library support eResearch?	Purdue University Libraries model (Carlson & Garritano, 2010)	Library organisational structures.
2	What positions in the organisation structure and competencies are available for coordinating eResearch?	Purdue University Libraries model (Carlson & Garritano, 2010)	Staffing competencies; eResearch coordination.
3	How is curation, analysis, and provenance (metadata) of both basic data and information produced by research achieved?	eResearch Capability Model (Whakamuri, Whakaaro & Me Aro, 2014)	Research data management; Institutional repositories.
4	What problems of data management, organisation, dissemination and preservation exist and how can they be addressed?	eResearch capability model (Whakamuri, Whakaaro & Me Aro, 2014)	Research Data Management challenges.
5	What procedures, tools, and policies are used to promote eResearch?	eResearch Capability Model (Whakamuri, Whakaaro & Me Aro, 2014)	Policy**;** Processes**;** Support**;** Tools; Collaborations.
6	What is the inclination of library and academic staff towards eResearch?	Literature review (Tenopir *et al.*, 2014)	Perceptions; Attitudes.

A comprehensive discussion of the theoretical models used to study eResearch is provided in chapter two of this thesis.

1.9 Research Methods

The study was based on the pragmatic research paradigm which allows a researcher to apply "whatever works" based on the research question at hand rather than relying on worldviews and preferences pinned on research methods (Fraenkel, Wallen & Hyun, 2011:559). The study employed a mixed method approach which involved the use of both qualitative and quantitative approaches to obtain data from university librarians, Reference Librarians, IR managers, Faculty and doctorate students who formed the unit of analysis for the study. This study is a multiple-

case study, thus, the design provides a rich understanding of the status of eResearch support in private university libraries in Kenya.

Private chartered universities in Nairobi County offering doctorate programs were purposively selected for the study. This includes six private chartered universities (see Table 4.1). Convenience sampling was applied on the PhD students and the Faculty in the selected universities. Sampling sizes for PhD students and Faculty were determined using the survey monkey calculator. Six University Librarians, 13 Reference Librarians, 7 IR managers, 462 academic staff members, and 306 PhD students were targeted for the study (See Table 4.2). The study adopted structured interviews which were conducted on the University Librarians, a mix of closed and open-ended questionnaires were used to obtain data from the PhD students and Faculty, Reference Librarians and IR Managers (See Appendices 1-4).

The validity of the data collection instruments was enhanced by deriving the questions from the research objectives and related data collection tools used in similar studies (See section 4.9.1). External validity was countered by conducting a multiple-case study involving six universities to generate results that can be generalised to private chartered universities in Kenya. Reliability was achieved through pre-testing the instruments at the Tangaza University College and subjecting the results to Cronbach's Alpha to test for internal consistency. The qualitative data from interviews and the open-ended questions for the IR Managers were analysed using thematic content analysis. Quantitative data from the surveys were analysed using the SPSS. Qualitative data from the open-ended questions in the questionnaires for PhD students and Faculty were coded and analysed using SPSS where applicable, as well as using content analysis.

A research permit was obtained from the Kenya National Council for Science and Technology that allowed the researcher to collect data in Nairobi County, Kenya. Ethical clearance was sought from the University of KwaZulu-Natal and permission for data collection was obtained from the participating universities. Participants' consent was sought for them to participate voluntarily. Confidentiality of data collected and privacy of respondents was observed. A detailed discussion of the methods is presented in chapter four of this thesis.

1.10 Thesis Outline

The thesis is structured in seven chapters as highlighted below:

Chapter One: Introduction

Chapter one covers the background to the study, statement of the problem, research objectives, research questions, significance of the study, delimitations of the study, preliminary literature, theoretical framework of the study, introduction to research methods, and the dissertation outline.

Chapter Two: Theoretical Framework

Chapter two provides the theoretical framework chosen for the study with the main focus being on: eResearch Capability Model and the Purdue University Libraries model.

Chapter Three: Literature Review

Chapter three provides a review of related empirical and theoretical literature covering organisational structures, data management systems, staffing competencies, policies, processes, procedures, tools, perceptions, and RDM challenges. Gaps in literature are identified and how this study contributes to addressing them is outlined.

Chapter Four: Research Methodology

Chapter four discusses the research paradigm, research approaches, research design, and a population of study, data collection procedure, sampling method, validity and reliability of research instruments, data analysis techniques and ethical considerations.

Chapter Five: Data Analysis and Presentation of Results

Chapter five presents data analysis and results using inferential and descriptive statistics based on the themes of research questions.

Chapter Six: Discussion of Findings

This chapter discusses the findings using extant literature and theory. The originality of the study is also adduced.

Chapter Seven: Summary, Conclusion, and Recommendations

This chapter presents a summary of the findings, conclusion and, recommendations. Areas for future research are also provided.

1.11 Summary

This first chapter puts the research into perspective by providing an introduction and background of the study. The conceptual setting has been presented through introducing the meaning of eResearch and its status within the global and African settings. The context within which the study took place, has been addressed by discussing the case settings, that is, the specific universities that were selected for the study and the rationale for their selection. The chapter has further provided the problem for the study, the research objectives, research questions, significance of the study and the delimitations. A brief outline of the preliminary literature, theories and the research methods for the study was presented. The chapter finalises with an outline of the chapters for this thesis. It emerged in this chapter that eResearch is increasingly becoming crucial particularly in the university setting thus, necessitating academic libraries to be proactive in supporting its advancement. The next chapter presents the theories and models underpinning the study.

CHAPTER TWO
THEORETICAL FRAMEWORK

2.1 Introduction

Grant and Osanloo (2014:12) state that a theoretical framework "serves as the structure and support for the rationale of the study, the problem statement, the purpose, the significance, and the research questions". It provides a lens through which a researcher stands intellectually vis-à-vis the research questions and how data is to be viewed as it informs the data analysis process (Troudi, 2014:2).

A theoretical framework is particularly important for the literature review. Grant and Osanloo (2014:19) find that it can be used as a rational guide to develop and understand the different, yet interrelated parts of the literature review. According to Troudi (2014:2), it provides a basis through which the researcher's constructs being investigated in the research questions, can be defined and located in the literature review; thus, the researcher's views of the concepts under study can be established, explained, and justified. Kumar (2014:56) established the relevance of the theoretical framework in setting up parameters within which literature can be reviewed and indicated that information reviewed from literature should be sorted within a theoretical framework. He asserts that failure to this, there is a likelihood of losing focus in the literature search which can lead to a researcher getting bogged down to unnecessary reading and note-taking that is irrelevant to the study.

This study sought to explore eResearch support in private university libraries in Nairobi County, Kenya. The research questions that were addressed included the following: How do the organisation structures of the university libraries support eResearch? What positions in the organisation structure and competencies are available for coordinating eResearch? How is curation, analysis, and provenance (Metadata) of both basic data and information produced by research achieved? What problems of data management, organisation, dissemination, and preservation exist and how can they be addressed? What procedures, tools, and policies are used to promote eResearch? What is the inclination of library and academic staff towards eResearch?

"A theoretical framework can be made up of a combination of a number of elements belonging to more than one theoretical model" (Troudi, 2014:2-3). This study, for instance, has adopted the elements of organisational structure, staffing, competencies, and, eResearch coordination derived

from the Purdue University Libraries model. On the other hand, the study adopted the elements of data, policy**,** processes**,** support**, c**ollaborations, and tools derived from the eResearch capability model. This chapter discusses these two models that underpin this study. Prior to this, other complementary models that may underpin eResearch studies have also been highlighted in section 2.2 below.

2.2 Overview of Related Theoretical Models

A variety of models that have been used to study the different aspects of eResearch include: Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM), Enhanced Technology Acceptance (ETA), Unified Theory of Acceptance and Use Theory (UTAUT), Diffusion of Innovations (DOI) and, Social Cognitive Theory (SCT).

2.2.1 Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) and Theory of Planned Behaviour (TPB) (Ajzen, 1985)

TRA and TPB assume that an individual's behaviour can be predicted by their intention and determined by their attitudes and perceptions towards the behaviour (Montano & Kasprzyk, 2015:95). TRA was developed by Ajzen and Fishbein (1980) to predict and explain individuals' behaviour as well as understand their psychological determinants. According to Moore and Benbasat (1996:133), TRA specifies the relationships between beliefs, attitudes, and behaviours. Otieno, Liyala, Odongo and Abeka (2016:5) posit that the fundamentals of TRA originated from the field of social psychology in a bid to explain how and why attitude affects behaviour. For instance, TRA can explain an individual's behaviour if the use of innovation is driven by behavioural intentions.

On the other hand, TPB is an extension of TRA developed by Ajzen (1985) in order to address limitations in the TRA. Thus, TPB goes further to include perceived behavioural control over the performance of an individuals' behaviour (Montano & Kasprzyk, 2015:95; Al-Aulamie, 2013:10). Hamilton and White (2008) defined perceived behavioural control as the amount of control individuals believe they have over performing a behaviour. Hence, in the case of eResearch, these theories would apply to explain why individuals adopt and use technologies driven by their intentions for the adoption of those technologies in the context of research. These

theories were, therefore, not used for this study, as the study did not aim to address the researcher's behaviours in the adoption and use of technologies in research.

2.2.2 Technology Acceptance Model (TAM) (Davis, 1989)

Davis (1989) introduced a variant of TRA which was referred to as Technology Acceptance Model (TAM). TAM, rooted in the theory of reasoned action explores the constructs of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) that affect an individual's intention to adopt and use technologies (Davis, 1989; Oye, Iahad & Rabin, 2011:26; Moore & Benbasat, 1996: 134). According to Davis (1989), perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his or her job performance" and perceived ease of use for "the degree to which a person believes that using a particular system would be free of effort".

Adeyinka (2011), for instance, used TAM to examine user acceptance of e-library system considering the heavy investment that goes into electronic resources, yet they were not being used to the maximum. The findings of the study revealed that, "the acceptance constructs, ease of use, perceived usefulness, actual use, satisfaction, relevance, awareness, computer/internet self-efficacy, and social influence, significantly correlate with e-library acceptance". Use of e-resources is a significant aspect of eResearch in support of aiding researchers to formulate ideas for their studies. TAM would, therefore, be relevant in eResearch with regard to the exploration of why individuals adopt particular technologies for research in terms of how useful and how easy the selected technologies are. The perspective of user acceptance is, however, not within the scope of this study; thus, the theory was not adopted.

2.2.3 Enhanced Technology Acceptance Model (ETA) (Venkatesh & Davis, 2000)

ETA, also referred to as TAM2 (Technology Acceptance Model 2) builds upon Technology Acceptance Model in that it goes further to interrogate the factors that drive perceived usefulness in technology adoption, while incorporating constructs such as social influences and cognitive instrumental processes (Venkatesh & Davis, 2000). Similar to TAM, this theory would focus on reasons for choosing and adopting technologies in research in the context of eResearch. The theory was, therefore, not useful in meeting the objectives of this study, thus, were not adopted.

2.2.4 Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis & Davis, 2003).

The UTAUT model which has been widely used and cited was developed by Venkatesh, Morris, Davis, and Davis (2003) through reviewing and integrating eight other technology acceptance models namely: Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), the motivational model, Theory of Planned Behaviour (TPB), a model combining TAM and TPB, the model of PC utilisation, Diffusion of Innovations (DOI), and the social cognitive theory (SCT). According to Kusumarani (2014:8), UTAUT enables the assessment of new technologies in order to determine the chances they have to be successfully adopted and if not, what interventions such as training and marketing can be designed to enhance their adoptions.

Otieno *et al.* (2016:5) and Kusumarani (2014:9) state that UTAUT considers four constructs namely: performance expectancy, effort expectancy, social influence, and facilitating conditions that directly affect user's behavioural intention. UTAUT model also addresses several constructs such as gender, age, experience, and voluntariness of use that are likely to determine an individual's acceptance and use of technology (Kim & Crowston, 2011:5). Otieno *et al*. (2016:5) assert that having combined other theories, UTAUT deals with the challenge of contextuality through the addition of independent variables such as "individual characteristics (gender, motivation etc.), situational variables (experience, training etc.), or organizational characteristics (subjective norms)".

2.2.5 Diffusion of Innovations (DOI) (Rodgers, 2003)

DOI aims at understanding individuals' technology adoption using four elements of diffusion: innovation, time, communication channels, and social systems. Rodgers (2003) asserts that in innovation of diffusion theory, an individual's adoption behaviour is influenced by "advantage, compatibility, complexity, trialability, and observability of the innovation". According to Moore and Benbasat (1996:133), diffusion refers to the behaviour of accepting or rejecting an innovation.

Rodgers (2003:177) defines adoption as a decision of "full use of an innovation as the best course of action available", and rejection is a decision "not to adopt an innovation". On the other hand, he defines diffusion as "the process in which an innovation is communicated through

certain channels over time among the members of a social system". Sahin (2006:14) finds that these definitions express innovation, communication channels, time, and social system as key components of the diffusion of innovations. In this study, the aim is not to test technology adoption and diffusion; thus, the theory was not adopted.

2.2.6 Social Cognitive Theory (SCT) (Bandura, 1986)

Social Cognitive Theory (SCT) indicates that an individual's behaviour can be directly influenced by learning from others through social interactions and experiences (Kim & Crowston, 2011:5). Bandura (1977) asserted that, in SCT, outcome expectations and self-efficacy influence behaviour, and in reverse, they are influenced by prior behaviour. This theory asserts that an individual may adopt technology based on, for instance, how other individuals use or encourage the use of the technologies. Thus, the theory was not relevant to this study, since the impact of technology adoption based on relationships among researchers is not being tested in this study.

According to Kim and Crowston (2011:1), "the main research problem in ICT adoption and use research is why and how people adopt ICTs and use them". Kim and Crowston (2011:3) further posit that individuals' ICT adoption can be understood in three phases: i. Pre-adoption: offers a chance for individuals to examine new technologies then consider their adoption; ii. Adoption: the actual purchase or acquisition of technologies and using them; and, iii. Post-adoption: refers to the ability of individuals to continue using adopted technologies or otherwise abandoning them.

In as much as the ICT adoption models presented above (see sections 2.2.1-2.2.6) are useful for eResearch studies, particularly in examining how researchers are adopting and using technologies to conduct research, these models were not used for this study. This is because their focus is on adoption of the technologies rather than on research process using technology. In addition, the technology adoption models outlined above have been extensively used and may not be useful in generating new research outcomes. This study was informed by a combination of two models discussed below that were found to be relevant to the research problems.

2.3 Overview of Theoretical Models that Underpin the Study

Considering the need to investigate the processes in eResearch in universities in Kenya and especially with regard to the support being provided to researchers by university libraries, two theoretical models namely eResearch Capability Model and Purdue University Libraries model were adopted for this study.

2.3.1 eResearch Capability Model (Whakamuri, Whakaaro & Me Aro, 2014)

Victoria University of Wellington's (VUW's) quest to remain at the top of rankings in New Zealand in terms of research quality led to the realisation that they needed to integrate eResearch methodologies and services into their business processes (Whakamuri, Whakaaro & Me Aro, 2014:5). Consequently, the University's strategic plan of 2009-2014 had a provision for a platform to support the development and increase of eResearch support at VUW which included research and capability goals (Whakamuri, Whakaaro & Me Aro, 2014:10). Despite this provision, eResearch was not extensive. A document was prepared by the Director of eResearch and the Director of IT Services indicating a lack of support for ICT use in research with recommendations to have a working group to look into the issues.

An eResearch Strategic Capability Working Group was formed which looked into best practices and ongoing eResearch practices at VUW in order to recommend the way forward. This group envisioned a future in which researchers would be "able to access eResearch tools and support for all aspects of their research" (Whakamuri, Whakaaro & Me Aro, 2014:12). Furthermore, the working group created an eResearch Capability Model (eRCM) which comprises eight elements perceived as core enablers for effective use of ICT in research by researchers. The elements include data, policy, processes, tools, collaboration, computation, mobility and support as understood by the researcher (See Figure 2.1).

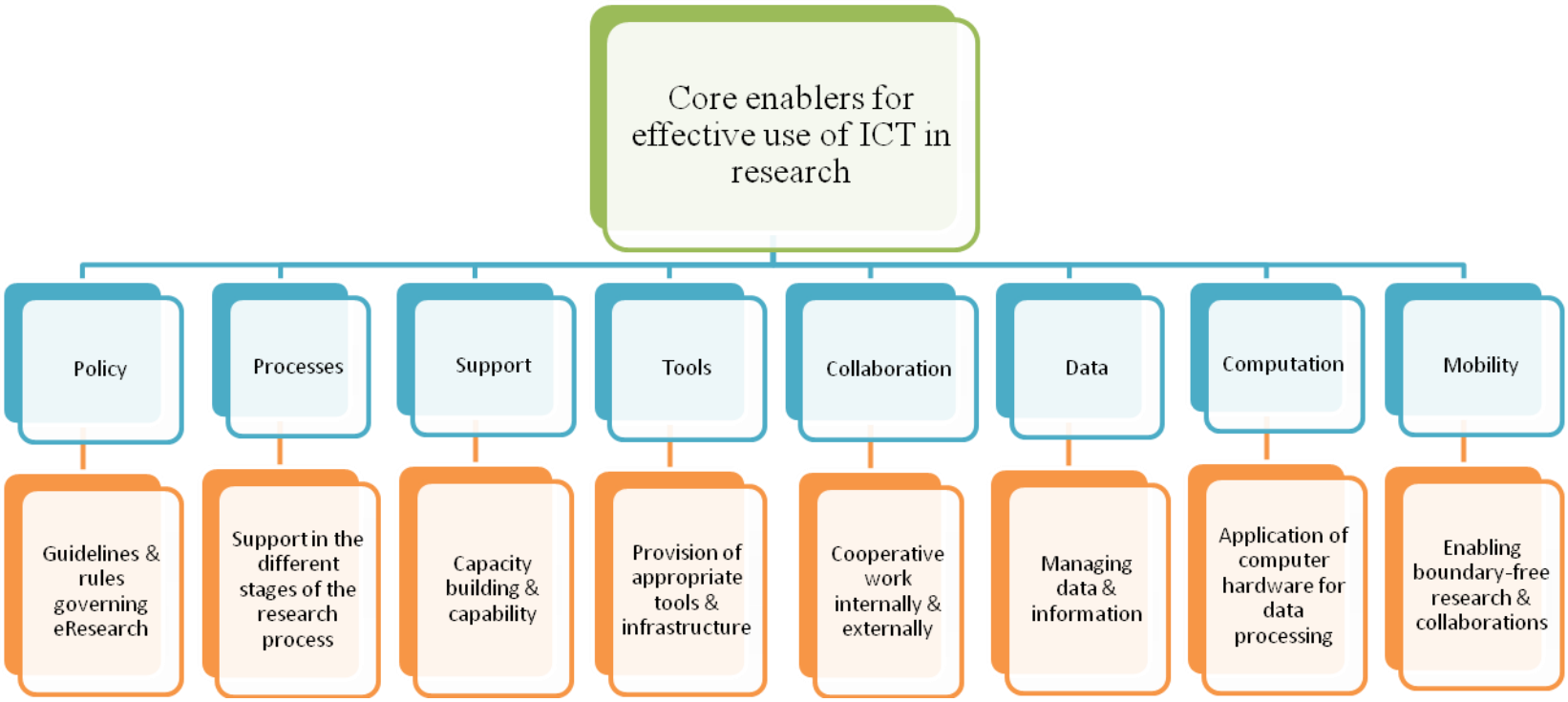

Figure 2.1: Elements of the eResearch Capability Model

Using these elements, an eResearch assessment was done at the VUW describing its eResearch capability at the time; furthermore, five-year targets for improvements were set for each element. Whakamuri, Whakaaro and Me Aro (2014:13-26) provide a detailed report on the assessment of each element which include policy, processes, support, tools, collaboration, data, computation and mobility which are briefly highlighted below.

i. Policy

"Policies are the guidelines and rules that govern what can and cannot be done within the University" (Whakamuri, Whakaaro & Me Aro, 2014:13). Policies provide a guideline on the university's position within the eResearch spectrum. The working group at VUW established that their policy was focused on old research practices and processes which hindered the support needed in the eResearch elements that had been identified. Some of their ICT policies were limiting researchers' engagement with national infrastructures and some relevant policies were also not available, such as a policy on RDM. The group recommended that eResearch policies and strategies should be created in order to build proficiency in eResearch methodologies.

ii. Processes

"Processes support the different stages of the research process from conceptualisation through to the dissemination of data and publication of results" (Whakamuri, Whakaaro & Me Aro, 2014:13). Adoption of eResearch approaches can significantly impact all the stages in a research process. At VUW, the working group found that some of the processes in the research lifecycle were supported, but the support was dispersed, and disconnected, and not principally developed to meet eResearch needs. The group recommended an improved process environment that would be achieved through increased collaborations between different research support groups whilst integrating their processes.

iii. Support

"Support is the organisational effort to ensure that research is undertaken and completed with little or no hindrance" (Whakamuri, Whakaaro & Me Aro, 2014:13). Effective support requires an organisational commitment to the development and sustainability of eResearch capability across the organisation. An assessment of eResearch support at VUW indicated that the library offered discipline focused research support through subject librarians and further, through the digital initiatives team, they provided digitisation expertise. Regardless, there was a low organisational commitment to eResearch awareness. It was recommended that there was a need to increase focus on eResearch support, services, and policies. There was also a plan to build

capacity and capability in eResearch at VUW, while considering the support provided by external services.

iv. Tools

"Tools are defined to cover the software applications, middleware and system architecture that enable and enhance research outputs" (Whakamuri, Whakaaro & Me Aro, 2014:13). The support for tools was found to be informal and inconsistent at VUW. Individual researchers acquired tools in an ad-hoc manner and generally, there was no strategy in the acquisition and provision of appropriate tools to support eResearch. The infrastructure was also found to be slow, thus, incapable of supporting research data practices. The group indicated a five-year target that would comprise of standardisation of relevant tools to support eResearch that would integrate the university's ICT environment and external services. Of major interest was to enable researchers to create or install applications and further track their research lifecycle without having to manage these from their desktops.

v. Collaboration

"Collaboration is cooperative work amongst Victoria and external researchers, including the sharing of ideas, data, and resources to realize a shared research goal" (Whakamuri, Whakaaro & Me Aro, 2014:13). The working group indicated that collaboration requires the transfer of data, access to shared data, real-time communication and, access to a remote resource. They found limited internal services in support of collaboration at VUW. The group recommended an enhanced environment in support of collaboration especially through the university's policies and appropriate tools.

vi. Data

"Data is the management of all research inputs and outputs that are in a digital format. This includes the collection, curation, analysis, and provenance (metadata) of both basic data and information produced by research" (Whakamuri, Whakaaro & Me Aro, 2014:13). At VUW, it was found that due to lack of an organisational policy, researchers chose what to do with their data. The increasing pressure from the government to researchers to make their data accessible,

and publishers asking for data to support work that researchers want to publish created a need for data management. The working group indicated a need to develop a policy for research data management at the VUW that would cover data storage, reuse, public access, and preservation. Furthermore, they indicated a need to develop technologies that would support research data cycle, and a digital preservation framework.

vii. Computation

"Computation is the use of computer hardware to process or analyse data" (Whakamuri, Whakaaro & Me Aro, 2014:13). At VUW, researchers used desktops essentially because it was what they are used to, vis-a-vis High Performance Computer (HPC) services. The working group recommended more support to researchers to enhance efficient use of their desktops as well as moving to high performance capabilities both within the university and externally.

viii. Mobility

"Mobility is the ability to research and collaborate from anywhere in the world, at any time and on any device" (Whakamuri, Whakaaro & Me Aro, 2014:13). The working group indicated that VUW provided remote authentication and network access to users, but not all aspects of mobility were being supported. Thus, it was recommended that the university adopts cloud services to enhance mobility.

2.3.1.1 Suitability of the eResearch Capability Model to the Research Problem

The eResearch Capability model provides critical elements for eResearch that can position an academic institution on a strong eResearch basis. The element of data of the eResearch Capability Model was relevant to research questions 3 and 4 respectively: *How is curation, analysis and provenance (metadata) of both basic data and information produced by research achieved? What problems of data management, organisation, dissemination, and preservation exist and how can they be addressed?* In addressing these questions, the study sought to establish the level of support that libraries provide in RDM and to investigate RDM challenges faced by the universities under study.

The elements of policy, processes, support, tools, and collaborations from the eResearch Capability Model were adopted for this study to address the fifth research question: *What procedures, tools, and policies are used to promote eResearch?* (See Table 1.2). The study sought to establish existing policies in support of eResearch; technological support that researchers get in the research processes such as availability of research grants and publishing options; the level of support provided by the academic libraries to researchers to enhance eResearch such as training, human resources, and legal obligations; tools available to facilitate eResearch and, to investigate research collaboration platforms and opportunities.

2.3.2 The Purdue University Libraries Model (Carlson & Garritano, 2010)

Carlson and Garritano (2010) reported on the Purdue University Libraries' approach to E-science. Despite Purdue University having made some accomplishments in e-science that had been articulated in their strategic plan for 2001-2006, such as the creation of Discovery Park in 2001 which serves to provide research spaces for researchers from different disciplines to work together and the NanoHUB which supports virtual communities in Nanotechnology, there were still some gaps in support of e-science at the university.

In 2004, Dr James Mullins took on the position of Dean of the Purdue University Libraries (PUL). Given the state of research infrastructure at the time, PUL was mandated to outline its role to support interdisciplinary research and collaborative partnerships. Dean Mullins took the initiative to engage all the department heads at the university in a bid to understand faculties' research needs. The general feedback indicated that they faced challenges in data management and that they lacked time and skills to address the problems. There was also the increasing impetus by funding agencies requiring researchers to organise and properly describe their data as well as make it available for mining and reuse. Even though the Faculty realised the usefulness of data sharing, they cited the inability to manage data.

Dean Mullins saw this as an opportunity for PUL to work directly with the researchers in pursuit of supporting eResearch but also realised a need to transform the libraries' way of offering services from the traditional role to better ways that would suit the researchers' information needs. The organisational changes by the PUL to involve the library in supporting eResearch followed the following assumptions:

i. *"In order to be effective in addressing data curation and preservation issues librarians will need to reexamine the role they play in the research process and modify their practices accordingly*" (Carlson & Garritano, 2010:16). This requires embedding librarians within the entire research process.

ii. To accept librarians as research partners to aid in developing and providing solutions to RDM issues faced by the Faculty and IT professionals. This is because it is assumed that the researchers would rather focus their energies on conducting research as opposed to data management and on the other hand, IT professionals would rather focus on technology aspects. This assumption indicates difficulty by researchers to achieve data management goals without collaborating with librarians.

iii. No readily apparent solutions existed, thus, a need to invest heavily in time, effort, and infrastructure; consequently, neither the libraries nor the other stakeholders could deal with the challenges single-handedly.

iv. PUL's involvement in supporting RDM would affect many and possibly all librarians. The scope of this support would go beyond appointing specific librarians to be in charge. There would be a need for multiple skills involving all librarians at Purdue who would need to not only continue providing traditional services, but also expand their capabilities to blended librarianship.

The above assumptions led to realigning of librarians to work closely with Faculty and other researchers. Mullins appointed an Interdisciplinary Research Librarian to be the project champion for the eResearch initiative. There was also an obvious need to realign the libraries' organisational structure. The library then got approval to create a research department and an Associate Dean of Research was appointed. The purpose of this department was to coordinate librarians' expertise to support e-science.

PUL had two approaches to having skilled librarians. The first was to employ new skilled librarians while the second included blended librarianship which involved reapplication of specialised skill set of traditional librarians to enable support for eResearch. Effort was made by the PUL to reach out to researchers in order to understand their needs to be assisted by the libraries. Subject librarian's received new roles that enabled them to work collaboratively with researchers at every stage of the research process. Despite facing challenges, it's reported that the

initiative led to more than 22 PUL librarians participating in more than 47 multidisciplinary grant proposals. Furthermore, individual librarians and the PUL were empowered to become more participative in research support. Carlson and Garritano (2010:36) state that, "the need for librarians to develop strong technical skills should not be underestimated, but technical skills alone are insufficient for success. Soft skills such as communication, creativity and flexibility, and risk-taking are equally important". Brandt (2007:367) pointed out that "…if librarians can play a role in helping to organise and describe digital objects at the very early end of the eResearch spectrum it will facilitate data mining in the future, which could truly facilitate new paradigms of research". Figure 2.2 highlights the key issues in the Purdue University Libraries model.

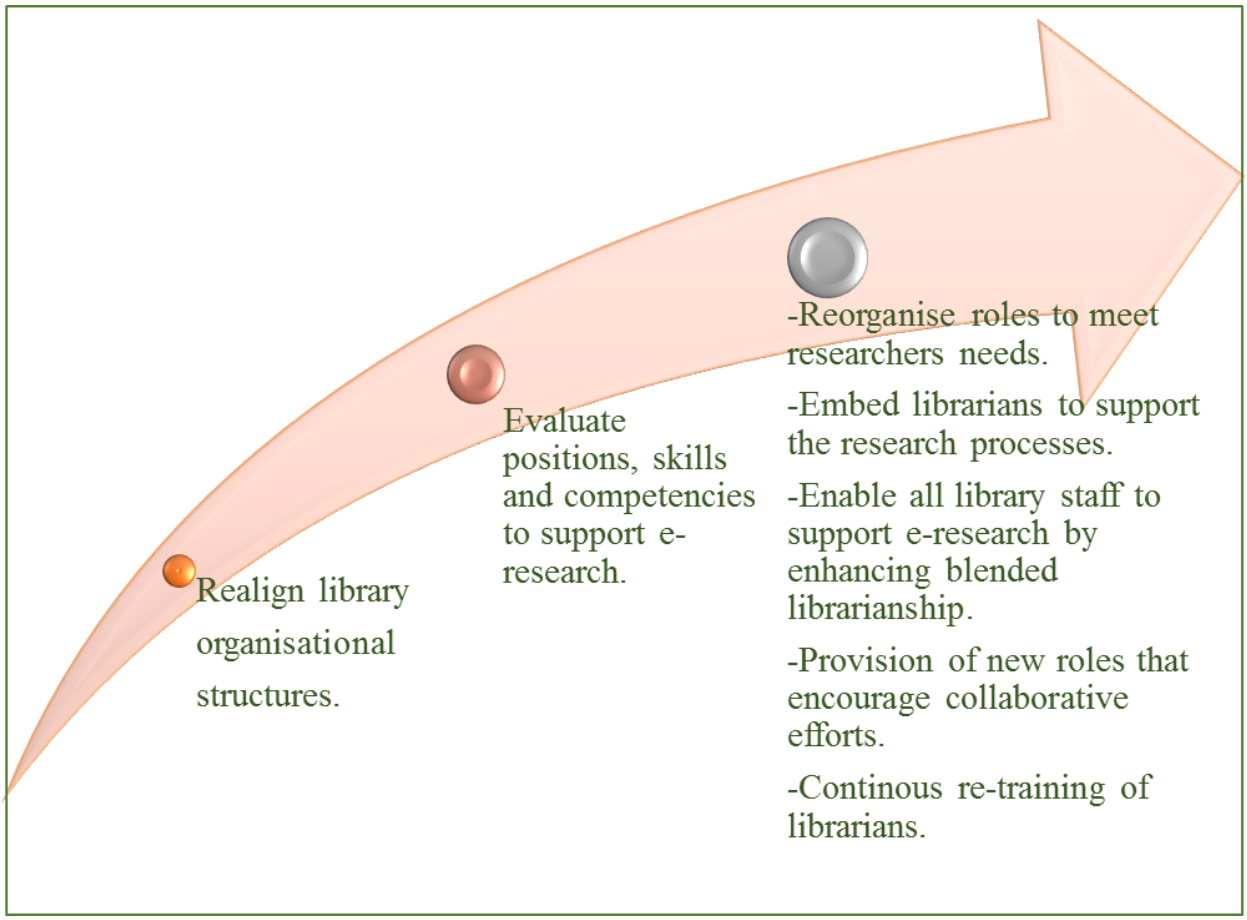

Figure 2.2: Key issues in the Purdue University Libraries model (Carlson & Garritano, 2010)

2.3.2.1 Suitability of the Purdue University Libraries Model for this study

In the background information in chapter one of this study, it was indicated that researchers in academic institutions in Kenya will need the help from their university libraries if eResearch was to be advanced and institutionalised (see section 1.1.2). This study, therefore, set out to investigate the ability of private university libraries to support eResearch. Thus the following research questions were posed: *how do the organisation structures of the university libraries support eResearch? What positions in the organisation structure and competencies are available for coordinating eResearch*? (See Table 1.2).

The Purdue University Libraries model focuses on the creation and improvement of new positions for library staff such as 'Dean of Research' and 'Data Research Scientist' and skills development to align the library staff with the researchers. According to Carlson and Garritano (2010:4):-

> *The Purdue model includes creating a new organizational structure within the libraries to support librarians active engagement in working directly with Faculty to research and develop solutions to address the problems of data management, organization, dissemination and preservation, and creating new positions to coordinate the libraries' research efforts and to help leverage the existing skills and relationships of subject librarians.*

Thus, this model was found relevant to the study as it addresses the variables of library organisational structure, library staffing, competencies and eResearch coordination adopted for the study. The study investigated positions in the libraries' organisational structures that support eResearch, programs, and strategies for enhancing librarians' skills to support research, knowledge and skills relevant to support eResearch.

2.4 Summary and Research Model

The purpose of this chapter was to outline models that underpin eResearch. A variety of technology adoption and use models were identified and discussed. This included: Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Technology Acceptance Model, Enhanced Technology Acceptance, Unified Theory of Acceptance and Use of Technology (UTAUT), Diffusion of Innovations, and the Social Cognitive Theory. These models were found to be relevant for eResearch studies that focus on the user's behaviour in adopting and using

technologies. However, they were inadequate in underpinning this study that is focused on the eResearch process.

The study adopted two theoretical models which have been discussed in this chapter. The first one is the eResearch Capability Model which was developed at the Victoria University of Wellington. The model contains the elements of data, policy, processes, tools, collaboration, computation, mobility, and support which were used by the VUW to examine their support towards eResearch at the university. The results indicated a lack of appropriate eResearch policies, insufficient eResearch support across the research lifecycle, minimal organisational commitment, insufficient integration of internal and external eResearch tools, uncoordinated collaborations, a lack of policies and support for RDM, lack of use of high computing infrastructures and, insufficient support to seamless access to research support regardless of geographical location and time. The VUW purposed to have a five year strategy to counter these challenges in order to enhance eResearch. This study found these eResearch Capability Models elements vital in providing a suitable framework in which to examine the current state of eResearch in private universities in Nairobi County, Kenya as well as how their university libraries support researchers in adopting technologies in the entire research process. Thus, the model was adopted to aid in meeting the objectives of this study related to investigating the level of support provided by libraries in the practices of research data management and institutional repositories. Furthermore, the model was found useful in examining eResearch procedures, tools, and policies that enhance eResearch in universities.

The second model adopted is the Purdue University Libraries model which posits that the organisational structure and librarians competencies must be re-examined and made useful to support the newer ways in which research is done which include researchers adopting technologies in the research process. Possible challenges of researchers not using technologies effectively included, lack of time to manage data, and lack of awareness of emerging technologies, among others. These challenges necessitate libraries to go out of their way to work closely with researchers to enhance the research process. Considering that eResearch is barely developed in the Kenyan context, this study examined the organisational structures and librarian competencies relevant to support eResearch. Thus, the PUL model was relevant to the set

objectives that address the variables of organisational structures and competencies. The constructs of these two selected models (organisational structures, staffing competencies, eResearch coordination, policy, processes, support, tools, collaboration, and data) complimented by theoretical models presented earlier helped develop the research/conceptual model (See Figure 2.3). The model in this figure illustrates the relationship between the topics being studied, the research questions, the research models selected for the study, and the variables derived from the models. This provides the basis for the literature reviewed in the next chapter.

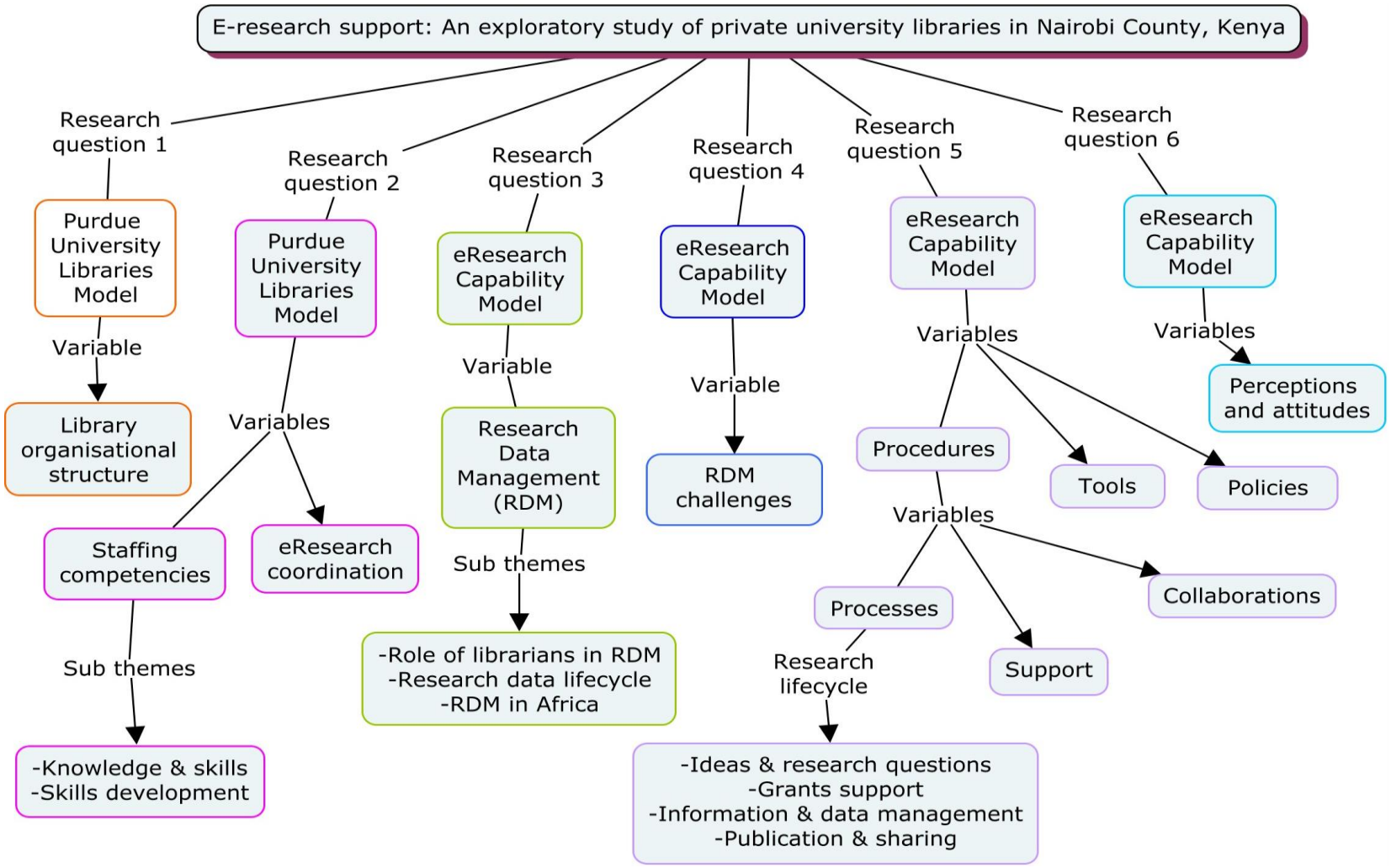

Figure 2.3: Conceptual model

CHAPTER THREE
LITERATURE REVIEW

3.1 Introduction

Alasuutari, Bickman and Brannen (2008:536) highlight that, "a literature review typically summarizes results of past studies, suggests potential reasons for inconsistencies in past research findings, and directs future investigations. Researchers often use a narrative approach to summarize and integrate research on a specific topic". According to Kumar (2014:48), the literature review enhances and consolidates one's knowledge base in their subject and aids in examining findings against that of other people. The literature review is an integral part of the research process and makes a valuable contribution to almost every operational step.

The literature for this study has been presented by building on the overview that was provided in chapter one (see section 1.7). Having already deliberated the eResearch concept in the first chapter of this study, this section focuses on library organisational structures, librarian competencies, and the role of university libraries in supporting eResearch. The chapter is organised by way of thematic areas derived from the research questions, theoretical framework variables, and broader issues related to eResearch.

This chapter is divided into seven major sections, each reviewing literature related to the studies' research questions (See section 1.4). Section 3.1 includes the introduction to the chapter. Section 3.2 reviews literature on university libraries' organisational structures in relation to supporting eResearch. In addressing the second research question, section 3.3 covers literature on competencies, positions, and the role of University libraries in eResearch coordination. Section 3.4 addresses curation, analysis, and provenance of data and information by addressing literature on RDM in Universities especially the role of university libraries. The fourth research question is addressed in section 3.5 with literature reviewing RDM challenges within university settings. In order to address the fifth question, the study adopted the variables of policy, process, support, tools, and collaborations from the eResearch Capability Model (See section 2.3.1) in order to review literature on the role of university libraries in eResearch using these aspects. This is presented in section 3.6 of this chapter. The last research question on attitudes and perceptions towards eResearch is addressed in section 3.7 respectively.

3.2 Structures for Coordinating eResearch in University Libraries

The study sought to find out how organisation structures of the university libraries support eResearch guided by the Purdue University Libraries model which posits that university libraries need to realign their organisational structures to support eResearch effectively (See section 2.3.2). Literature on organisational structures in relation to eResearch is presented in this section.

3.2.1 University Libraries Organisational Structures and eResearch

Simons and Searle (2014:2) posit that, "the success of librarians in eResearch support depends not only on efforts to expand individual staff members' skills and knowledge, but also on the development of organisational structures, ways of working, and career pathways that are outside the current norm". Traditionally, academic libraries have been structured alongside departments offering frontline services such as reference services, information literacy training, and circulation services among others. These have been supported with back-office support systems such as IT and technical department services (Frances, Fletcher & Harmer, 2011:4-5). Conventionally, academic libraries have also relied on liaison or subject librarians to provide research support in a university setting. According to Keller (2015:81), the present liaison librarians have the ability to provide a wide range of services above reference services, yet, it is impossible for them to fit everything in their job profiles considering the range of support required in eResearch.

Keller (2015:81) provides evidence through a survey on organisational charts available on Australian university libraries that there are other organisational positions such as institutional repository manager, research data management and eScholarship specialists, as well as research support coordinators who are directly involved in research support beside liaison librarians. Richardson, *et al*. (2012:264) also reports on a survey of the role of libraries in supporting eResearch at Queensland, which indicated that a library's research support portfolio majorly rests on an Associate Director or is shared across several leaders of the library. The library further embeds research support staffs and teams into various sections of the library. These examples reflect that university libraries can no longer depend on a few of their staff members to support eResearch, but rather, the need to involve all specialists.

Another aspect that will impact on the libraries organisational structure is the increasing need to focus on the users' needs vis-à-vis library products. This was articulated in the Purdue University Libraries model which revealed that understanding Faculty members' research needs was crucial to eResearch planning (See section 2.3.2). An in-depth study by Procter, Voss and Asgari-Targhi (2013:1680) on problems faced by the UK eResearch community, indicated that both current and prospective eResearch users find it daunting. Those who have already adopted eResearch practices face frustrations, while the potential users are uninformed of the benefits, as well as how to make the most out of them. The study indicates that these challenges are faced because of failing to recognise the human infrastructure that should support eResearch; and instead, focusing more on the technical infrastructure.

The needs of research communities that the library seeks to support must be considered when changes are being made on the library structures. There is a need to shift the focus from product delivery such as from reference services or publications to supporting research processes and teams (Shearer & Argaez, 2010:12; Luce, 2008:48). Success in supporting eResearch will heavily be reliant on a deep anticipatory understanding of what researchers need in order to perform their work effectively (Luce, 2008:49). For instance, the University of New South Wales (UNSW) library realised the need to rethink and restructure how they provide services by recognising that it was relevant to build stronger relationships with its research communities aside from providing technical support. Frances, Fletcher and Harmer noted that, to support eResearch effectively, the library:

> *Reorganised its technical service area from resourcing print materials to supporting electronic requirements; this restructuring called for library staff to develop skills and capabilities for managing digital resources and systems, including learning about emerging technologies for institutional repositories and open access scholarly communication* (2011:3-5).

Organisational structures provide a way for connecting structures with resources, strategies, and systems. Currently, most libraries apply the hierarchical structures emphasising on, line, lateral staffing, with ranks and positions which may not be flexible enough to support eResearch. For libraries to work outside the physical buildings there is a need to rethink the organisational structures and move from reactive to proactive approaches. Libraries could opt for team-based structures rather than hierarchical and matrix structures (Kesselman & Watstein, 2009:396-397).

Often, eResearch entails the formation of virtual teams especially in the early planning phases of a research project. This characteristic calls for more fluid staffing structures compared to the usual model that entails library departments or subject liaison supporting research which does not offer dynamic participation in the emerging research trends. Libraries are required to work seamlessly across institutional boundaries to support eResearch effectively (Luce, 2008:48). Kesselman and Watstein (2009:397) suggest the formation of virtual teams consisting of embedded librarians as the best organisational structure for virtual environments. This is attributed to the fact that embedded librarians are accustomed to working in virtual spaces, and that virtual teams go beyond the physical boundaries of buildings; thus, can provide the appropriate environment to work with researchers whether they are based within the confines of the institution or outside.

Another strategy is to enable librarians to become part of the research process proactively by working closely with individual researchers or research teams. The team at the Purdue University Library (See section 2.3.2) discovered that researcher's lacked time to engage in data management necessitating a structure that would enhance close collaborations between librarians and researchers in order to enhance the research process and output. According to Luce (2008:48), this can only be facilitated if library staffs embed themselves among the research communities that they are supporting. This structure will require significant changes to staffing profiles and skill sets. Shearer and Argaez (2010:12) support this by indicating that new library services ought to be designed around the early research phases of a research project as data lifecycle commences early in the research process and this will enable libraries to offer data preservation and reuse. According to Frances, Fletcher and Harmer (2011:2), it is critical for academic libraries to have organisational flexibility in order to be responsive to the changes that are affecting how research is conducted and the developments in scholarly communications.

3.3 Competencies and eResearch Coordination in University Libraries

The second research question sought to understand the positions in the university libraries' organisational structures and competencies that are available to support eResearch. Using the variables: staffing competencies and eResearch coordination espoused in the Purdue University Library Model as a lens, literature was reviewed on competencies that are relevant to eResearch

support, ways librarians can develop competencies, and coordination of eResearch with regard to library support. The reviewed literature is presented in this section.

3.3.1 Competencies for Library Staff to Support eResearch

A wide range of competencies is expected of librarians to support eResearch effectively. Kesselman and Watstein (2009:391) assert that the increasing capabilities of web-based collaborations involving large sets of digital text, data, and multimedia will require the expertise of librarians with knowledge management to facilitate these collaborative environments. Keller (2015:81) points out the need for librarians to learn new skills promptly. He highlights that they need to possess interpersonal and communication skills; the increasing need to have business analytics skills to facilitate working with researchers; familiarity with strategic research priorities and the university's performance measurements; as well as a need to integrate contacts between librarians and researchers in a Customer Relationship Management system which can enhance monitoring of research performance measures.

Technical skills have become crucial whilst supporting eResearch considering that it involves the use of technologies in the entire research process. According to Simons and Searle (2014:2), "librarians in eResearch must explicitly demonstrate how their skills can be combined in productive ways with technical specialities, including software development and business analysis" even though information professionals have always had information retrieval skills, for instance, National Research Council (2002 as cited by Denison, Kethers & McPhee, 2007:11) that indicated information professionals will need to improve their information retrieval techniques in order to manage large and complex distributed databases that are currently being developed.

Frances, Fletcher and Harmer (2011:5-7) alluded to the fact that there is a need to build in-house skills for the development and customisation of library systems. For instance, Java web development skills were identified as core skills in maintaining web services. Integration of workflows across the library necessitates new sets of skills for all library staff. Skills such as project management and communication planning become crucial, as librarians need to communicate and engage in projects that involve other stakeholders such as IT staff. Another strategic initiative that's been found relevant includes data librarianship, considering the

increasing need for RDM. These views reflect the assumptions by PUL model which indicated that libraries will have to work with other stakeholders and that supporting RDM will involve all library staff (See section 2.3.2).

Although technical issues can pose a challenge to librarians, soft issues such as cultural challenges can present a daunting task for librarians (Denison, Kethers & McPhee, 2007:4). To try and bring these changes calls for awareness and advocacy initiated by university libraries. Such practices that involve awareness and advocacy may not require significant new knowledge from librarians, but rather an ability to be innovative. Procter, Voss and Asgari-Targhi (2013:1675), for instance, report that awareness can be raised through several mechanisms such as presenting success stories that have involved the application of technologies in research. They, however, point out challenges likely to be met such as researchers' inability to relate the practices to their own needs, which can limit the application of the technologies.

More complex tasks such as RDS will require skills development. Shearer and Argaez (2010:11) identify core competencies for data management as "migrating data to new formats; building ontologies, hierarchical structures, and interactive thesauri; metadata production; data organization and preservation; and the development of access and discovery tools". Addressing the digital curation lifecycle, Heidorn (2011:669) pointed out that these can only exist within an institutional framework with staff members that have appropriate skills to support each of the phases in the cycle. Some of these required skills include "the ability to add checksums to data sets, transform documents from one format to another, and the ability to write computer scripts to transfer very large files to backup partners". This view is similar to what was reported in the PUL model (See section 2.3.2). One of the assumptions in the model that informed organisational changes in the PUL was the realisation that data curation can be effectively supported if librarian's roles were re-examined to support the entire research process. Simons and Searle (2014:7-10) identify the following core set of skills and knowledge relevant in eResearch support role: advanced metadata skills; high level communication skills; high level documentation skills; knowledge of the broader research environment; knowledge of the research process of scholarly communication; knowledge of legal and regulatory frameworks; technical skills; and project management.

University Librarians have a great role to play in eResearch. Simons and Searle (2014:1) indicate that librarians will not only work with individual researchers but are also expected to extend their services to university-wide projects that involve RDM, enhancement of researcher and university profiles, tracking of research impact; following up on funding agencies demands; and ensuring compliance on OA mandates, among other tasks. Thus, the need for a wide range of skills and competencies alongside working in teams, become mandatory for librarians.

3.3.2 Developing Librarians Competencies for eResearch Support

A wide range of skills is required by librarians to support eResearch as highlighted in section 3.3.1 above. It becomes difficult to acquire all the necessary competencies through formal education considering the rapid changes that are being experienced in the research sphere. In order to keep oneself updated with the necessary competencies, a number of ways have been suggested in literature. Simons and Searle (2014:8) suggest that librarians ought to develop the necessary skills through work experience by working in different areas; volunteering to collaborate on projects that have different professionals, thus, learning different skills from them; by making effort to network outside the library community; reading about scholarly and general subject areas; having formal education on the relevant subject areas; attending to training courses such as webinars; attending to events such as OA events; acquiring peer mentorship from experts; self-training; joint appointments to roles where one can learn from the other person; and having in-house training in order to ensure that all staff members have the skills required to support eResearch.

Simons and Searle (2014:10-13) indicate three training pathways that can be taken by librarians: formal (tertiary) education, training courses (in-house or externally provided) and informal learning, either self-directed or supervisor/peer-assisted. This is supported by Cox *et al*. (2017:22) who proposed that both formal and informal approaches should be adopted by librarians in need of acquiring new skills and knowledge in support of eResearch. According to Shearer and Argaez (2010:11), data management skills have generally been developed in-house through collaborations with Faculty or research projects, but the skills acquired cannot be sufficient when a library requires robust RDS.

Short courses may also provide ideal training for librarians to acquire new skills. Cox *et al* (2017:27) assert that the "development of short courses suited to work-based learning or day release from academic libraries, may be an appropriate strategy for iSchools to help fill the data services talent gap". An example is the short course in research data management offered by the department of information and library studies at the University of Cape Town which targets librarians and researchers (University of Cape Town, 2018). There are also free online courses that librarians can take to improve their knowledge and skills. Examples of these courses in the area of RDM include the RDMRose course (RDMRose, 2015) which is a continuing professional development (CPD) course funded by Joint Information Systems Committee (JISC) and tailored for information professionals; and secondly, MANTRA (University of Edinburgh, 2018) maintained by the data library staff at the University of Edinburgh. In a blog posted by Searle (2014), Brown was of the view that it would be ideal to have more practical-oriented training.

When deciding on what training programmes to take, one has to consider both the background of the librarian and details of the expanded role they are required to play (Brown, Wolski & Richardson, 2015:229). This view is also expressed by Frances, Fletcher and Harmer (2011:5) while outlining the strategies and processes that were adopted by the library at the UNSW to integrate eResearch services to existing business. It was reported that the library had to identify professional development needs for the library staff before engaging in training. The training included sending all staff to attend various national and international conferences and workshops on eResearch, OA, digital library, and library systems. They further indicate that library staffs were encouraged to attend sessions that are not limited to their comfort zones or their specific areas of responsibilities, but rather to be open minded to learn more.

In a paper about new skills development for research support librarians at the Griffith University, Brown, Wolski and Richardson (2015:232), reported that: i) while formal skills is crucial for librarians as they take up on new research roles, there is equally a need for informal training that include mentorship and support networks; ii) "library roles which support research need to be scoped to determine the skills and expertise required within a team, faculty, and the institution. This is because all support librarians will not only have the same roles, but also there is a need to have expertise in some areas, such as information technology, standards and project

management"; iii) A need to have in-depth knowledge of the research process in various disciplines to enable appropriate contributions by librarians as partners in research practices.

Searle (2014) narrated his experiences while working at Griffith University, indicating that supporting eResearch is taxing and most of the learning happens on the job, through trial-and-error with constant consultations happening from professionals and a wide network of colleagues. Through his job, he had to learn skills such as software development lifecycles, semantic web and linked open data approaches to metadata, which were challenging. He proposes that it is beneficial to have librarians support eResearch initiatives, but there is also a need to expand their knowledge base to support eResearch.

The nature of eResearch initiatives, however, renders it difficult to pinpoint specific skills and competencies that librarians require to support it. Simon and Searle (2014:1) assert that no single organisational method for delivering eResearch exists and there are no well-known career paths into eResearch roles. Librarians also consider themselves as generalists because of the wide range of skills, knowledge, and expertise that they require, so much that it becomes difficult to specialise in specific skills. Simons and Searle (2014:10) add that, "new roles in eResearch can be ill-defined, and it is largely up to the occupant to take the initiative and redefine the role of the librarian in this context". Applebee and Bannon (2007 as cited by Stokker & Hallam, 2009:565) affirm that eResearch support is not a one-size fits all, but rather a discipline and project dependent. As a result, it becomes difficult for university libraries to support it, as new services have to be tailored to suit the variety of needs from different disciplines.

3.3.3 eResearch Coordination in University Libraries

Effective eResearch in universities requires that university libraries take an active role in supporting researchers by working closely with them in all the research phases. This is especially because technologies keep emerging that continue to impact the way research can be conducted. Thus, there is a need to guide researchers. For several years, librarians have been involved in supporting the conventional research practices in universities.

Brandt (2007:365) states that for long, librarians have been recognised as taking the lead in the development of structures, procedures, and approach that support information delivery and use. These have included the creation of finding aids for archival materials, cataloguing and

classification of print sources, and, developing of indexes and taxonomies for databases. Heindorn (2011:670) indicate that close to a decade ago, librarians were already aware of document metadata, classification schemes, and keywords. However, data requires different metadata structures, schemas, and vocabularies; this has posed a challenge, as librarians with the necessary skills are scarce. Kesselman and Watstein (2009:388) speak to the issue of information literacy and indicate that librarians have always played a critical role in conducting training to researchers in areas such as search strategies and evaluating search results. Kesselman and Watstein (2009:392) further indicate that academic libraries have played a pivotal role in the preservation of resources, even though the increasing numbers of born-digital resources present new challenges and opportunities that demand a close working relationship between librarians and researchers.

As technology continued to impact on library services, academic libraries embraced embedded librarianship and the use of liaison librarians to support researchers. Blended librarianship was one of the approaches adopted by the PUL to enhance skills for eResearch support (See section 2.3.2). Kesselman and Watstein (2009:387) report on the role of embedded librarians in academic settings and indicate that embedded librarians operate in collaborative learning environments; work closely with research teams; work in academic departments; and play the role of co-instructors both in physical and online classrooms by providing leadership in scholarship. These calibres of librarians barely play supporting roles in libraries. They are viewed to work in virtual worlds, playing an integral part as key players in supporting research and instruction teams. This is not to mean that the physical library seizes to be relevant; it continues to play a critical role in the provision of an environment conducive for research, study, and collaborations. However, the remarkable increase in electronic resources and technological capabilities that support studying and research has influenced how librarians provide their services. The need to take the library and librarians to the users wherever they are has become the basis for embedded librarianship. According to Kesselman and Watstein (2009:392), "indeed, we suggest, and the literature and case studies demonstrate, that the successful development, management, and delivery of embedded library services is fuelled as much by the human side of the equation—by attributes, knowledge, skills, abilities, and values—as it is by anything else".

Liaison librarians, on the other hand, have played a pivotal role in academic libraries by mainly being responsible for subject-specific or complex research queries. Their roles have, however, considerably changed, since they are now required to have knowledge of research impact, to establish contact with researchers, to be actively involved in groups that are working to promote institutional repository and research data. In order to tackle these new roles effectively, Keller (2015:81) suggests the need to free-up liaisons librarians from desk duties which has consumed much of their time from information literacy training and, collection development responsibilities. In the PUL model, for instance, subject librarian's had to be reassigned new roles that were geared towards enhancing close collaborations with researchers in all the phases of the research lifecycle (See section 2.3.2). According to Koltay (2016:98), libraries should create positions such as data librarians, and develop more professional staff skills. Richardson, *et al*. (2012:271) is of the view that with the many changes in the research sphere, libraries have a chance to be more proactive through the building of teams from a wide range of information professionals rather than just relying on liaison librarians to support research.

3.4 Research Data Management in Universities

Discussions on the issues of Research Data Management (RDM) have been on-going for over a decade when authors such as Henty (2008:1) indicated that collaborative efforts across disciplines in collecting, analysing and simulating data are likely to provide solutions to numerous global problems as could be experienced in areas such as global warming and in the pursuit for political stability among nations. This is also echoed by Macquarie University (2016:8) that pointed out "sharing data enables collaborations that contribute comprehensive solutions to the world's pressing issues". Consequently, governments have become eager to provide research support in a bid to ensure that publicly funded research is well managed to be easily and freely found in OA repositories in order to enhance ethical data re-use.

The changes experienced in computing, telecommunications and ICT, in general, have impacted the research environment which is now being conducted in the digital sphere resulting in the massive production of born-digital research data at a rapid pace (Pinfield, Cox & Smith, 2014:1; Heidorn, 2011:664). This has been experienced even among researchers who are producing and exchanging what would seem as small volumes of data at individual levels, but collectively, are staggering volumes (Heidorn, 2011:663). Technology has improved the creation, processing,

storage, and the management of data electronically, leading to enhanced sharing, replication and combination of data (Shearer & Argaez, 2010:3; Brandt, 2007:365). As technology continues to present opportunities for faster and innovative ways to process and analyse data, enormous opportunities for data curation is presented to universities, researchers and the end-users (Macquarie University, 2016:3; Brandt, 2007:365). This, however, calls for the generation of appropriate systems, structures, policies, infrastructures and services for the management of data geared towards aiding researchers in the creation, collection, manipulation, analysis, transportation, storage and preservation of datasets (Pinfield, Cox & Smith, 2014:2).

RDM is a key area of eResearch; and is about 'the organisation of data, from its entry to the research cycle through to the dissemination and archiving of valuable results (Whyte & Tedds, 2011:1). RDM involves "caring for research data, facilitating access to it, preserving, and adding value to these data throughout its lifecycle" (University of Edinburgh, 2015). The many activities required in order to manage research data present a range of challenges. Pinfield, Cox and Smith (2014:3) point out technical, culture, management, legal and policy related issues. Regardless of the enormous challenges, frequently, research data is being viewed as a valuable asset presenting benefits beyond the purpose for which it is created (Shearer & Argaez, 2010:3). The value of data can only be realised as because of its proper management (Macquarie University, 2016:8). The effective management of data enables: validation of the accuracy of results which can only be enhanced through direct access to original data; reproduction of data; progression of solutions; sharing of data; re-use of published data especially for distinct research problems; enhanced collaborations and communications among researchers; and, the possibility of unearthing unique data that cannot be replicated (Macquarie University, 2016:8; Heidorn, 2011:664; Henty, Weaver, Bradbury & Porter, 2008:1). Collecting data is an expensive venture, thus, effort ought to be made to avoid duplication; and hence, the need for data management (Henty *et al*., 2008:1).

Given the complexity of RDM, the responsibility of planning and managing this cannot solely rest with the researcher, but rather also on institutions that support research as well as funders (Strasser, 2015:6). MacDonald and Uribe (2008:37) alluded to the fact that "higher education institutions need to take some responsibility with regard to implementing effective data

management systems for research data outputs". Globally, universities are being subjected to the increasing need to set up infrastructures and processes for sound data management in order to cope with the altering research environment.

The upsurge in data-intensive research and funding mandates issued by the government and non-governmental funding bodies are creating an impetus for researchers to share research data openly and to demonstrate its value (Morgan, Duffield & Hall, 2017:299; Tenopir *et al*., 2015:1; Heidorn, 2011:663). In response to these needs, universities are figuring out strategies of supporting RDM be it on aspects such as advisory and training programs, setting up infrastructure for data sharing, storage and curation, security, preservation, replication, administration, technical aspects, and compliance with funding requirements, among others (Cox & Pinfield, 2013:300). There are enormous activities to be considered that are critical to the successful management of data in universities with university libraries being viewed as critical in these endeavours. According to Stokker and Hallam (2009:565), "libraries recognise that their skills in organising information provide a strong foundation for some of the expertise required to undertake an active role [in] data management, and many are starting to develop research data management services, usually in collaboration with service areas from other areas of their universities, which inevitably presents further opportunities for service convergence".

3.4.1 Role of University Libraries in Research Data Management

A common mission statement for university libraries is to acquire and disseminate information that supports the university's education and research goals (Heidorn, 2011:663). In this budding data era, libraries are presented with an opportunity to establish new ways of providing research support to the university community. Lewis (2010:2) posits that data is an essential element in the global research knowledge base and, consequently, as a natural extension of the library's role, data should be managed and published. A study by Brown, Wolski and Richardson (2015:225) indicated that university libraries are confronted with the new roles for supporting research data. Similar views were echoed by Shearer and Argaez (2010:3) who indicated that roles and responsibilities for supporting data stewardship are yet to be established in libraries. Similarly, Heidorn (2011:665) assert that, "librarians know relatively little about current data management practices of scholars. Institutions have not yet established who will conduct data curation work, [while] funding models are still being developed and the economies of scale must

be examined". Despite these limitations, the advancement of RDM is continuing relentlessly in universities. Pinfield, Cox and Smith (2014:17) suggest the need for libraries to approach the RDM challenge through rolling out the different research data elements into a single RDM agenda that can thereafter be managed coherently.

A variety of authors have indicated that libraries are capable and well positioned to support research data stewardship basing their view on a wide range of activities and roles that libraries have previously been engaged in within the university setting. Some of these include: the recognition of their role over the years to preserve and provide access to information content and having "strong links with the disciplinary communities" (Shearer & Argaez, 2010:3); and having experience in resource sharing coordination across several institutions which can come in handy on coordination and distribution of data in institutions (Luce, 2008:47). Morgan, Duffield and Hall (2017:304) highlight their experience in the management of research output such as books and journals, familiarity with data vs. Metadata, skills in storing and retrieving information in the digital environment, experience with handling publisher requirements such as embargos, and ability to enable maximising and replication of research output. Cox and Pinfield (2013:300) find that librarians' expertise around metadata is likely to play a key part in both retrieval and curation aspects of the management of data. Further, they have an understanding of information management and information organisation standards. They argue that the provision of RDM advice and training would be a natural extension of existing library work in advisory and information literacy training. They also find an impending connection between RDM and the open-access agenda which are being actively driven by the library. A bit of this connection can be found in the discussion on repositories (see section 3.3.5). Following these positions, it can be seen that the libraries have great leverage in supporting RDM in universities.

Equipped with the basics, librarians can, therefore, take up the challenge of data management. There are challenges likely to be faced in this endeavour such as lack of appropriate competencies (See section 3.2), but this cannot hinder the university library from beginning RDM initiatives. A study by Cox *et al*. (2017:2-3) indicates that it is apparent that libraries have started to play a role in RDM even though the nature and extent of their participation have remained unclear. RDM roles for librarians have been suggested. Luce (2008:44) and Brandt

(2007:368) point out that the involvement of librarians in the initial stages of eResearch will enhance future data management. Brown, Wolski and Richardson (2015:226); Pinfield, Cox and Smith (2014:21); Shearer and Argaez (2010:4) find that it is crucial to raise awareness about data stewardship to the university community and that libraries are well positioned given their existing relations, particularly established through subject librarians and research support staff.

Lewis (2010:11-18) raised a variety of tasks that libraries can focus on which include: developing the library staffs' confidence in data management by increasing their knowledge and awareness; provision of data advise as they have been providing the same on OA and scholarly communication; developing awareness to researchers on issues such as legal implications; teaching postgraduates on data literacy, which may impact on how the future researchers will approach data whilst conducting studies; developing of capacities for data curation with institutional repositories being viewed as a starting point; identification of required data skills with LIS schools; providing leadership on the creation of data policy, both at the university and national levels. Brown, Wolski and Richardson (2015:226) report that libraries have begun to provide a variety of support that includes creating data management and preservation policies; influencing how researchers will create, store and publish data and work with stakeholders such as information technologist to find appropriate data storage.

Libraries should actively participate in the development of institutional research data policy (Koltay, 2016:98). Tenopir, Birch and Allard (2012) observed that "few academic libraries are developing research data policies and that formal data management infrastructure is almost non-existent". The lack of policies can negatively influence RDM effectiveness. Henty (2008:4) noted that institutional policies and advocacy have a major role to play in terms of enhancing attitudes and understanding towards RDM. University libraries can aid in policy creation and implementation. According to Luce (2008:44), libraries can be involved in the early stages of the research by creating policies for data description, management, access, and sharing with the aim of enabling unrestricted access to literature. Another role for libraries as pointed out by Task Force, Vice Chancellor for Research's Data Management (2012:56) involves the creation of collection development policies while providing criteria on what can be preserved and for what duration while addressing the ability to reuse data that has been stored. "National and

international policy developments related to advances in eResearch (networked data-intensive science) have similarly created opportunities for libraries to create value by extending their stewardship and service activities to the management and sharing of research datasets as an increasingly vital dimension of the global research knowledge base" (Corrall, Kennan & Afzal, 2013:639). Henty (2008:8) pointed out that RDM can be made easier if stakeholders such as researchers, research units, and research organisations make effort to have policies that guide the creation and management of data.

According to Koltay (2016:98):

> *Academic libraries can provide help in increasing the visibility of research data, and they are well placed to advocate best practices in data management and data citation. Supporting RDM is a new role for them, so they have to be encouraged to adapt to this changing landscape. The main reason for this is the need to minimise the time that researchers have to spend on technical and administrative processes*.

As an example, Wolski, Richardson and Rebollo (2011:1) report about Griffith University which has already taken leadership roles in data collection and exposure that was successfully implemented through the involvement of the information professionals who designed and implemented a framework. Evidently, university libraries will have to take a crucial step in supporting RDM.

3.4.2 The Research Data Lifecycle and University Libraries

To enhance long-term preservation, data ought to be created and maintained consistently and this would involve vigorous management of data in its entire lifecycle (Shearer & Argaez, 2010:3). The role of lifecycle models is to provide a structure that would aid the many operations required in data management throughout the life of data records. Data curation can be made relatively easier if there is an advance plan (Ball, 2012:3). This plan can be greatly enhanced through the lens of a data lifecycle. Corti *et al*. (2014:2) assert that data lifecycle was encouraged to provide support for data curation activities since the 1990s and early 2000s, and this practice has continued to gain approval. According to Yu (2017:284), there is an increased need for RDS encompassing planning, collection, analysis, storage, documentation, metadata, archiving, discovery, and sharing activities forcing libraries to reconsider their service provision.

A range of data management lifecycle models that include the DCC Curation Lifecycle Model; I2S2 Idealized Scientific Research Activity Lifecycle Model; DDI Combined Life Cycle Model; ANDS Data Sharing Verbs; DataONE Data Lifecycle; UK Data Archive Data Lifecycle; Research360 Institutional Research Lifecycle; and Capability Maturity Model for Scientific Data Management exist (Ball, 2012). Using the UK Data Archive Data Lifecycle, this study highlights the various potential stages that libraries can focus on in supporting RDM activities. The UK data archive data lifecycle consists of the following components: creating, processing, analysing, preserving, giving access, and re-using data (Ball, 2012:9-10) as illustrated in Figure 3.1 below.

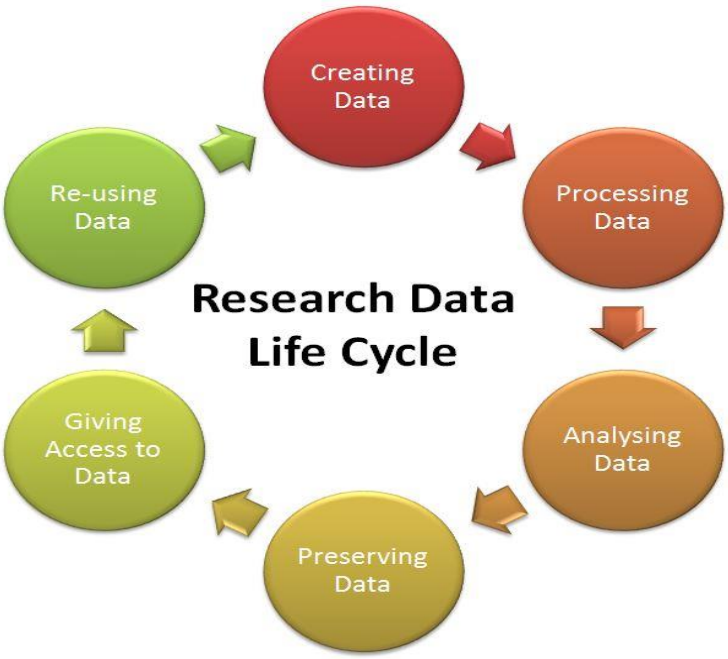

Figure 3.1: UK data archive data lifecycle (Source: Ball, 2012).

The following table highlights the various activities enshrined within the stages of a UK data archive data lifecycle.

Table 3.1: Stages in the UK data archive data lifecycle

Stages	Activities
i- Creating data	▪ design research ▪ plan data management (formats, storage etc.) ▪ plan consent for sharing ▪ locate existing data ▪ collect data (experiment, observe, measure, simulate) ▪ capture and create metadata
ii- Processing data	▪ enter data, digitise, transcribe, translate ▪ check, validate, clean data ▪ anonymise data where necessary ▪ describe data ▪ manage and store data
iii- Analysing data	▪ interpret data ▪ derive data ▪ produce research outputs ▪ author publications ▪ prepare data for preservation
iv- Preserving data	▪ migrate data to best format ▪ migrate data to suitable medium ▪ back-up and store data ▪ create metadata and documentation ▪ archive data
v- Giving access to data	▪ distribute data ▪ share data ▪ control access ▪ establish copyright ▪ promote data
vi- Re-using data	▪ follow-up research ▪ new research ▪ undertake research reviews ▪ scrutinise findings ▪ teach and learn

(***Source: Ball, 2012:9-10***)

a) Creating data

"Effective data curation also requires that librarians be involved with data at an earlier stage of research" (Bracke, 2011:66). The minute one starts to collect data, the library ought to assist researchers to ensure that data has appropriate formats, descriptions and other metadata which needs to be collected during data creation (Heidorn, 2011:668). The creation phase of the UK

data archive data lifecycle includes planning for data formats and consent for data sharing, locating existing data, collecting data, and data capturing. It is expected that researchers should deposit their research data in a repository to facilitate access (Burnett, 2013). One of the critical aspects in the creation stage involves the formation of data management plans (DMPs). "DMPs represent the basic level of both RDM and RDS" (Molloy & Snow, 2012). There has been recognition that planning before beginning research is crucial and has led to an increasing demand by research funding bodies that researchers provide DMPs alongside their proposals submissions during grant application processes (Yu, 2017:791; Strasser, 2015:2; Burnett, 2013; Molloy & Snow, 2012; Wolski, Richardson & Rebollo, 2011:3).

According to Task Force, Vice Chancellor for Research's Data Management (2012:56), there is a need to provide a one-on-one consultancy to researchers about the creation of DMPs which will go a long way to saving their time that is required on such an activity. Henty (2008:7) indicated that since libraries have long been involved in information literacy (IL) trainings, they can integrate the skills related to data management planning in these IL sessions. A systematic review of RDS provided by academic libraries conducted by Yu (2017) indicated that libraries that are involved in providing RDS also offer DMPs services or support mostly through providing consultancy on DMP creation. Considering that a DMP is vital as it will aid a researcher to plan for hardware and software to be used, intellectual property rights, data collection plans, among other fundamental issues, it is ideal that all researchers create one regardless of whether it is a mandate by a research funder or for individual use. A DMP aids in providing clear guidance; hence can save the researchers time. Some tools have been developed to guide researchers in the creation of a DMP. For instance, the DMPonline provided by the Digital Curation Centre (DCC) (Digital Curation Centre, 2018).

b) Processing data

This involves data entry, translation, transcription, validation, cleaning, anonymity, and description. Data entry is the process of entering data into a computer, for instance, entering of data into SPSS from hardcopy questionnaire responses; data translation entails changing data from a form used in a particular system to another that will be compatible with a different system. For instance, importing data from Excel and converting it into a format that can be read by SPSS; data transcription includes converting data from a spoken form into a written form to

enable analysis; data validation is a process usually controlled by computer commands to ensure that data is correct and meaningful; data cleaning includes the identification of incorrect, incomplete and/or duplicated data, thus, removing it from or changing it in the system; data anonymity entails the removal of personal or private information from data to enhance secrecy so that the respondents are not identified, and, data description includes the assigning of metadata to enable data discoverability (Computer Hope, 2019; Ball, 2012:9-10).

c) Analysing data

This involves data interpretation which entails making sense out of data that has been collected and processed; followed by production of research output, for instance, through the creation of a report; author publications, that is, identification and creation of authorship, and lastly, the preparation of data for preservation (Ball, 2012).

d) Preserving data

There is a need to integrate data in a permanent repository to enhance its re-use. The preservation of this data necessitates vigorous management of data throughout its lifecycle. This will involve "appraising, selecting, depositing or ingesting data into a repository, ensuring authenticity, managing the collection of data and metadata, refreshing digital media, and migrating data to new digital media" (Shearer & Argaez, 2010:8). Koltay (2016:98) asserts that libraries should support the data lifecycle through the provision of storage, discovery and permanent access services.

Storage: Data storage and back up is crucial for any research project yet it is apparent that this activity is often neglected by researchers (Strasser, 2015:11). A study of library staff from different UK institutions conducted by Pinfield, Cox and Smith (2014) analysed the contribution of academic libraries to RDM in the wider institutional context and found that storage of data should be a high institutional priority and a key driver for RDM. This followed concerns about researchers using "local storage solutions for their data, ranging from the use of small-scale portable storage devices to large-scale server-based installations" which was viewed as causing data security risks. Respondents indicated dissatisfaction with the institutions' centralised storage services pointing out that the libraries role in providing storage infrastructures were limited and that IT department should take the lead.

Heidorn (2011:668-669) on the other hand reported the relevance of conducting appraisal and selection on what should be stored as not all data is valuable. Furthermore, he pointed out that digital curation does not rest with data storage as there is a need for constant nurturing, using and refreshing of the content. The role of the library would entail working closely with data creators and users in the establishment of policies that will enhance appropriate data appraisal.

Metadata: The creation of metadata for datasets is a crucial component of RDS. According to Luce (2008:45), "standardizing approaches to metadata collection is fundamental, and metadata must be a required part of the eResearch communication process." Proper metadata and indexing enhances effective data mapping and sharing that can be easily understood and hence, be re-used (Strasser, 2015:7; Heidorn, 2011:668; Shearer & Argaez, 2010:6; Luce, 2008:45). Libraries have a role in consulting with researchers in order to understand and to effectively provide appropriate descriptions for data based on ideal metadata standards (Koltay, 2016:98). Several metadata standards exist thus, researchers can find it daunting to select given their limitations in data stewardship (Strasser, 2015:3). Consequently, libraries have to take a responsibility in providing this service to researchers.

Luce (2008:45) assert that metadata management is an already established task in the library community even though the current practices cannot handle the scales envisioned. "The pervasive use of machine-aided semantic annotation, using well-structured metadata, is the only feasible approach for effectively organizing and describing eResearch data." Research libraries can be responsible for curating and preserving smaller-scale data repositories arising from local research groups (Luce, 2008:46). Given that digital media can be unstable, libraries have the culture and mandate to ensure proper curation for posterity (Heidorn, 2011:664). Yale University Library is an example of a university library that provides metadata services such as consultation services, training on metadata creation, educating on emerging trends in metadata and database maintenance (Yale University Library, 2017). eResearch roles call for an understanding of metadata. For libraries to be able to effectively support this service, there is a need for enhancing librarians' skills particularly, upskilling them in metadata creation.

Archiving: This involves the provision of long-term retention of and access to research data. Libraries advocate for research data to be made available and accessible through local OA

repositories and they play a critical role in advising researchers on the types and characteristics of available repositories (Yu, 2017:792).

e) Providing access to data

Disseminating research findings is crucial for innovation but the output has been expanded to include not only publications but also research data (Richardson *et al*. 2012:259). In the university context, it is imperative to understand how researchers access and use their data (Henty, 2008:15). Reaping the results of data deluge requires that data is shared in a way that it can be interpreted and be reused. Sharing research data is a complex endeavour requiring an understanding of the "nature of data, research, innovation, and scholarship, incentives and rewards, economics and intellectual property, and public policy" (Borgman, 2012:1059). Strasser (2015:10) indicates that proper licensing or waivers are crucial given that data sharing enables the users to download, use and reuse data.

The rationales for data sharing as outlined by Borgman (2012:1072) include: enabling reproduction and verification of research; making publicly funded research available; to enable questions to be raised on existing research data; and, providing avenues for the advancement of research and innovation. These rationales would be impacted by the many stakeholders based on the arguments they have for sharing data, benefits to be accrued, motivations and incentives.

The libraries role in enhancing data sharing, control, copyright establishment and promotion is essential to data access. Shearer and Argaez (2010:7) find that libraries can enhance access to data through appropriate cataloguing and linkages of varied datasets held in different places or expansively, embrace data curation activities. Koltay (2016:99) pointed out that libraries can engage in the promotion of data citations through the application of persistent identifiers to research data. A study by Yu (2017:792) indicated that the majority of libraries advocate for data sharing through providing consultancy, guidance and best practices on how to share research and data. The University of Virginia, for instance, "identifies the advantages of using such repositories for the services they provide in areas such as persistent and citable identifiers, access controls, terms of use licenses, guidelines for deposit, data preservation and professional backup and documentation, as well as well-developed standards for quality control."

f) Re-using data

Data can be re-used and re-analysed for different purposes not originally created for. They can be used to verify results or to be analysed using new techniques, thus, universities have been increasingly under pressure to create infrastructures for managing data (Henty *et al*., 2008:1). According to Strasser (2015:1), managing data appropriately increases use and re-use thus translating into enhanced collaborations for researchers and maximum return-on-investment for the funders.

Empirical studies on the role of libraries in RDM such as Corrall, Kennan, & Afzal (2013); Tenopir *et al.* (2015); Cox & Pinfield (2013) have suggested that libraries role in RDM has majorly been focused on providing advice, support and training services vis-à-vis technical services. According to Cox *et al.* (2017:27-28), there is an indication of significant leadership from the library community but also, evidence of a less developed service portfolio in RDM implementation. They find that offering RDM services is intricate as a wide range of both advocacy and technical aspects are required in the various research data lifecycle phases and further, appropriate skills and capabilities ought to be put in place.

3.4.3 RDM in the African Context and the Role of University Libraries

A study on RDM activities in higher education conducted by Cox *et al*. (2017) indicated that libraries in Australia, Canada, Germany, Ireland, the Netherlands, New Zealand and the UK have taken leadership in RDM. A related study by Koltay (2016) on the tasks and roles for academic libraries in supporting research 2.0 and particularly addressing the data component indicates that the development of RDM is highly dependent on research funding requirements. Consequently, high activities of research funding put the UK at the forefront with considerable developments in Austria, Germany, Ireland, the Netherlands and Norway.

There seems to be scarce information addressing purposely RDM in the African context with much of the literature available through Google Scholar using the search terms “RDM in Africa” and “Research Data Management in Africa” highlighting developments in the South African context. “In South Africa, those involved in research are also increasingly aware of the importance and value of curating and sharing the research data produced through public funding and RDM policies are emerging” (Kahn *et al*., 2014:296). Thus, like in the developed countries,

research funding requirements have majorly compelled the RDM initiatives in the South African context. Kahn *et al*. (2014:296) state that the National Research Foundation (NRF) which hosts the South African Data Archive (SADA) advocates for proper RDM especially to researchers who are receiving research funding.

Studies have expressed the RDM state of affairs in South Africa (SA). According to Kahn *et al*. (2014:297-298), awareness and capacity building has already taken shape in SA. An example is given of the Network of Data and Information Curation Communities (NeDICC) which organises seminars, workshops and conferences create awareness about digital curation. They also report on a workshop organised by LIASA and facilitated by DCC, UK which took place in Cape Town in the year 2014 that aimed at raising awareness and practice skills on RDM issues to LIASA members who include librarians and information specialist all of whom were invited to attend the workshop. South Africa also has data repositories that would enable handling of big data. This includes: the South African National Park (SANParks), the National Health Information Repository and Data Warehouse; the South African Very Large Database and the Data Intensive Research Infrastructure for South Africa (DIRISA), which, recently in May 2018, in conjunction with NRF, released a pilot DMP tool to be tested by researchers from around Africa (University of Free State, 2018).

Lotter (2014) reported on the RDM position in South Africa with entities involved in RDM to include HEIs, research councils, NRF, Government agencies, NGOs private entities and data centres/libraries (Lotter, 2014:5) with RDM policies such as ethics policy, data sharing policy among others being available at varying stages in the various entities (Lotter, 2014:11). Universities such as Witwatersrand (Wits), University of South Africa (UNISA), University of Cape Town (UCT) and University of Pretoria (UP) are reportedly engaged with researchers in training and advocacy about RDM (Lotter, 2014:12). Besides, storage and preservation platforms have been set up or suggested, for instance, use of institutional repositories, linking of data sets to theses and dissertations, use of data centres, and use of national research facilities for big data (Lotter, 2014:13). Finally, various training opportunities to empower staff to support RDM have been applied through workshops, in-house training, knowledge sharing platforms, and self-learning, networking among others (Lotter, 2014:15).

Studies by Van Wyk have also contributed to informing the developments in RDM in the South African context especially in the area of formal education which is crucial as there is a gap in skills and developments among librarians in supporting eResearch as discussed in section three of this study (See section 3.2). Van Wyk *et al*. (2017:6) reported on developments in the education of RDM in SA in which it was indicated that UP planned to introduce a Master's degree in IT (Big Data Science) from 2017, Wits in Johannesburg would offer a BSc Honours (Big Data Analytics) and, Sol Plaatje University would present a Bachelor of Science degree in Data Science. Van Wyk *et al*. (2017:8) furthermore noted that UCT was the only university in Africa at the time of this reporting that teaches a Masters in Data Curation and several related other short courses on RDM. UP established the Carnegie funded Master's in Information Technology (M.IT) and Continuing Professional Development (CPD) which integrate RDM training. Van Wyk *et al*. (2017:9) also pointed out that community of practice (CoP) such as the Network of Data and Information Curation Communities (NeDICC) has also enhanced RDM by engaging practitioners in SA. In terms of policy making, only the UP had a formal RDM policy as of 2014 (Woolfrey, 2014). The UP had a policy for the preservation and retention of data as early as 2007 and by 2015, they had established an RDM policy (Van Wyk, 2015) which was later approved by the UP executive in 2016 (Van Wyk, 2016).

Following these studies, it is evident that various stakeholders including the government, universities and their libraries, NGOs, research councils have all played a critical role in the advancement of RDM in SA. There is limited information on RDM in other African countries and hence, there is a need to address this gap if the African continent is to move at par with the other developed countries in terms of RDM.

3.5 Research Data Management Challenges

Research data is complex and therefore, presents challenges for its organisation, dissemination, and preservation in a university setting. "Although research data often have value beyond the purpose for which they were originally created, most data are still not shared or made publicly available" (Shearer & Argaez, 2010:6). Data sharing has remained common only in particular areas such as in astronomy and the practice varies widely in many other fields. This is especially augmented by the fact that research data varies and is handled in a variety of ways, through varied approaches and presents challenges even in their interpretation as their initial context

counts (Borgman, 2012:1059). The human and technical aspects of research are critical for the successful implementation of RDM initiatives. The involvement with RDM attracts a variety of challenges that would affect both the researchers and university libraries adopting this new innovation. For example, the cultural aspect is a challenge faced when a university is adopting RDM. With Faculty members and even librarians having been used in particular ways of handling data, the transformation may not come automatically among every stakeholder.

Given the experiences at Flinders University, Morgan, Duffield and Hall (2017:302) revealed that cultural change is a key challenge citing an example of the amount of time required to be invested by academics in data services as posing a challenge by itself, even in cases where the benefits of RDM are appreciated. Consequently, calling for the need for continuous engagement as the pace of change and adoption to RDM is not instantaneous. Deninson, Kethers and McPhee (2007:9) also expressed the same concern by asserting that researchers regard themselves as time poor and would want services that are interoperable with their usual work practices and technologies. Therefore, there is a tendency to avoid non-core tasks unless they are proven to have considerable benefits. Heidorn (2011:668) notes that there is insufficient training for researchers with regard to long-term access and preservation of data, thus, with the increasing demand for DMPs by funding agencies, they seek assistance from libraries during grant writing. Consequently, libraries that understand this need, position themselves to provide the necessary assistance. "Libraries have the skill sets, longevity, and most of the infrastructure needed to accomplish this task for many types of data. If libraries do not actively engage in the task, then society may choose to create a new type of institution to curate digital data" (Heidorn, 2011:670).

Koltay (2016:95) outlines the issue of motivation asserting that research funding agencies have been crucial in areas such as European Union (EU), Australia, Canada, and the USA, in pushing for OA to research data, which has been a motivator to academic libraries to engage in RDM services. However, less research-intensive universities may have a challenge to convince the top management of the need for data curation and development of a skill set towards this endeavour. Countries with less pressure about OA to data may also experience low levels of RDM activities.

Yu (2017:793) reported that various libraries are viewing the provision of RDS as a valuable addition to the services they provide to their users; hence, academic libraries are providing

advice to researchers to take advantage of OA repositories to safely store and access research data. However, these efforts are thwarted by the lack of "formal data management infrastructure and policies in many academic libraries, insufficient staff training and preparation and inadequate funding" which makes RDM initiative to continue being driven by funding agency requirements vis-à-vis being a self-starter university service.

As the pressure continues to mount for libraries to support RDM, Cox and Pinfield (2013:300) point to the increased staff time required on librarians to provide this service in the midst of already over-stretched library services. Supporting RDM may push libraries to downgrade other services and a top this, there is still instability in terms of infrastructure, policy, and governance which leaves the library at a stalemate in terms of positioning itself to support RDM. Furthermore, Cox and Pinfield (2013:301) point to the lack of technical knowledge, domain-specific expertise, and limited research experience as potential barriers to librarians taking up a critical role in RDM support. According to Heidorn (2011:667), having all the skills required to represent all the information and descriptions for data can be problematic for academic libraries because data varies widely requiring a range of schemes to create appropriate metadata. This may require a close working relationship with data creators in order to understand their data and there is a need to work with other institutions in order to identify appropriate standards and practices for various datasets.

A study by Luce (2008) identified funding as a challenge in RDM because long-term data preservation would require adequate and sustainable funding to cater for appropriate infrastructure. In the study, Luce (2008:49) poses questions that,

> *The cost of owning and managing data, hardware, and software is very high. How do we offset and share multi-institutional infrastructure investments? Because it takes a community to meet these challenges, how many research libraries need to work together to meet specific eResearch needs, and how do we collaborate in new, more effective ways*?

These challenges call for innovative ways to work collaboratively both at the national and international levels. Lewis (2010:11) states that academic libraries and IT managers have had a challenge when it comes to making decisions on how RDM services can be best handled locally, nationally or internationally.

Ethical issues have also come into play as a challenge in RDM. Data about humans may raise privacy concerns while some data may be classified by a nation for security concerns, thus, requiring a library to apply appropriate access controls (Heidorn, 2011:668). "Data may be sensitive, containing personal information for example, and so needs to be managed with appropriate security measures in place" (Cox & Pinfield, 2013:299). For data that has to be stored externally, there have been concerns with regard to the level of trust that can be placed on external agencies to be in charge of the long-term preservation of data (Lewis, 2010:11). Trust in the technology used in terms of being reliable and stable is also of concern to researchers. They want to be able to trust the organisation that is managing their data, and as well, that the research community will not "misuse, alter, or steal the data" hence, libraries managing these data have to ensure that there is sufficient security in order to build trust in the systems and infrastructures being used in RDM (Denison, Kethers & McPhee, 2007:9).

Storing massive data that is continuously being generated by researchers is challenging, as they have to be stored in a way that is accessible, can be processed and may be analysed. These data sets may be vulnerable to storage failures and technological obsolescence. In addition, "a whole range of other activities commonly associated with datasets, such as reformatting them for analysis in various software packages, shipping them between sites, processing them for potential reuse, and carrying out various preservation actions upon them" as highlighted by Cox and Pinfield (2013:299) would need attention. Technological infrastructure is, therefore, a challenge in itself and requires careful planning to avoid loss of data. "Just as many academics find themselves challenged to adjust to new requirements in order to continue funding their research" (Akmon *et al.*, 2011:330), libraries are challenged to develop RDM support that cuts across their own organisational structure. As they establish partnerships to offer RDM services in collaboration with other campus stakeholders—including offices of research, offices of sponsored programs, technology service units, research compliance offices, and academic departments—they must work broadly across disciplinary and functional units (Humphrey 2014). This breadth renders the development of RDM services an organisational challenge within research institutions" (Flores *et al*., 2015:92).

3.6 Procedures, Tools and Policies for Promoting eResearch

eResearch is characterised as data-intensive: generating and often using large volumes of data; collaboration involving researchers across multiple institutions, and often transnationally; Grid-enabled computing: using high-capacity networks and middleware (Lewis, 2010:8). Similarly, eResearch can incorporate collaborative technologies, research data management, scholarly communication, computation, visualisation, data collection, and analysis (Thomas, 2011). eResearch, therefore, incorporates the use of not only high computing technologies, but also the integration of emerging technologies such as web 2.0 tools in the research lifecycle to enhance research.

eResearch has brought about changes in how researchers' conduct and publish their research work which has impacted on how academic libraries are required to provide their services (Koltay, 2016:94). Often, libraries have played a role as a store for end products for created works but this practice is changing to involve more engagement in the research process (Henty, 2008:4). University libraries are now tasked to have more engagements with the researchers, thus, "traditional roles providing information support and training have been expanded to include support in all aspects of the research lifecycle" (Brown, Wolski & Richardson, 2015:232). In a bid to support research, Macquarie University, for instance, has focused its attention on "*enabling* systems, structures, policies, processes and support, increasing the ease by which researchers can access and use these to drive research outputs, engagement and outcomes" (Macquarie University, 2016:3).

In trying to bring to light the procedures, tools and policies that are used to promote eResearch in universities, this study has similarly adopted the aspects of eResearch policy, process, support, tools and collaboration adopted from the eResearch Capability Model (See section 2.3.1) to review literature on the role of university libraries in supporting eResearch as presented in this section.

3.6.1 eResearch Policies

Research policies would go a long way in aiding the implementation of eResearch in universities as they would provide appropriate guidelines for RDM. eResearch policies have been entwined

in visions and missions, strategic plans, institutional, national and international policy frameworks with the majority focusing on one or more aspects of eResearch such as data management and institutional repositories. Queensland University of Technology (QUT), for instance, has a policy that mandates researchers to submit papers to their ePrints repository (Stokker, 2008). Queen Margaret University, on the other hand, is reported to have a policy that indicates what should be deposited in the repository, that is, all-inclusive allowing both peer-reviewed and non-peer reviewed works. In addition, they have an advocacy policy that informs researchers about the rationales for depositing their research output in the repository (Muir, 2009:52). The University of Reading has an e-strategy plan that oversees enhanced research support in terms of appropriate human resourcing, systems and tools (Mithen, 2015). Estrada (2013:123) notes that organisational support for eResearch emanates from strategies, policies and management decisions.

Nations and individual organisations have played a crucial role in catalysing the advancement of eResearch. Two cases presented here illustrate this role. A report by Kahn *et al*. (2014) indicated that the JISC-funded Digital Curation Centre (DCC) worked with thirty UK universities with the aim of developing and implementing RDM policies. These policies are well developed and can be more effective if a close working relationship is established with researchers and other relevant stakeholders such as librarians, ethics and legal offices during its development and implementation. This was meant to ensure that policies were realistic and sustainable in line with established policy statements.

In the African context, Pienaar and Smith (2008:7) reported that the SA national research and development strategy established in 2002 aimed at involving stakeholders to rethink their role within a changed society that was increasingly being impacted by technology. This strategy influenced the information sector and obliged institutions to work together in order to meet the information services support that would be required and could not be handled by any individual institution. As a result, the South African Research Information Services (SARIS) project team was established that spear-headed eResearch support services within the SA context. From these cases, it is evident that eResearch policy creation involves many stakeholders regardless of the person or institution kick-starting its development and implementation.

University libraries have also been reported to have a critical role to play in supporting the creation and implementation of eResearch policies within the university setting. According to Hart and Kleinveldt (2011:37), academic libraries have always identified with research support through their missions, but there is a need to review how these missions identify with researcher's perspectives in view of the changes being experienced in information seeking and sharing in the online environment. The relevance of policies in RDM and libraries role has been discussed in section three of this study (See section 3.3.1). From these studies, it is coming out that that there are no standardised ways of eResearch policy creation and implementation among universities.

3.6.2 eResearch Processes

Increased digital content being created across the research lifecycle has led to institutions becoming more accountable about the creation and management of their research output through the development of appropriate infrastructures. This environment has provided academic libraries with an opportunity to contribute significantly in the research arena, thus, having an impact in the academic setting. "By exploiting its experience and understanding of managing content, knowledge of information systems, and knowing the value of collaboration, the academic library can contribute substantially to research information infrastructure" (Frances, Fletcher & Harmer, 2011:2).

In this section, the role of university libraries in supporting eResearch is discussed through the following four phases of a research lifecycle: Formulation of ideas and research questions; Research grant; Managing information and data; as well as Publishing and sharing. Figure 3.2 illustrates the four phases and indicates that technology has an impact on all the phases of the research process that are discussed in this section.

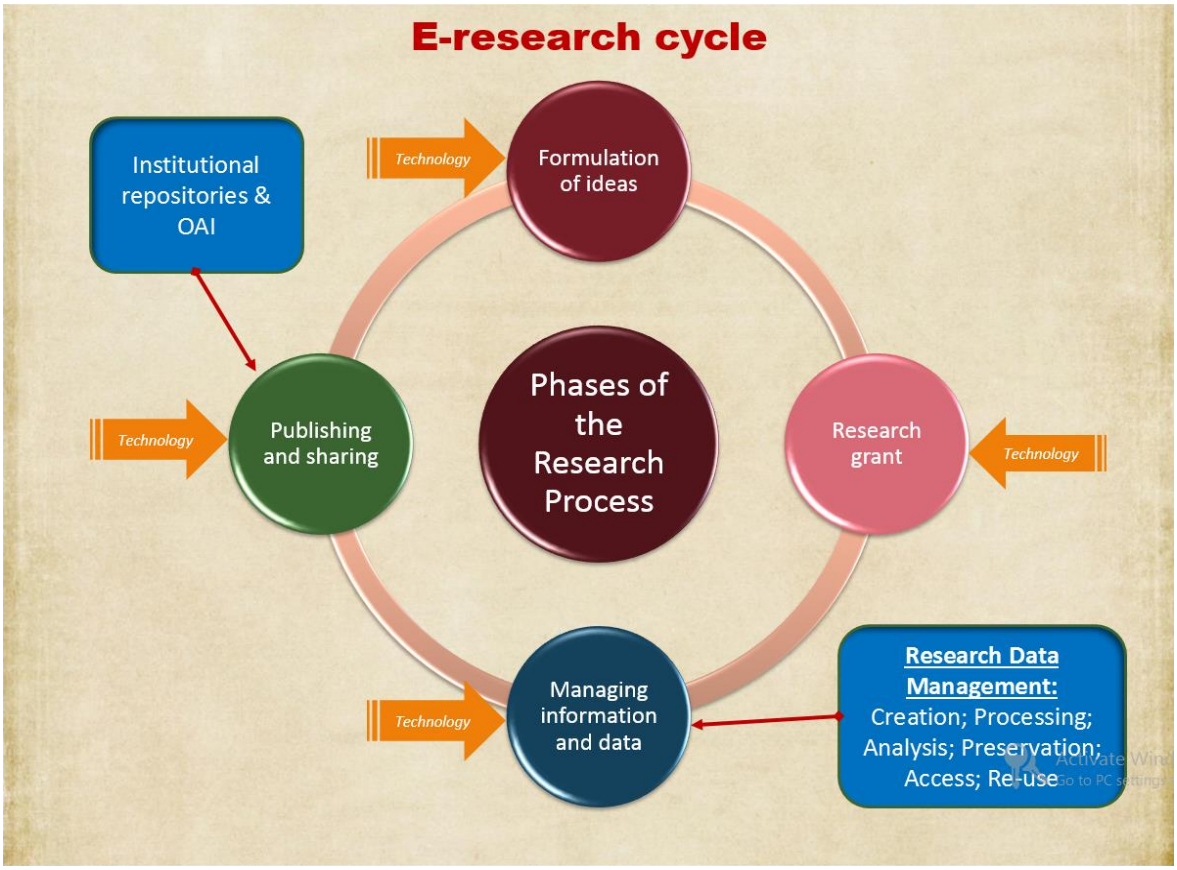

Figure 3.2: eResearch cycle

3.6.2.1 Formulation of Ideas and Research Questions

University libraries have had a critical role to play in supporting researchers at their initial stages of the research process when they are formulating ideas and research questions by providing access to information resources which Adeyemi and Oluwayibi (2013:247) found to be a significant element of the research process. "The academic world has reached an era where printed materials for research are being replaced by electronic materials that can be accessed via the internet" (Okite-Amughoro, Makgahlela, & Bopape, 2014:1). E-resources greatly compliment print-based resources in a traditional library setting (Akussah, Asante & Adu-Sarkodee, 2015:33). They are more convenient to use given that it is easier and faster to search online resources that have been well organised in a variety of categories within databases thus enhancing access to more comprehensive information (Noreh, 2009:2). Most e-resources contain powerful search and retrieval facilities that facilitate effective and efficient literature searches any time of the day at the convenience of the user's location such as through a desktop (Imsong & Kharbudon, 2016:31).

In the past, researchers had to physically visit the library, spend hours searching through catalogues so as to find information resources to support their research topics, a system that is still widely applicable in the developing countries but the use of e-resources has equally been adopted (Noreh, 2009:7). According to Lewis (2010:5), the 1980's and 1990's saw university libraries "conducting several thousand mediated online bibliographic searches per year on behalf of their researchers, the majority of them involving a detailed client interview, with the useful secondary outcome that the library liaison staff involved would have a good picture of the client's research". Technology has, however, changed not only the way information is packaged, processed, stored, and disseminated, but also the information seeking behaviour of users. This has raised the question as to how resources can be moved to an electronic platform to support the research lifecycle (Adeyemi & Oluwayibi, 2013:248) given the increasing adoption of technologies to conduct research.

As more and more researchers adopt the use of e-resources, they are becoming essential resources for everyday use (Noreh, 2009:6). As a result, university libraries have been engaged in acquiring e-resources to enable their users to access them. Academic libraries have remarkably progressed in the provision of a wide range of research materials through e-resources and resource discovery tools, thus, bringing libraries closer to the research communities to answer their respect needs (Carlson & Kneale, 2011). There have been, however, some challenges to effective use of e-resources, as outlined in studies. For instance, Gabbay and Shoham (2017) conducted a study on the role of academic libraries in research and teaching in three academic institutions in Israel. The study established that the Faculty members found their libraries useful in technical aspects and provision of resources which supported teaching but they did not support aspects such as locating and providing comprehensive information relevant to support their research. This finding was contrary to what the librarians in the study had indicated that they support research needs, which resulted to the recommendation that librarians' perceptions had to change and that actual assistance to researchers in finding resources ought to be provided.

A study by Egberongbe (2011) on the use and impact of electronic resources at the University of Lagos revealed that despite researchers using e-resources, the practical use of these resources did not add up to the investments that go into acquiring them; thus they recommended that more

training and advocacy is required. Adeyemi and Oluwayibi (2013) on the other hand conducted a study that examined the views of postgraduate students on the role of the Kenneth Dike Library which is a university library in supporting their research through the provision of information resources. The study established that the majority of the respondents appreciated the critical role played by their library in providing appropriate information resources, but it also revealed that a number of these students lacked some awareness about the resources and services provided by their library, thus a need for awareness was raised.

Gannon-Leary, Bent and Webb (2008) reported on a study conducted in 2006 by the Research Information Network. They found that e-resources are underutilised by researchers because of the need for one to sieve through a lot of resources which evokes information overload that the majority of researchers would not like to deal with. Moreover, some respondents indicated that they barely go past the abstracts of the articles. Therefore, it was established that the library has a critical role in directly delivering relevant content to researchers. Keller (2015:79-80) indicated that researchers do appreciate the benefits of e-resources but librarians perceptions towards the acquisition of these resources could determine effective use. For instance, he finds that Australian librarians are keen on the value-added services that the e-resource collection brings to their users, whilst the European librarians still significantly find pride in having a rich collection.

These challenges show the need for libraries to intensify strategies that will ensure e-resources are easily accessed and used to support research. For example, information literacy has for years been used by university libraries to advocate for e-resources. Wema and Manda (2013:2) assert that effective use of e-resources often goes hand-in-hand with strong information literacy skills. Imsong and Kharbudon (2016:33) supported this by stating that information literacy is critical in enhancing e-resource usage, but they pointed out that full potential in retrieving e-resources is yet to be achieved. In the context of eResearch, librarians will have to do much more than advocacy and information literacy training. They will be required to understand the researcher's topics and work closely with them, individually if possible, to ensure that relevant resources are accessed and put to use. By so doing, the quality of research can be enhanced from the early stages of topic selection.

3.6.2.2 Research Grant

Librarians will be engaged as partners in the research process through activities such as aiding researchers in drafting research grant proposals (Stokker, 2008:8). Generally, the processes of grant applications are supported by research offices in universities, but increasingly, libraries are playing a critical role in supporting researchers through the grant application procedures. According to Downing (2009:111), a university library can support the grant-seeking process by acquiring grant-seeking tools to support researchers; collaborating on various grant-based projects in conjunction with other departments which will enhance their experiences in the process, and, by including a librarian in the university groups that develop research policies and grant-seeking infrastructures, thus enabling the library's participation. Additionally, libraries can become integral through dedicating a librarian to be in charge of grants or by utilising the existing subject specialists to be part of a university's grants programs.

Research Information Network (RIN) in collaboration with Research Libraries UK (RLUK) commissioned a study to examine the contributions that libraries make to research. They found that grants support was one of the key library's roles and that in as much as research offices assisted researchers in creating high-quality grant applications, some libraries do offer support too but more as a response to specific requests from researchers vis-a-vis proactively. "Libraries could play a greater role if researchers knew that support was available, and if their involvement were more formalised. Libraries have an opportunity to use their skills to help researchers improve the quality of their funding applications, and to increase the institution's success in winning research income" (Jubb, 2011:43). The RIN and RLUK report (2011:28) suggested that libraries are increasingly helping in grant applications through:

> *Advice on collections (e.g. for digitisation projects), and ensuring that researchers will have access to the content they need to support their research; conducting literature reviews and surveys, and providing references for inclusion in grant applications; quality checking of data; undertaking to provide resources and expertise for the project (e.g. a systematic literature review); advice on data management plans* (2011:28).

Increasingly, research funders are keen on open data and the impact factor of researchers output in order to provide funding. According to Richardson *et al*. (2012:262) researchers globally are implementing policies that require DMPs from grant seekers and holders. Libraries are playing a

critical role in aiding researchers to prepare for these. Ball and Tunger (2006:565) observed that researchers do not have the know-how to perform bibliometric analyses. Given the increasing pressure on the impact factor of research output, Roemer and Borchadt (2012) assert that, "many librarians have stepped forward to help [Faculty] negotiate the landscape of both traditional impact metrics... and emerging Web-based alternatives". A more recent study by Otter, Wright and King (2017) discussed how librarians can play a critical role in avoiding research waste during grant applications. The study finds that librarians can check for the originality, relevance and suitability of research designs before researchers invest in grant writing. Otter, Wright and King (2017:263) noted that librarians can help to improve the quality of applications which can greatly enhance the success of winning grants and, they can also aid in pointing out to research questions not worth pursuing which can save the researchers time and resources.

By getting involved in research proposal writing, librarians get the chance to closely work with researchers, hence, may be included in funded research teams. Otter, Wright and King posit that:

> *The diversity of the research ideas, funding bodies, and possible sources of evidence make grant proposal work challenging but also fascinating and rewarding. It helps the librarian develop professional skills in project work, report-writing, the grant application process, and wider university issues. It can also raise the profile of librarians within the research team and lead to further opportunities* (Otter, Wright & King, 2017:272).

3.6.2.3 Managing Information and Data

Luce (2008:43) reported that knowledge preservation has become one of the key roles of libraries and that libraries that envision to support eResearch are poised to face four key challenges: "ensuring the quality, integrity, and curation of digital research information; sustaining today's evolving digital service environments; bridging and connecting different worlds, disciplines, and paradigms for knowing and understanding; and archiving research data in a data world". Globally, institutions concerned with digital preservations and services are evolving due to the growing importance of preserving data and information (Brown, Wolski & Richardson, 2015:225). Libraries have played a critical role in managing information through the years; initially, this was majorly in physical libraries, but increasingly managing digital information and more recently, involvement in the management of data. The following discussion focuses on the role of university libraries in managing information and data

electronically with a special focus on the use of institutional repositories which play a critical role in enhancing eResearch.

a) Role of Institutional Repositories in Managing Information in University Libraries

Institutions are keen on the use of institutional repositories for many reasons that include showcasing institutional research output, securing funding, and marketing of their institutions, all of which are intertwined (Denison, Kethers & McPhee, 2007:10). IRs provide infrastructure to centralise, preserve and to provide access to an institution's intellectual output. Furthermore, they form part of a network of global repositories that have formed a basis for new ways of scholarly publishing (Negahban, 2010). According to Adewumi and Ikhu-Omoregbe (2010:1), "…an IR is tailored specifically to capture, preserve and disseminate the intellectual output of a university community or research institution". A repository, therefore, offers a great opportunity to universities in the effort to manage information. University libraries have taken the critical role of managing repositories. Stokker (2008:2) reported that it is not surprising that university libraries embraced repository management, and this he attributed to the long-standing core library skills to gather, organise, describe, and to provide access to information.

Sterman (2014:361) asserts that librarians ought to be keen on new technologies such as IRs which have great potential to disseminate information to several people. He further points out that due to the increasing push for OA initiatives, decreasing library budgets, rising costs of traditional scholarly publishing and, increasing IR platforms, IR development has increased. Statistics indicate that there are 3519 repositories listed in the Directory of Open Access Repositories (DOAR) as at March 2018, out of which 157 are in Africa accounting for 4.5% on a worldwide scale, which is a small number compared to Europe's 47% (1617) (OpenDOAR, 2018). The above mentioned is an increment compared to the statistics which had been captured from openDOAR by Adewumi and Ikhu-Omoregbe (2010:1) which indicated that Africa had 46 repositories in 2010 that accounted for 2%, while Europe was at 45% at the time. Cullen and Chawner (2011:460) attribute this growth to academic libraries which are keen on advancing OA. A study by Chilimo (2015) revealed that Kenya has made some progress in a bid to adopt OA having 12 IRs with five mandatory self-archiving policies listed on OA Repositories Mandatory Archiving Policies (ROARMAP). In addition, INASP has greatly supported libraries

in Kenya to be involved in OA week during which the libraries have raised OA awareness, launched IRs, and have conducted OA workshops.

However, as much as libraries are making great effort in developing IRs and encouraging OA initiatives, studies by Cullen and Chawner (2011:460; 2009:271) have indicated that the researchers have not embraced repositories as part of the publication process thus, there has been reluctance in depositing their research due to "lack of interest, lack of knowledge, or through concern over the purpose and function of repositories". This presents an on-going challenge to libraries, as they need to continuously market and advocate for repositories and OA to ensure sustainability. Sterman (2014:363) noted that, "it is difficult to get researchers to voluntarily submit their own research. It takes time to explain what the repository is and how it might help a researcher. Researchers need compelling reasons to take time from their busy schedules to assign basic metadata, figure out the copyright status of an article, and then find the PDF of the appropriate version of their work. Education and outreach ease of use, and implied benefits are often not enough to foster a culture of participation that encourages researchers to deposit".

Critical to the development of IRs is advancing the OA agenda. According to Stokker and Hallam (2009:565), "an open-access model essentially provides access to scholarly information without any subscription or author fees". Increasingly, libraries are encouraging researchers to self-archive their resources in OA repositories. Chilimo (2015:29) asserts that, "many universities, funding agencies and even national governments have put in place either mandatory or voluntary OA policies on self-archiving with the aim of providing free access to research publications". "OA self-archiving policies are strategies implemented by institutions requiring scholars to deposit copies of their research publications in a repository or on a website, a procedure commonly referred to as self-archiving" (Chilimo, 2015:29). Self-archiving has the potential of empowering researchers to deposit their scholarly work leaving the libraries to quality check of the deposited work. This would greatly enhance the scholarly communications practices within an academic institution.

b) Role of Institutional Repositories in Research Data Management

Academic libraries have traditionally focused on the output of scholarly communication in which case they have collected final products of research such as journals and books (Koltay, 2016:94) for their management and dissemination. The inception of eResearch has, however, changed this practice due to the increasing focus on the management, use, sharing, re-using, storing, and preservation of data with libraries being well placed to provide infrastructures that support these processes (Henty, 2008:2). Luce (2008:45) highlights that caring for data calls for the management of data throughout its life cycle, which includes its acquisition, treatment, provenance, persistence, and preservation. Data preservation, whose goal is in ensuring that data can be accurately rendered over time is the last step in the data lifecycle and is different from data storage. To ensure long-term preservation of data, requires appropriate strategies and policies that enable on-going usability and appropriate preservation strategies such as maintaining multiple copies and migrating content to new media are required. Long-term data preservation can be attained through the use of trusted repositories (Strasser, 2015:13) with an increasing need for libraries to provide these repositories (Koltay, 2016:99).

The past decade has seen the majority of academic libraries in institutions spearhead the development of repositories both in developed and developing countries with the former being ahead in the number of repositories established (Cullen & Chawner, 2011:461). OA repositories have especially been on the increase providing significant opportunities for digital data and information management in libraries. Observations by Shearer and Argaez (2010:8), and Henty (2008:2) indicate the growing interest in data management by libraries with IRs evolving to have a critical role to play in the data lifecycle especially in the storage and preservation of data. A study by Yu (2017:783-784) highlights that OA repositories have considerably changed the data landscape with the past five years experiencing an increasing need for data management with mandates arising from funding agencies and governments. He states that "academic libraries are taking advantage of open access repositories by advising researchers to use the available resources alongside their local repositories for data safe-keeping and sharing" (Yu, 2017:783). This benefit was also outlined by Cullen and Chawner (2011:461) who assert that researchers are freed from maintaining their data on personal computers and websites.

Examples of university libraries that have adopted repositories for data management include: the Purdue Libraries, which built a free-standing repository using Fedora (Bracke, 2011:67); the Massachusetts Institute of Technology (MIT), which has used the DSpace repository software to archive, preserve and provide access to researcher's data through the PLEDGE project (Shearer & Argaez, 2010:8); and Princeton University which uses Dspace for maintaining different data sets (Princeton University, 2018a). Further, they provide RDM guides to researchers (Princeton University, 2018b).

Challenges to adopting repositories for data management have been reported. Denison, Kethers and McPhee (2007:6) reported about issues found in literature that may affect the uptake of publication and data repositories as: "ownership of data; existing non-collaborative culture; reluctance to change workflows; ignorance of the benefits; lack of incentives; difficulty of adequately representing the context of data and sharing it meaningfully; and lack of resources." Creaser (2010) assert that academic staff generally report little knowledge of the concept of institutional repositories, institution's policy (including whether deposit is mandatory or not), and are as well ignorant of their own and publishers' Intellectual Property rights. Libraries managing repositories may recognise that some special expertise is required to manage data using repositories. However, the administrative structures will be very familiar (Heidorn, 2011:666). Long-term preservation which calls for attention to libraries is also raised as a concern (Bracke, 2011:67).

A study of library staff from different UK institutions on contribution of academic libraries to RDM by Pinfield, Cox and Smith (2014:11) found that the respondents acknowledge that libraries have been involved in the adoption of repositories for RDM, but it was uncertain the extent to which libraries are involved in this with scepticism being expressed as to how libraries can use repositories for large datasets. The study, therefore, indicated that "data storage and other technical infrastructure was identified as outside the library remit, with IT services identified as leading in this area". Mevenkamp (2018 as cited by Smith, 2018) indicated that while Dspace has been adopted at Princeton University for RDM, the challenge remains it is not well suited for supporting big data, as their biggest file is 43GB, which is on the extreme in terms of the software's capabilities. It was also highlighted that, "once DSpace creates a permanent URL, it does not allow regular submitters to change anything about the submission. So either the

researcher finalises the submission after article publication or a DSpace administrator has to enhance the submission's metadata with the article URL later on". This example indicates that even libraries would have challenges in handling data, especially big data; hence, the need for strategies and collaborations with other organisations.

3.6.2.4 Publishing and Sharing

The increasing use of technology in research has had an impact on research publishing and ways of sharing research products. Cullen and Chawner (2011:460-461) reported that the traditional scholarly communication cycle that involves submitting findings to journals, rigorous peer review then dissemination of publications through library subscriptions has been perceived to consume unacceptable time lags which has not only frustrated authors, but has derailed them from keeping up with developments in their fields. The development of IRs has, however, presented new opportunities especially in the advancement of OA publishing, which has brought about benefits to researchers such as enhanced visibility, usage and increased citations on their research products. Engeszer and Sarli (2014:1) pointed out that the internet has presented a chance to remove the barriers of accessing peer-reviewed scholarly works enabling proponents of OA to change scholarly communication processes with the aim of accelerating the discovery and access to research findings. According to Henty (2008:3), OA was originally meant to preserve research outputs such as journals and books, but has increasingly been embraced to promote alternative ways of publishing, whilst still observing peer review and scholarly integrity. A study by Nwagwu (2013:4) indicated that the OA movement has provided Africa with a chance to publish and share the rich knowledge resources produced in the continent with the rest of the world.

Koltay (2016:94) avers, "No doubt, changes in researchers' information behaviour and in the publishing world are calling for a major transformation of the role and tasks of the academic library". For decades, academic libraries have been involved in scholarly communication initially focusing on ethical issues, such as fair use and copyright restrictions, but the range of involvement has extended to other aspects such as "author rights, promoting the use of institutional repositories, and, most recently, using publication metrics and other indicators to analyze the impact of research", which has resulted in many academic libraries establishing

formal scholarly communication programs with specific positions to support the programs (Engeszer & Sarli, 2014:2).

Librarians should be at the forefront in informing the research staff about OA publishing, metadata, and on various available publishing infrastructures (Frances, Fletcher & Harmer, 2011:5). Information should be provided about: the Diamond, Gold, and Green OA routes; Article Processing Charges (APCs); and, the relatively new and controversial challenges revolving around predatory publishers (Koltay, 2016:100). Ferris and Winker (2017:279) warn that:

> *Predatory journals, or journals that charge an article-processing charge (APC) to authors, yet do not have the hallmarks of legitimate scholarly journals such as peer review and editing, Editorial Boards, editorial offices, and other editorial standards, pose a new challenge for authors, editors, and readers. Their motive is financial gain, and their modus operandi is a corruption of the business model of legitimate open-access publishing*.

A study by Publishers Communication Group (2014) investigating the role of libraries in OA funding and support within institutions established that although the financial responsibility of publishing funding lies with the author, the library has a crucial role to play to control APCs. According to Zhao (2014:3-4), predatory publishers take advantage of author-paid OA models and the increasing need for researchers to publish. Since some of them may not have an understanding of the operations and implications of OA publishing. Given that academic librarians understand OA, legal issues, bibliometrics, as well as how to access a variety of resources, they are better placed to enhance scholarly publishing literacy.

It is crucial for academic libraries to educate their communities about predatory publishing, as well as how to distinguish them from genuine journals (Berger, 2017:206; Ferris & Winker, 2017:282-283). Trent University Library, for instance, on their website, provides information on predatory journals and a list of these on their website to assist researchers to spot them (Trent University, 2018). Zhao (2014) asserts that, "scholarly publishing literacy should be treated as an extension of information literacy delivered through a broader research support framework". It is vital that librarians involved in eResearch are aware of the changes that are happening in scholarly publishing such as "the role of open access, emerging trends such as data journals, and

how research outputs are measured (bibliometrics, altmetrics, data citation, research profiles and impact)" (Simons & Searle, 2014:8). Furthermore, a working knowledge of ethical issues such as licensing and copyright will be relevant (Simons & Searle, 2014:9). Kear and Colbert-Lewis (2011) also noted that the Faculty may be challenged to prove the quality of their work, thus, requiring librarians to work with them.

3.6.3 University Wide and External Support for eResearch

Richardson *et al.* (2012:259) points out that, "Governments worldwide are investing in national research information infrastructures to drive national innovation. Because universities clearly have a central role in the generation of knowledge and innovation, they are major stakeholders in national innovation strategies". Effective eResearch in universities necessitates a wide range of stakeholders to be involved in supporting it. This level of support includes not only the university libraries' who are key players as extensively discussed in this study, but also the university at large, national, and international involvement are proving relevant to eResearch endeavours. This is increasingly becoming a necessity especially in the area of RDM that may require high computing infrastructures for data storage and sharing that may not be affordable to one single university. The increasing need for research data has also made nations to become keen and proactive about eResearch development. According to Richardson *et al*. (2012:261), governments globally are challenged to create research e-infrastructures to enable the management, accessibility, and discoverability of copious amounts of research data; while on the other hand, universities are facing pressure to align their research strategies with national initiatives. Taha (2012:849) posits that the ultimate mission is for universities to provide appropriate infrastructures such as grid computing and digital libraries that support eResearch alongside appropriate personnel.

"Many, if not all, of the National Science and Research Priorities rely on Data Science and eResearch tools, applications and practices" (Macquarie University, 2016:5). National agencies such as the JISC (UK), the Australian National Data Service (ANDS), and the Research Data in Canada have played a critical role in coordinating RDM initiatives providing a great leadership role to institutions such as universities (Cox *et al*., 2017:4). Way back in 2004, the UK in recognition of the need for a national infrastructure, involved the Office of Science and Technology (OST) and partly, the Department of Trade and Industry to develop a national e-

infrastructure in support of research and innovation, as well as to provide leadership into its implementation. Taking Australia as another example, several reports reveal high-level involvement in eResearch activities which has spearheaded its development from the top level down to university level.

Macquarie University (2016:5) reports that the Australian Government recognises the relevance of data management, thus, provides research infrastructure and national strategies to handle big data and eResearch. Richardson *et al*. (2012:259-260) report about the implementation of Excellence in Research for Australia (ERA) by the Australian government;

> *A national research evaluation initiative which is designed to provide benchmarking data for Australian universities compared with international measures. As a result, government funding and policy guidelines are placing pressure on universities to increase the accessibility of their research output. Clearly, the major objective is to drive substantial growth in national productivity*.

The ANDS has also proved to be of great support in the RDM development. Cox *et al*. (2017) indicate that libraries have collaborated with ANDS to offer RDM services. Lewis (2010:10) asserts that ANDS has provided an effective roadmap for eResearch. Wolski, Richardson and Rebollo (2011:5-6) assert that ANDS funded the Metadata Exchange Hub, which was a joint Griffith University and Queensland University of Technology (QUT) project created to develop;

> *A master collection of research data within the respective institutions, along with an automated update (feed) to Research Data Australia (RDA). The Hub collects appropriate metadata from research collections (at the content metadata level where possible) within the University through customised feeds from the various university content management systems*.

In South Africa, RDM sustainability and curation efforts are reliant upon governance and call for greater participation at the international level (Kahn *et al*, 2014:304). The African continent is increasingly experiencing the rapid development of National Research and Education Networks (NRENs) which are providing platforms for research collaborations, access to high technologies and big data. A report by Foley (2016:34-35) commissioned by the World Bank shows that eighteen countries in Africa have operational NRENs with Kenya having the Kenya Education Network (KENET). According to the Association of African Universities (AAU, 2018:4),

KENET "is both the physical network and the organization delivering access to shared services like domain names, data centre, cloud computing and science gateways. KENET also provides capacity building and network security services for its members." KENET is hosted in three university libraries in Nairobi, Kenya. That is, the University of Nairobi (UON), the United States International University (USIU) and more recently, the Catholic University of Eastern Africa (CUEA). Two of these universities form part of this study. By having KENET with its high computing facilities housed within university libraries, an opportunity presents itself to these libraries to collaborate in supporting eResearch.

Despite the efforts being made at the top level of organisations, the sustainability of e-infrastructures will most likely rely on demand-driven rather than supply-driven services. Thus, there is a need for both the nations and universities to influence community engagement and contribution to infrastructure support and utilisation, for instance, by adopting web-based technologies (Procter, Voss & Asgari-Targhi, 2013:1686). Therefore, apart from the provision of infrastructures and skilled personnel, university libraries must be aware of the changes in eResearch both at the national and international level and the increasing needs of the researchers in order to play an intermediary role. Furthermore, studies indicate the need for these libraries to intensify awareness, training, and advocacy on eResearch and its infrastructures. Nitecki and Davis (2017:2) point out the need for librarians to provide advocacy and awareness on the changes in research workflows and RDM. Procter, Voss and Asgari-Targhi (2013:1675-1681); Shearer and Argaez (2010:5) advocate for trainings and skills development for researchers to ensure effective and sustainable use of e-infrastructures. This should be embedded as part of their regular trainings. The trainings should include an introduction to eResearch concepts, advise on data management plans, technical standards, data cataloguing, metadata standards and processes, and preservation management, as well as empowering them with skills that will enable them to select and exploit technologies that best match their requirements. HEIs need to provide trainings locally but need to draw resources from a wider eResearch community.

Shearer and Argaez (2010:5) also assert that, since libraries are already being approached by researchers for advice, libraries could be more creative and provide online resources such as how-to guides and online training tutorials such as for RDM. The MIT Libraries, for instance, has a website that contains a "Data Management Checklist" and offers advice for developing

data management plans. Other sections of the website include: Why Manage Your Data?, What is Data?, Evaluate Your Data Needs, Documentation and Metadata, File Formats, Organizing Your Files, Backups and Security, Sharing Your Data, Citing Data, Data Integration, Funding Requirements, Ethical and Legal Issues (MIT Libraries, 2018).

A survey of university libraries support in Queensland indicated that,

> *Libraries provide individual consultations, workshops, and support materials to support research skills training. Topics covered include advanced information retrieval, assistance with writing literature reviews, using bibliographic management software, cited reference searching, current awareness services, creating publication strategies, monitoring research impact, research data management, and tools to facilitate collaboration* (Richardson, *et al*., 2012:268).

Evidently, university libraries have a crucial role to play. Taking the Kenyan context as an example, university libraries, university Vice Chancellors and ICT Directors are constantly informed by the KENET through mailing lists about the developments in e-infrastructures at the KENET. If libraries do not play a proactive role in bringing these to the attention of their researchers and providing the necessary trainings, then there is likely to be a gap in terms of adoption and usage of these facilities among researchers. Consequently, full utilisation will not be realised.

3.6.4 Tools to Support eResearch in Universities

Technological infrastructures play a critical role in eResearch considering that eResearch by definition encompasses the use of technologies in all the phases of a research life cycle. Technological infrastructure may include not only the adoption of high-performance computing technologies such as grid computing, but also the use of web-based technologies such as social networks. According to Luce (2008:42), "the revolutionary potential of eScience is the ability to work at a much greater scale and intensity using distributed networks and powerful tools" but consequently, "there is a need for workflow tools that capture emerging communication modalities" (Luce, 2008:44). A study by Procter, Voss and Asgari-Targhi (2013:1676) revealed that there is a general lack of capacity within HEIs to provide ICT and more advanced services in support of eResearch with the support often found to be "limited, fragmented and difficult to access". The need to employ various stakeholders to offer support in order to provide appropriate

tools and technologies has been presented in section three of this study (See section 3.6.3). Globally, universities and their libraries are making a tremendous effort to provide the relevant tools to support the wide range of activities interlinked in the research phases.

At the initial research stages, when researchers are formulating ideas and drafting proposals, they require online services and resources such as access to a wide variety of databases. Masese *et al*. (2016) assert that libraries have undergone transformations into digital libraries in which case print information resources have changed to electronic resources such as e-books and e-journals enabling global dissemination of information. As Kumari (2015:151) pointed out, increasingly, "scholars prefer to have trouble-free access to intricate information, including easy access to full text and reference linking". E-resources platforms enable these needs by allowing users who have internet access to search and retrieve information from anywhere and anytime. E-resource databases have, therefore, become essential tools in supporting university libraries to disseminate electronic information. In the same breath, to enhance access to local institutional content, libraries have embraced the use of digital repositories. Open software tools such as DSpace have become critical to most university libraries in disseminating institutional content and increasingly in enhancing OA to data and information (See section 3.6.2.3).

Increasingly, researchers also require updates on new research or call for papers and proposals. In response to these needs, journal publishers have integrated web alert features that provide email or text notifications to the end users who subscribe to the services. They are alerted "when something of interest to library or user has been added to a database or published about newly published resources on a specific topic or when new articles are published in a journal" and the types of alerts may consist of: "Table of Contents; Search alerts; Citation alert; new publication alerts; Really Simple Syndication (RSS); new book alerts; Webpage alerts; and Conference alerts" (Kumara, Rajalaxmi & Devendrappa, 2013:1-2). Providing informal alerting services is one way of providing individual support to researchers (Koltay, 2016:99). University libraries have a crucial role in bringing to the attention of their researcher's information and training on these vital tools.

Supporting the research data cycle phase calls for a wide range of tools from simple desktop tools, web-based tools to high computing facilities. The Western Sydney University (2017) stated that;

Individual researchers use eResearch tools and resources to secure their research data and make it citable, to discover and gain access to research data generated from previous research, to gain access to computing resources beyond their desktop, and to collaborate and share with their colleagues. eResearch provides researchers with out-of-the-box and custom data management and computing solutions (that is, computing power and specialised software) which streamline and uplift their research. eResearch helps researchers deliver reproducible research and to meet appropriate compliance standards.

Data management tools are useful in supporting data creation, for instance, the use of online survey tools such as Google forms and SurveyMonkey to gather data; supporting data mining and visualisation, for instance, Edith Cowan University (ECU) in Australia provides to researchers two facilities known as Mount Lawley and Joondalup to support data visualisation which involves identifying, detecting and understanding intricate patterns and datasets in new ways (ECU, 2018); supporting data storage through use of cloud computing tools; enabling data analysis through use of tools such as SPSS; managing and disseminating digital works, for instance, by use of data repositories; and, increasingly supporting the creation of DMPs which have become a necessity in grant applications (See section 3.3.2a). For the management of big data, high computing facilities have become indispensable (See section 3.6.3). An example is the blue waters supercomputers set up at the University of Illinois which is used by Scientists to tackle a wide range of intricate problems and it is supported by the University and the National Science Foundation. It has about 1.5 petabytes of memory, 25 petabytes of disk storage and 500 petabytes of tape storage; thus, has the ability to easily facilitate the manipulation of images, data and audio (University of Illinois, 2018).

Researchers also require online tools to enhance collaborations. Collaborative technologies such as video, tele and web-conferencing technologies, instant messaging, wikis, social bookmarking, SharePoint/Google groups, websites, content management systems, and online workflow tools enhance communication and collaboration among researchers regardless of their localities (Thomas, 2011). Collaborations have become a critical part of eResearch (See section 3.6.5) with libraries such as Harvard libraries developing a guide for collaboration tools for researchers (Harvard Law School Library, 2017).

Virtual Research Environments (VREs) are on the rise to support collaborative research. Shearer and Argaez (2010:9) highlight that VREs are "a set of online tools, systems, and processes interoperating to facilitate or enhance the research process within and without institutional boundaries". "The VRE helps to broaden the popular definition of e-science from grid-based distributed computing for a scientist with huge amounts of data to the development of online tools, content, and middleware within a coherent framework for all disciplines and all types of research" (Fraser, 2005). This supports the views that eResearch is not only about high tech computing. In a study by Pienaar and van Deventer (2009) on whether SA Malaria researchers need a VRE, it was discovered that researchers did not have access to some tools that can support their research, and consequently, the study proposed a consolidated model that represents a range of tools from simple to sophisticated ones that could be useful in supporting collaborations in the various stages of a research lifecycle (see Table 3.2). This table illustrates the potential of adopting both 'simple' tools such as MS Office and 'complex' tools such as supercomputers in the various phases of a research process to enable eResearch.

Table 3.2: Consolidated model of Malaria VRE components (***Adopted from Pienaar and van Deventer, 2009***).

Stage in Research Process	**VRE components**
Identification of research area	Web/wiki/blog: search engines, databases; researchers & topics; funders, portals, communication, projects
Literature review & indexing	Internal shared database of indexed articles
Identification of collaborators	Expertise lists and commercial services e.g. Web of Science and Research Africa
Proposal writing	Document management system
Identification of funding sources	Generic software e.g. MS / Open Office
Project management	Project management system
Scientific workflow	(Free) Data analysis software
Scientific workflow	Access to research networks & super computers
Scientific workflow	Sophisticated instruments that generate digital information and data
Scientific workflow	Mathematical modelling tools; numerical algorithm tools; simulation software; in silico experiments
Scientific workflow	Servers with data files
Scientific workflow	Integrated data management system
Scientific workflow	(Collaborative) Electronic Lab book
Training/mentoring etc	E-learning system for researchers
Real time communication	Skype, smart board, video conferences
Dissemination & artefacts	Repositories: research results; experiments; literature & documents

With regard to the publishing and sharing phase, research impact and metrics have become crucial not only for global visibility of research output, but also as part of research funders mandates. As a result, online tools have been developed to maximise research impact and to provide research metrics. Alternative metrics (often called altmetrics) refers to providing metrics about alternative research outputs. The presence of vast amounts of resources in electronic format makes it possible to apply research 2.0 to measure metrics instead of using the traditional methods. These alternative methods may, however, not be easily institutionalised and accepted by some stakeholders such as researchers, funders, publishers and university research centres with some concerns arising from researchers that there will be an emphasis on social media presence vis-à-vis quality. Nevertheless, altmetrics are increasingly proving to be valuable in supplementing and not replacing the existing models for measuring research impact (Koltay, 2016:100; Strasser, 2015:18).

According to Sutton (2014:5-6), OA has been instrumental in the growth of altmetrics with academic libraries having a key role in supporting researchers and institutions to understand and manipulate their research impacts especially in the midst of increasing demands for evidence in public expenditures such as in research funding in universities. Chilimo states that:

> *If properly collected and analysed, altmetrics can be a useful tool for IR managers and authors who deposit publications in IRs. Altmetrics can be a valuable tool in the context of developing countries where most of the publications archived in IRs constitute grey literature and other unpublished materials, such as theses and dissertations. Altmetrics can provide evidence of the value and impact of these publications as most of them are not published and may never receive citations* (2015:30).

Several online tools have been applied to maximise impact such as Google Scholar, ResearcherID, Scopus, and ORCID among others. According to Roemer and Borchardt (2015), tools such as Facebook, Twitter, YouTube, Amazon, Goodreads, Slideshare, and GitHub were not designed to provide altmetrics, but nonetheless, they provide insights on scholarship impact. On the other hand, tools such as institutional repositories, CiteULike, Mendeley, Academia.edu, ResearchGate, and Social Science Research Network (SSRN) were designed as academic tools for organizing and sharing information and thus, they generate some metrics. Lastly, tools such as Almetric, Impactstory, PlumX, and, Kudos were designed with a major focus on harvesting metrics.

3.6.5 The Library's Role in eResearch Collaborations in Universities

Supporting distributed, research collaborations is at the core of eResearch and the needs of all stakeholders such as researchers and organisations (Sinnott *et al*. 2012:342). A study by Procter, Voss and Asgari-Targhi (2013) on fostering the human infrastructure of eResearch found a disconnection between human and technical infrastructure and, thus, suggested that HEIs ought to enthuse closer collaborations between computing services and users in order to make effective use of technologies available and opportunities presented for innovative research practices. This gap in integrating technologies in communication and collaborations among researchers can be filled through support provided by libraries.

Henderson (2016) points out that, academic libraries are increasingly demonstrating their value by providing and building stronger partnerships for their communities through developing unconventional services above the traditional liaison programs. According to Frances, Fletcher and Harmer (2011:6), researchers are busy, therefore, and so it is in the interest of libraries to reach out to them constantly about eResearch and to collaborate with them in the practices. Luce (2008:44) asserts that researchers need more than just research storage services provided through the current IRs.

> *Groups conducting research will need access to information in collaborative Web spaces. These collaborative Web spaces will be populated by information feeds customized for individual teams of researchers. Some of these feeds will be customized for researchers fitting specific profiles; others will be pulled from external sites. Still, others will be created by intelligent agents crawling the Web, remote repositories, and local resources*" (Luce, 2008:44).

Researchers will need libraries that facilitate a Web 2.0 service environment that enhances on-going and synchronous communications.

Kesselman and Watstein (2009:393-394) posit that Web 2.0 tools present numerous opportunities for collaborations such as virtual environments and social networking sites that enable researchers to provide comments on works in progress and share their workflows. These platforms enable cross-institutional and cross geographic collaborations. They further point out that "virtual collaborations between researchers would be well served by virtual collaborations of librarians and information professionals". This suggests that in as much as collaborative tools are

available, effective use can be made possible by libraries being proactively involved. Libraries can adopt several ways to enhance research collaborations. One way is for the library to establish teams that can foresee research collaborations. For instance, in 2009, the University Librarian at the UNSW recommended the establishment of UNSW's eResearch Coordination Group tasked with ensuring that the university provides an integrated approach for eResearch (Frances, Fletcher & Harmer, 2011:6). Creation of partnerships with researchers may also provide relevant platforms for eResearch collaborations as librarians will have a chance to provide relevant training, advice and even work closely with researchers. Koltay (2016:98), for instance, suggested that libraries should "liaise and partner with researchers, research groups, data archives and data centres to foster an interoperable infrastructure for data access, discovery, and data sharing".

Libraries can also provide online web guides to collaborative tools. An example is the University of Washington Health Science Library which has provided an online guide to help researchers to find collaborators (Health Sciences Library, 2018). Luce (2008:47) indicated that libraries "can foster collaboration networks and provide collaboration space (both virtual and physical) where researchers can work". Increasingly, university libraries have been providing online collaborative platforms as well as providing physical spaces such as research commons to enhance collaborative research. For instance, the research Commons at the Ohio State University is set to provide "a suite of services and space through which researchers can explore collaborative, interdisciplinary, and emerging research methods and connect with experts for support at any stage of the research process" (Ohio State University, 2018).

A study on changing research practices in Australia conducted by Denison, Kethers and McPhee (2007:2) found that researchers "are operating in an increasingly institutionally diverse and interdisciplinary environment in which collaboration is widespread. They also found increasing demand for access to diverse sources of information, for access mechanisms that cut across disciplinary silos, and for access to, and management of, non-traditional, non-text digital objects". As a result, Universities should create partnerships with a wide range of groups and organisations to cater for eResearch needs effectively. This is well illustrated by the University of Queensland Australia which enhances eResearch collaborations with various partners that

include: State groups such as the Australian Institute for Bioengineering and Nanotechnology (AIBN) and Queensland Government, Department of Environment and Resource Management (DERM) among others; National groups such as the Australian National Data Service (ANDS) and National eResearch Collaboration Tools and Resources (NeCTAR); and, International groups such as Joint Information Systems Committee (JISC) and Open Archives Initiative (University of Queensland, 2015). This level of collaborations enriches eResearch support at the university.

3.7 Perceptions and Attitudes Towards eResearch in Universities

The perceptions and attitudes of librarians and researchers towards eResearch can influence its effectiveness. Researchers' attitudes toward applying technologies in every phase of the research process, their views about e-resources, RDM, OA publishing, among other aspects play a significant role in eResearch. There are minimal studies that address specifically perceptions and attitudes towards eResearch as an independent concept. Rather, varieties of studies have looked at perceptions and attitudes towards particular facets of the research life cycle such as e-resources, RDM, and institutional repositories. Examples of studies focused on eResearch include Dutton and Meyer (2008), whom, following concerns that social scientists are not adaptive to eResearch, surveyed 526 researchers in the UK and worldwide to assess eResearch awareness and attitudes among the social scientists. The findings suggested that younger cohorts of researchers were most open to the integration of technologies in research. In addition, it was revealed that researchers regardless of their disciplines and methodological perspectives had an interest in eResearch.

Another study by Whitmire (2013), a research scientist turned data librarian, addressed the concern of librarians using the 'jargon' eResearch within the cycles of researchers. The paper discussed the confusion that emerges with the concept of eResearch with some defining it as the use of high computing technologies to facilitate data manipulation, while in some cases, it is viewed as the adoption of technologies to support existing and new forms of scholarly research including "research performed digitally at any scale". The paper discussed the results of a survey of faculty that revealed they understood eResearch as just research regardless of the new paradigms. This paper calls to librarians to be keen on the emphasis they put on the term

'eResearch' and its meaning, while introducing it to the research community so as not to abet a disconnect between the intended meaning vis-à-vis the stakeholders understanding.

Several studies have been conducted by Tenopir in relation to user behaviours, perception, and attitudes towards integrating technologies in different components of the research processes. Tenopir (2003:1) citing Montgomery and King (2002) indicated that several libraries are increasingly acquiring digital resources for several reasons including:

> *Digital journals can be linked from and to indexing and abstracting databases; access can be from the user's home, office, or dormitory whether or not the physical library is open; the library can get usage statistics that are not available for print collections; and digital collections save space and are relatively easy to maintain. When total processing and space costs are taken into account, electronic collections may also result in some overall reductions in library costs*.

Tenopir (2003:44-45) examined more than 200 studies on user behaviour towards e-resources and established that graduate students were heavy users of e-resources while Faculty will use them mainly if they support their natural work; social scientists and humanists used both electronic and print resources; heaviest usage of e-resources was for research purposes followed by teaching and current awareness; younger users were more enthusiastic and early adopters of e-resources; and, little evidence indicated that gender in most cultures influenced the use of e-resources. Generally, the study established that most modern users are flexible and adaptive towards the use of e-resources. Tenopir (2003:45) posits that there is an annual increase in e-resources usage among faculty, graduate students, and other professionals, although this has been accompanied by a reduction in physical library visits. Tenopir *et al.* (2009) surveyed the reading patterns of some faculty members and found that there is a continuous increase in the use of e-resources from a wide range of databases and reading patterns have been influenced through use of e-resources.

In relation to RDM, Tenopir *et al* (2012) investigated the USA and Canadian academic librarians' attitudes towards the relevance of RDS. With 223 librarians responding to the survey, a vast majority found RDS to be an essential service consistent with research missions with about 62% stating that libraries are better placed to provide the services.

Another study focused on scientists was conducted by Tenopir *et al* (2015) examining 1329 scientists to explore their data sharing practices and perceptions on barriers and enablers to sharing data. The study found that some of the reasons why data is not shared by scientists included the lack of time and funding. It was also established that the majority of these scientists were satisfied with their short-term processes vis-à-vis long-term data preservation. Lastly, it was found that most organisations did not provide the necessary support required for researchers to manage their data either for short or long-term purposes. The researchers indicated a willingness to share data within certain conditions.

Another study by Tenopir looked at the adoption of social media in research. Tenopir, Volentine and King (2013) conducted a study on 2000 respondents from six higher learning institutions in the UK to investigate the use of social media in research. The study found that most academics adopt one or more social media for their work, but the frequency of adoption and use is minimal. Some factors influencing usage include discipline and age, while the use and creation of social media have not had an adverse effect on traditional scholarly practice although it was established that high-frequency users or creators of social media tend to read more scholarly materials than the others.

Other studies in relation to perceptions and attitudes are as follows: A study on perceptions toward RDM by academicians in the top 25 universities in Turkey revealed that largely, the respondents lacked skills and knowledge such as metadata creation and data curation to support effective RDM. They, however, had an understanding of the benefits of sharing data and thus expressed willingness to share data within certain circumstances (Aydinoglu, Dogan, & Taskin, 2017). Blekinge Institute of Technology library conducted a study on 40 most productive researcher and postdocs, to investigate the management of data and the researcher's attitudes towards data sharing. The study established that regardless of a positive attitude towards data sharing, there was a need for awareness and support for RDM, DMPs and clarity for data ownership (Linde *et al.,* 2015). The challenges that are likely to hinder effective RDM practices were discussed in section three of this chapter (See section 3.3.4). These largely contribute towards the researchers' perceptions and attitudes.

Several studies have also addressed the issues of OA and IR in relation to perceptions. A survey conducted by Abrizah (2017) on researchers in a research-intensive university in Malaysia investigated the use of OA repositories exploring their awareness, experiences and opinions of OA publishing, and the university's IR. Findings from the respondents indicated that there was a willingness to deposit in an OA IR with making their publications publicly accessible being a great motivator. The deterrents included copyright, plagiarism publisher's policies, readers' trust, and preservation challenges. It was also established that mandates from employers and funders on OA would meet minimal resistance. A study by Cullen and Chawner (2010) investigated IR development in New Zealand and found that, while librarians were positive about the value of IR, academics were slow in embracing it despite high awareness rates; consequently, leading to low deposits with issues such as extra workload, confidentiality, plagiarism and less competitive advantage being barriers.

A study conducted by Dorner and Revell (2012) to establish subject librarians' perceptions on institutional repositories found that they have both positive and negative perceptions, thus, with little knowledge on IRs, it becomes difficult for these librarians to promote the use of the repositories. Consequently, it is not enough for library managers to focus on content input but rather to ensure that librarians are trained well enough so that they can fully participate in the advocacy. Hamid *et al*. (2014) surveyed 3650 authors from different Geographical locations that had published in international journals to establish their drive towards reading, citing and publishing practices. The study found that researchers from developing countries were keen on the author and publisher reputation when deciding to publish and were more likely to publish in OA journals. On the other hand, researchers from more developed countries such as the UK and USA were keener on peer-reviewed journals and were less convinced that repositories and social media significantly increase publicity of their research output.

From the studies above, it can be established that despite a willingness to adopt eResearch among researchers, their perceptions, and attitudes can be influenced by a wide range of factors that include age, locality, awareness, training, funding, ethical issues, and a competitive advantage among other issues highlighted.

3.8 Summary

This chapter sought to explore the increasing role of university libraries in eResearch. With limited literature addressing specifically the eResearch concept, this study sought literature that addresses the library's role in supporting the various aspects of the research lifecycle with a special focus on technology-oriented services. Using the elements derived from Purdue University Libraries model and eResearch Capability Model as a focal point, this chapter has reviewed empirical literature related to the role played by university libraries in supporting eResearch. The study reviewed literature on the support provided in both the data lifecycle and research lifecycle. This is supported by (Corti, Van den Eynden, Bishop and Woollard, 2014:7) who asserts that "the significance of taking an approach which takes into account the whole of both the research lifecycle and the data lifecycle is that it allows all participants to understand their roles and responsibilities in context".

The literature reviewed also discussed librarians' competencies and library structures in relation to supporting eResearch; the vital role of university libraries and librarians in RDM, and the increasing role of libraries in supporting the integration of technologies in the research lifecycle. The literature revealed that librarians globally are making effort to encourage the use of technology in supporting research practices but there are barely structured strategies to guide effective eResearch approaches. It was also established that libraries could play a critical role in advancing research but challenges such as appropriate skills, competencies, and structures would need to be addressed. The most extant literature on eResearch was found in developed countries such as Australia and USA. There are limited resources addressing eResearch and data management in the African context. This study sought to contribute to filling this gap by exploring and providing evidence-based study for eResearch in Kenya. The next chapter presents the research methodology.

CHAPTER FOUR
RESEARCH METHODOLOGY

4.1 Introduction

Research methodology refers to the means by which a research problem is systematically solved and in it, the various steps adopted by a researcher alongside the logic for their adoption are expressed (Kothari, 2004:8). The purpose of this study was to explore eResearch support in private university libraries in Nairobi County, Kenya with the aim of contributing to the literature on the status of eResearch through the lens of a developing country. The study is, therefore, an exploratory research which according to Kumar (2014:13), refers to "when a study is undertaken with the objective either of exploring an area where little is known or of investigating the possibilities of undertaking a particular research study". In order to meet the purpose, primary data was collected and analysed using scientific research procedures. Building on the brief introduction of methods presented in section 1.9 of chapter one of this study, this chapter highlights the methodologies that were adopted for the study including the research paradigm, research approach, research design, population, sampling techniques, data collection and analysis methods, validity and reliability, and ethical considerations.

4.2 Research Paradigms

A research paradigm is a particular worldview that defines what is acceptable to research and how it should be done (Bertram & Christiansen, 2014:22). It is "a way of describing a worldview that is informed by philosophical assumptions about the nature of social reality", thus, researchers are able to raise questions and to apply "appropriate approaches to systematic inquiry" (Chilisa & Kawulich, 2012:1). No single worldview is 'correct', hence, it is upon a researcher to establish the most appropriate paradigm suitable for informing their research design so as to best answer the questions under study better (Chilisa & Kawulich, 2012:2). Some major research paradigms associated with social sciences include the positivist, postpositivist, constructivist/interpretive, transformative, and, pragmatic worldviews.

A positivist approach is a strict worldview that holds that the only way to ascertain truth and objectivity is through the use of scientific methods. Reality is viewed as being objective and knowable. It is an approach inclined towards the natural sciences, as it stipulates that science is

the only foundation for true knowledge and that, "the methods, techniques and procedures used in the natural sciences offer the best framework for investigating the social world" (Chilisa & Kawulich, 2012:7). This paradigm is consistent with a quantitative methodology. "Such research is value-free and based on precise observation and verifiable measurement. Typical research designs include quantitative approaches, such as experimental and quasi-experimental research, correlational research, and causal-comparative research" (Chilisa & Kawulich, 2012:17-18).

The postpositivists challenge the traditional notion of the absolute truth of knowledge (Phillips & Burbules, 2000) that is enshrined in the positivism paradigm. It dictates that no matter how faithfully the scientist adheres to scientific method research, research outcomes are neither totally objective nor unquestionably certain (Crotty, 1998). According to Creswell (2014:7):

> *The knowledge that develops through a postpositivist lens is based on careful observation and measurement of the objective reality that exists 'out there' in the world. Thus, developing numeric measures of observations and studying the behaviour of individuals becomes paramount for a postpositivist*.

Chilisa and Kawulich (2012:9) state that constructivism and interpretivism "are related concepts that address understanding the world as others experience it". This paradigm enables the understanding of how respondents interpret their own experiences within their contexts. According to Chilisa and Kawulich (2012:18) constructivists or interpretivists believe there are multiple realities that are socially constructed and that knowledge is subjective, while truth depends on the context. "The goal of the research is to rely as much as possible on the participants' views of the situation being studied" (Creswell, 2014:8). Interpretive studies are inductive in approach and commonly associated with qualitative approaches to data collection and analysis. Typical research designs include "phenomenology, ethnography, symbolic interaction, and other naturalistic designs", while favouring "qualitative methods such as case studies, interviews, and observation because those methods are better ways of getting at how humans interpret the world around them" (Chilisa & Kawulich, 2012:18).

The purpose of transformative paradigm is to obliterate myths, illusions and false knowledge so that to provide empowerment to people who can then transform the society. This worldview stands for research designs that are influenced by philosophies and theories aiming to emancipate and transform a group of people (Chilisa & Kawulich, 2012:11-12). A researcher adopting this

paradigm needs to be addressing specific vital social issues that touch on daily happenings such as "empowerment, inequality, oppression, domination, suppression, and alienation" (Creswell, 2014:10). This research paradigm has a great focus on the view that "reality is shaped by culture, politics, economics, race, gender, ethnicity, and disability" (Chilisa & Kawulich, 2012:18) with consideration to values being of great relevance, since they differ from a culture to another. Chilisa and Kawulich (2012:18) further note that, "typical research designs may involve quantitative and/or qualitative approaches, such as action research and participatory research". "Quantitative research is typically associated with a positivist and objectivist stance, while qualitative research is associated with an interpretivist and constructionist one" (Bryman, 2008:13). This thesis necessitated the application of both, thus, the adoption of a pragmatic research paradigm as discussed below.

4.2.1 Pragmatic Research Paradigm

This study was conducted within a pragmatic research paradigm. Pragmatism is characterised by the following: it focuses on the research questions with an aim of providing concrete solutions to social problems (Tashakkori & Teddlie, 2003); it is grounded on the belief that theories can apply to both a particular context and can also be generalised by transferring it to a different situation and further, the researcher is "able to maintain both subjectivity in their own reflections on research and objectivity in data collection and analysis" (Shannon-Baker, 2016:322); pragmatic paradigm arises from actions, situations and consequences and, it is not entwined in a specific philosophy or reality; it allows researchers the freedom to choose methods, techniques and procedures that they find suitable for their studies; it recognises that the truth is what works at the time and allows a researcher to adopt multiple methods, assumptions, data collection and analysis forms (Creswell, 2014:10-11); its concern lies in action and change as well as the interplay between knowledge and action thus making it appropriate for approaches that target to intervene in the world vis-à-vis observing it (Goldkuhl, 2012:2); it allows a researcher to apply "whatever works" based on the research question at hand rather than relying on worldviews and preferences pinned on research methods (Fraenkel, Wallen & Hyun, 2011:559); it acknowledges that humans are unpredictable, thus, requires a researcher to have some level of flexibility and openness since unexpected data can be collected (Feilzer, 2010:13); and, it "does not require a particular method or methods mix and does not exclude others. It does not expect to find

unvarying causal links or truths but aims to interrogate a particular question, theory, or phenomenon with the most appropriate research method" (Feilzer, 2010:14).

The pragmatic paradigm offers a wide range of advantages to a researcher who is keen on mixing methods. This worldview was found appropriate for this study as it supported the adoption of a mixed methods approach by allowing the researcher to make decisions on the appropriate strategies to apply in the study based on the research questions. Both the qualitative and quantitative approaches were adopted within the pragmatic paradigm. Quantitative approach was adopted by employing majorly close-ended questions to the PhD students, Faculty, and Reference Librarians with minimal open-ended questions (See Appendices 1 and 3); open-ended questions were posed to the IR Managers with the aim of getting rich qualitative information on the IT support provided to researchers by the libraries (See Appendix 2) and, qualitative interviews were targeted to the University Librarians as they are at the centre of implementations of library support, thus, rich opinions were sought from them through use of interviews (See Appendix 4).

4.3 Research Approaches

Creswell (2014:4) highlights the three most common research approaches namely: qualitative, quantitative, and mixed methods. According to Creswell (2014:4), quantitative research is a means for testing objective theories by examining the relationship among variables which can be measured, typically on instruments, so that numbered data can be analysed using statistical procedures. Qualitative research, on the other hand, is a means for exploring and understanding the meaning individual or groups ascribe to a social or human problem. According to Tewksbury (2009:50):

> *Qualitative research seeks to provide in-depth, detailed information which, although not necessarily widely generalisable, explores issues and their context, clarifying what, how, when, where and by and among whom behaviours and processes operate, while describing in explicit detail the contours and dynamics of people, places, actions and interactions*.

Creswell (2014:4) states that often, the distinction between qualitative and quantitative research is framed in terms of using words (qualitative) rather than numbers (quantitative), or using close-ended questions (quantitative hypotheses) rather than open-ended questions (qualitative

interview questions). The mixed method incorporates elements of both qualitative and quantitative approaches. Punch (2009:288) and Bryman (2008:13) define mixed methods research as an empirical research that involves the collection and analysis of both qualitative and quantitative data. According to Flick (2011:192), this combination can entail linking qualitative and quantitative research as well as triangulating different qualitative or different quantitative approaches, while viewing the mixing pragmatically, while asking oneself: "what is necessary for a sufficiently comprehensive understanding of the issues you study? What is possible under the given circumstances of your own resources and in the field you study?"

The mixed method aims at selecting the best methods, irrespective of the qualitative-quantitative boundaries in order to find answers to the research questions on the basis that certain situations call for qualitative, while others would require quantitative techniques. Thus, the best outcome in some studies can be achieved by adopting both methods (Kumar, 2014:15-16). Punch (2009:290) points out that the rationale behind the use of the mixed method is to combine the methods in a way that achieves complementary strengths and non-overlapping weaknesses. Creswell (2014:19) posits that a study may begin with survey aimed at generalising the results to a population and thereafter, the researcher can focus on qualitative, open-ended interviews with an aim of collecting views from participants that can aid in explaining the initial quantitative survey. Therefore, Gay and Weaver (2011:28) posit that mixed methods approach "encourages the use of multiple worldviews or paradigms rather than the typical association of certain paradigms for quantitative researchers and others for qualitative researchers".

Mixed methods can be applied sequentially or concurrently. Creswell (2009:14) discusses the sequential and concurrent mixed methods approaches. In a sequential approach, the researcher seeks to elaborate on or expand on the findings of one method with another method. This may involve beginning with a qualitative approach and follow up with a quantitative approach or vice versa. In a concurrent approach, on the other hand, the researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. Both forms of data are collected at the same time and then integrated into the interpretation of the overall results.

The concurrent triangulation strategy was preferred for this study. According to Creswell (2009:213), in this strategy, the researcher collects both quantitative and qualitative data

concurrently and then compares the two databases to determine if there is convergence, divergence, or some combination. This strategy was selected as it allowed the researcher to collect both quantitative and qualitative data at the same time (concurrently), hence save time. Qualitative research approach enabled the researcher to obtain broad views from the University Librarians about the status of private university libraries' organisational structures, staff competencies and data management systems in relation to supporting eResearch at the universities in order to respond to sub-questions 'i', 'ii', 'iii', 'iv' and 'vi' (See section 1.4). A mix of qualitative and quantitative research was used to obtain data about data management, policies, eResearch processes, training and advocacy, tools, perceptions and data management challenges from Reference Librarians and IR Managers (*See Appendices 1 and 2*). On the other hand, the quantitative research approach was adopted in order to aid in the collection of data about the kind of eResearch support that the PhD students and Faculty are getting from the library especially in the areas of data management, tools, perceptions towards eResearch, and challenges of data management as adopted from the eResearch Capability Model (See Table 1.2). This was done in order to respond to the research sub-questions 'iii', 'iv', 'v' and 'vi' (See section 1.4).

4.4 Research Designs

"Research designs are types of inquiry within qualitative, quantitative, and mixed methods approaches" (Creswell, 2014:12). Creswell (2014:11-15) discusses various research designs applied in quantitative, qualitative and mixed methods approaches. Figure 4.1 below highlights the design inquiries.

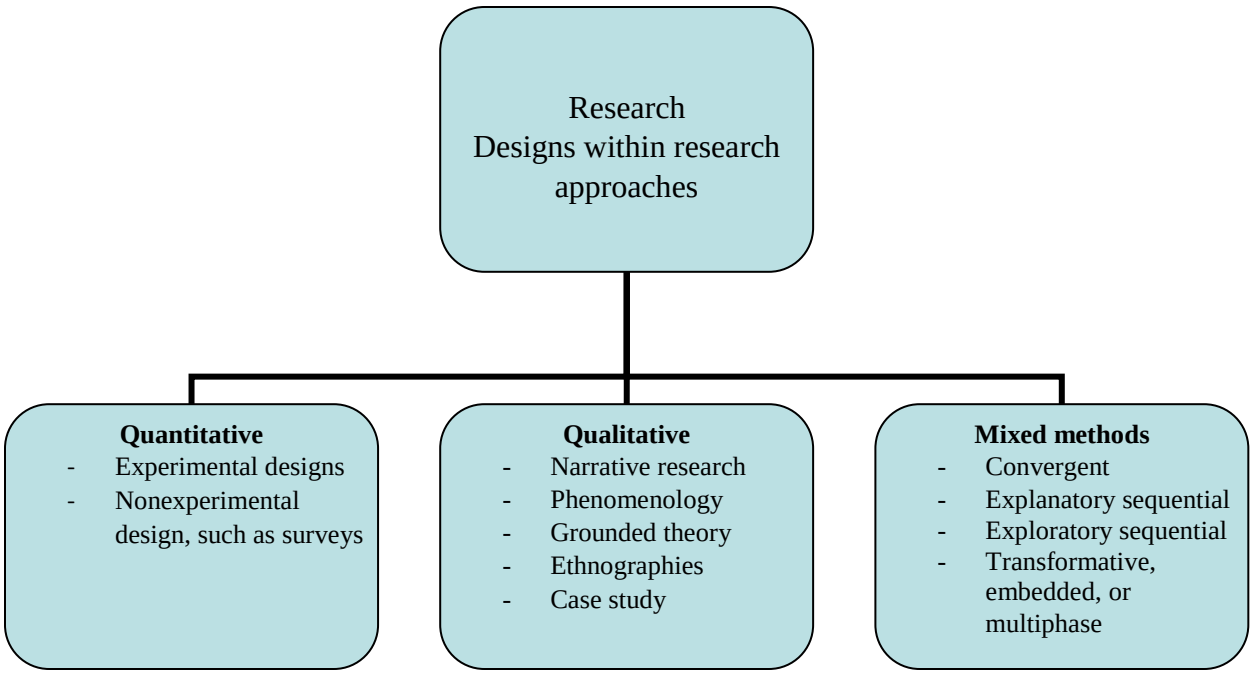

Figure 4.1: Research designs (Source: Creswell, 2014)

In discussing the research designs applied in mixed method studies, Creswell (2014:15-16) indicated that the convergent parallel mixed method encompasses the researcher collecting both qualitative and quantitative data at roughly the same time, then integrating the two during interpretation. The explanatory sequential involves the researcher firstly collecting and analysing quantitative data, then, building on the results through explanations using qualitative data. Exploratory sequential in which the researcher collects and analyses the qualitative data during the first phase then builds to quantitative data. Finally, the transformative involves the researcher converging data or sequentially using one set can be used to build on the other.

This study employed the convergent parallel design. Both the qualitative and quantitative data was collected during the same phase of data collection. Interviews with University Librarians were conducted within the same period when data was being collected from PhD students, Faculty members, Reference Librarians and, IR Managers using survey questionnaires. Analysis of the various components was done separately and thereafter, the results were mixed during interpretations based on the various themes derived from the study variables. A multiple-case study design discussed in the following sub-section was found appropriate for this study.

4.4.1 Multiple-Case Study

Gorman and Clayton (2005:47) define a case study as an in-depth investigation of a distinct entity such as a single setting, subject, collection, or event with the assumption that knowledge of a wider phenomenon can be derived by investigating the single case. According to Flick (2014:122), case studies "capture the process under study in a very detailed and exact way". Three types of case studies are presented by Fraenkel, Wallen and Hyun (2011:435) as: i) the intrinsic case study which entails the study of a single, specific individual or situation most often in an exploratory study that seeks to have an in-depth understanding of a little-known phenomenon; ii) an instrumental case study in which the researcher seeks to learn more than the particular case in order to gain a broader understanding and to draw conclusions that are not narrowed to the case being studied; and iii) multiple- (or collective) case study in which the researcher studies multiple cases at the same time as part of an overall study.

This study adopted a multiple-case study research design. Multiple-case design (or collective) involves studying a number of case studies carefully selected in order to enhance an understanding of an issue that is being studied or to theorise about a broader context with the researcher having the opportunity to select cases that have similar characteristics to facilitate the analysis of findings across similar cases (Chmiliar, 2012:2). In this study, the researcher selected six private chartered universities based in Nairobi County, Kenya that offer Doctorate programs (See section 4.5). Leedy and Ormrod (2010:137) indicate that a multiple-case study enhances the ability for a researcher to "make comparisons, build theory, or propose generalizations". This was effective for this study as responses from the different case settings provided a rich understanding of the status of eResearch support in private university libraries in Kenya.

In a multi-case study, "several instrumental, bounded cases are examined using multiple data collection methods" thus, the design gains superiority over single case settings given that more far-reaching explanations about phenomena are provided, which enables cross-case examinations for in-depth understanding, thus enhancing generalisability (Chmiliar, 2012:3). In this study, both interviews and questionnaires were used for data collection; consequently, the researcher was able to collect both qualitative and quantitative data that was instrumental in strengthening the interpretations and findings. Cross-examinations among the selected universities were done. Chmiliar (2012:3) further posits that,

The interpretation of the data in multiple-case study design follows several stages. First, each case in the research is treated as a single case. All of the data in each single bounded case are carefully examined, and the data organized into a comprehensive description that is a unique, holistic entity.

This augured well with the convergent parallel design that was selected for this study (See section 4.4).

4.5 Population of Study

The population refers to the "group of interest to the researcher, the group to whom the researcher would like to generalize the results of the study" (Fraenkel, Wallen & Hyun, 2011:92). The population for this study consisted of private chartered universities in Nairobi County. Within the private universities, the unit of analysis consisted of the University Librarians, PhD students, Faculty, and IR Managers who were assumed to be involved in research activities. Furthermore, only main campuses which are largely in Nairobi County were targeted, as there are meagre library services in the majority of satellite campuses outside Nairobi. Munene (2016) described the situation of services and resources at satellite campuses as a grim contrast to the main campuses citing lack of libraries, proper services and resources and internet facilities which impede quality teaching and research. Table 1.1 presents the private chartered universities with main campuses in Nairobi County, Kenya. Out of the eighteen private chartered universities in Kenya, nine were found to be based in Nairobi County (See Table 1.1). Out of the nine targeted universities, three that included the KAG, Strathmore, and KCA universities were found not to offer PhD programs and were, therefore, excluded. Hence, only six private chartered universities in Nairobi County qualified for inclusion in the study. The six universities selected included: the Africa International University, Africa Nazarene University, Catholic University of Eastern Africa, Daystar University, Pan Africa University, as well as United States International University. These universities have been described as university A-F in this study, not necessarily in the order listed here, to enhance anonymity (See Table 4.1).

As already pointed out, the population for the study comprised of librarians (different categories): University Librarians were included in the study as they are drivers of eResearch support in the private universities in Kenya; Liaison, Reference and/or Research Librarians were also included given their critical role in offering library research services directly to the

university populations, thus, they were assumed to be able to offer relevant data about eResearch services; and, the other target group from the library consisted of institutional repository Managers and/or System Librarians from whom the researcher collected data on IR role in eResearch and support tools. The population also consisted of full-time Faculty (Lecturers, Senior Lecturers, Associate Professors and Full Professors), and, the PhD students. This selection was based as already pointed out on an assumption that these groups are actively involved in research activities. Part-time Faculty members were excluded from the study, since they are not necessarily obligated to contribute to the research output of the universities that employ them. Apart from that, they juggle from one university to another (Munene, 2016b), and do not have permanent office space in the universities in which they are temporarily employed. Table 4.1 below presents the population of the study as derived from the various offices (Libraries, Registries, and HR) of the respective universities.

Table 4.1: Population distribution

	Private chartered university	University Librarian	Reference Librarians	IR Manager(s)	No. of full-time Faculty	No. of PhD students
1	A	1	4	1	237	141
2	B	1	1	1	120	20
3	C	1	5	2	120	129
4	D	1	1	1	35	25
5	E	1	1	1	50	35
6	F	1	1	1	60	40
	Total	**6**	**13**	**7**	**622**	**380**

(Source: University Offices, 2017)

4.6 Sampling Procedures

Sampling refers to the process of selecting individuals who will participate in a research. Studying an entire population of interest would be preferred by researchers, but limitations such as large populations, diversity, and a population being scattered geographically can make it time-consuming and expensive, thus, impossible. For this reason, it becomes necessary to select a sample for a study (Fraenkel, Wallen & Hyun, 2011:91). Most empirical studies involve making a selection from a group for which propositions will be advanced at the end (Flick, 2011:70). Sampling enables a researcher to employ strategies that assure one has the 'right' cases in a

study. "'Right' means that they allow generalization from the sample to the population because the sample is representative of the population" (Flick, 2011:77).

There are two major sampling procedures in research referred to as probability and non-probability. According to Leedy and Ormrod (2010:204), probability sampling enables the researcher to specify in advance each segment of the population to be represented in a study. This is done through random selection, meaning that the samples are chosen in such a way that each member of the population has an equal chance of being selected. On the other hand, in non-probability sampling, the researcher has no way of guaranteeing that each element of the population will be represented in the sample; thus, some members of the population have little or no chance of being sampled. This study adopted two non-probability sampling techniques known as purposive sampling which allowed the researcher to select groups that were most appropriate to respond to the research questions, and convenience sampling given the context of the target population, which included a variety of faculty members in different universities, hence, no guarantees could be given that each member of these groups would have a chance, as it is in the case of probability sampling techniques.

4.6.1 Purposive Sampling

Purposive sampling refers to a researcher's judgement on subjects that are most likely to provide relevant information that will aid in achieving the set objectives. The researcher selected people who can not only provide relevant information but also would be willing to share it. This sampling strategy is usually inclined towards qualitative research (Kumar, 2014:244). Bryman (2008:13) justifies the selection of a purposive sampling by stating that, "the basis for making selections of cases and human subjects is consequently purposeful or purposive, since random selection might easily fail to yield the most informative sites or samples of human subjects, skewing findings because of sampling bias".

The study employed a purposive sampling technique to select private universities in Nairobi County offering PhD programmes. Purposive sampling was also used to target Librarians (involved in providing eResearch support), as well as Faculty and Doctorate students because they are most likely to be involved actively in research. The advantage of purposive sampling lies in the fact that the researcher has a free will to select the respondents majorly "based on previous knowledge of a population and the specific purpose of the research" (Fraenkel, Wallen

& Hyun, 2011:100). Although Fraenkel, Wallen and Hyun (2011:100) indicate that purposive sampling has a limitation in the sense that the researcher's judgment may be incorrect. The researcher attempted to counter this limitation in the current study by involving multiple-cases.

4.6.2 Convenience Sampling

The study also adopted convenience sampling which is a non-random sampling technique. Flick (2011:76) states that:

> *Convenience sampling refers to choosing those cases that are most easily accessible under given circumstances. This can reduce the effort in sampling. Sometimes this is the only way to do a study with limited resources of time and with difficulties in applying a more systematic strategy of sampling*.

This sampling strategy is guided by convenience to the researcher which may include: "easy accessibility, geographical proximity, known contacts, ready approval for undertaking the study, or being part of the group" (Kumar, 2014:244). It reflects a subjects' willingness to participate or to grant access to a site (Bryman, 2008:13).

Fraenkel, Wallen and Hyun (2011:99) assert that a convenience sample is a group of individuals who (conveniently) are available for study, offering the advantage of convenience, but with a possible disadvantage of bias in the sample. This limitation was overcome in this study by the fact that the population (PhD students and Faculty) had been clearly defined and matched, with defined sampling frames. Thus, with an appropriate sampling size, the chances of bias were expected to be minimised. Leedy and Ormrod (2010:212) state that convenience sampling allows the researcher to take people or other units that are readily available. Convenience sampling was applied to the PhD students and Faculty members in the selected universities. The rationale for adopting this method was because being a multiple-case study, the institutions are scattered; the availability of academic staff and the students could also not be guaranteed. The researcher, therefore, used the respondents that were available at the time of the data collection as long as they met the criteria described for the target population.

4.6.3 Sample Sizes

The sample sizes were determined using the SurveyMonkey sample size calculator (SurveyMonkey, 2017) at a confidence level of 95% and a margin of error of 5%. Six University

Librarians, 13 Reference Librarians, 7 IR Managers, 462 Faculty members, and 306 PhD students were targeted as expressed in Table 4.2 below.

Table 4.2: Sample sizes calculated using SurveyMonkey *(2017)*

Subjects	University A	University B	University C	University D	University E	University F	Total
University Librarians	1	1	1	1	1	1	**6**
Reference Librarians	4	1	5	1	1	1	**13**
IR Managers	1	1	2	1	1	1	**7**
Faculty	147	92	92	33	45	53	**462**
PhD Students	104	20	97	24	24	37	**306**
Total	**257**	**115**	**197**	**60**	**72**	**93**	**794**

4.7 Data Collection Procedures and Methods

A researcher is required to seek formal permission from the gatekeepers before collecting data by specifying exactly what is to be done on site during the data collection (Pickard, 2007:73). In this study, the researcher sought permission from the selected universities by writing formal letters to seek permission that were subsequently granted (See Appendices 12-17). Data collection ran from February 2018 to May 2018 and included several visits to the sites. The researcher, through the universities' research offices, engaged the help of research assistants who aided in distributing and collecting the questionnaires. At the initial visit, the researcher with the help of the research assistants distributed the questionnaires to the PhD students and Faculty members in the various universities on different agreed days. Thereafter, the research assistants followed up with the respondents to collect the questionnaires. In two of the large universities (A and C), research assistants were selected for each school and this helped to reduce the number of respondents that they were to follow up and consequently increase the response rates. In one of the smaller universities (F), a librarian volunteered to distribute the questionnaires and to collect them back personally.

The survey questionnaires for the Reference Librarians and IR Managers (See Appendices 1 and 2) were personally distributed and collected back by the researcher in universities A, B, C, and E. The University Librarians in university D helped with the distribution and collection of the

surveys to these target groups and a Senior Librarian in university F assisted with the same. The interviews were personally administered by the researcher. Appointments were made and interview schedules (See Appendix 4) were sent to the University Librarians in advance before the actual interviews took place. Interview sessions lasted between 18.21 minutes to 49.45 minutes with an average of 30.3 minutes.

In a mixed method research, data is collected through the use of two or more complementary methods of data collections that enable the collection of both qualitative and quantitative data. This study used primary methods to collect data that encompassed both qualitative and quantitative data collection instruments. This included the use of interviews and questionnaires. The questions in both the data collection instruments reflected themes derived from the research questions, theoretical framework, and literature review that included staff skills and competencies, library organisation structures, research data management and RDM challenges, institutional repositories, eResearch policies, eResearch process, eResearch support, eResearch tools, collaborations, and perceptions. One common approach of the mixed method is the integration of open questions in a self-administered questionnaire (Gilbert & Stoneman, 2016:125) and this was the case for questionnaires for the PhD students and Faculty members, as well as for the Reference Librarians. Another level of mixing involves the use of quantitative and qualitative tools and this was adopted by using self-administered quantitative questionnaires and qualitative interviews for the University Librarians.

4.7.1 Survey Questionnaire

A survey questionnaire was adopted as a data collection instrument for this study. A questionnaire is a set of questions designed to extract information relating to a survey. According to Kumar (2011:145), in the case of a questionnaire, there is a need to ensure that the questions used are clear and easy to understand, while the layout of the questionnaire should be easy to read. A pre-test was done to achieve this (See section 4.7.3). A questionnaire offers greater anonymity, thus, it is likely to obtain accurate information (Kumar, 2014:181). Through an informed consent letter, the respondents were informed that their responses would be reported unanimously (See Appendix 6). Three sets of questionnaires were developed for the Reference Librarians (See Appendix 1), IR Managers (See Appendix 2), as well as the PhD students and Faculty members (See Appendix 3).

The survey questionnaires integrated both closed and open-ended questions. Kumar (2014:185) posits, "Closed questions are extremely useful for eliciting factual information and open-ended questions for seeking opinions, attitudes, and perceptions". All the questionnaires included a section A for demographic information, while the rest of the sections were organised based on the themes highlighted in section 4.7 with a view of establishing the level of eResearch support provided in the universities. Kumar (2014:182) added that one of the disadvantages of a questionnaire is the "lack of opportunity to clarify issues" in the case where respondents cannot understand some questions (Kumar, 2014:182). This limitation was likely to be encountered in this study especially because the concept of eResearch is still new, and the study was exploratory. In addition, the target population was large and therefore, the researcher could not have been able to interact with the targeted population single-handedly. To counter this, the researcher went through the questions with the research assistants that were engaged to collect data in order to enhance their ability to respond to potential queries from the respondents that were not raised during the pilot study.

4.7.2 Interview Questions

Interview questions ought to be carefully planned and precisely worded in order to yield the kinds of data that the researcher needs to answer the research questions. Interviews can be structured or unstructured (Leedy & Ormrod, 2010:191). Structured interviews involve the preparation of a predetermined set of questions specified in an interview schedule. Unstructured interviews, on the other hand, offer complete freedom to the researcher in terms of the content and structure of the questions to be used on respondents (Kumar, 2011:145). This study adopted the structured interviews of which the researcher prepared an interview schedule using the specified variables in this study (See Appendix 4). Interviews were conducted on the six University Librarians selected for this study at their offices on dates and time agreed upon by the interviewees and the researcher. All the interviewees allowed the researcher to use a recorder by signing consent for audio similar to the copy attached in appendix 7. Interview sessions lasted between 18.21 minutes to 49.45 minutes with an average of 30.3 minutes. This was close to the 30 minutes that had been approximated after the pilot study, which was communicated to the interviewees prior to booking appointments.

The interviews were used in order to obtain information on organisational structures and library staff competencies to address research questions numbered one and two (See section 1.4). Furthermore, questions on the variables: RDM, policies, support, tools, and perceptions were also presented given that the University Librarians would be able to indicate the level of eResearch support that their libraries provide in these facets. This helped to provide relevant information in response to research questions three to six (See section 1.4).

Interviews offered great advantages to this study including that the researcher was available to structure the interview and motivate the respondents; optimal communication that included the use of verbal and non-verbal communication was possible; and, the use of open ended-questions that allowed the researcher to rephrase or probe where necessary; thus, clarity was enhanced (Bryman, 2008:317). Kumar (2014:182) also pointed out that interview offers an advantage for the researcher to collect in-depth information through probing and also to explain concepts/rephrase questions to be understood (Kumar, 2014:182). This became important especially in clarifying some concepts used in eResearch such as the difference between data repositories and information repositories.

4.7.3 Pilot Study

A pilot study is a small sized study which may be used before a larger scale study of any type. It aims at testing procedures, steps, methodology. "Before the final form of the survey or questionnaire is constructed, it is useful to conduct a pilot study (or dress rehearsal) to determine if the items are yielding the kind of information that is needed" (Simon, 2011:1). It is important that an interview schedule or questionnaire is tested out before actual data collection and this should be carried out under actual field conditions on a population with similar characteristics to the study population. This enables the identification of problems likely to be experienced with the set questions (Kumar, 2014:191). Pre-testing of the data collection instruments was carried out at the Tangaza University College (TUC). This site was selected as it has similar characteristics with the universities selected for the study. These include its location at Nairobi County, has a library with a librarian, repository manager and Reference Librarian, as well as PhD students and Faculty members. Tangaza was also accessible to the researcher. Permission for data collection was sought and granted (See Appendix 11). Table 4.3 below illustrates the population at Tangaza for the targeted group and the sample sizes for the study.

Table 4.3: Population, sample, and response rate for the pilot study at TUC

Subjects	Population	Sample size used	Returned	Response rate
Faculty	150	15	11	73%
PhD Students	68	7	4	57%
Chief Librarian	1	1	Interviewed	100%
Reference Librarian	1	1	1	100%
IR manager	1	1	1	100%
Total	**221**	**25**	**17**	

The Librarian, the Reference Librarian, and the IR Manager were purposively selected in order to test the questions that had been set for these set of groups. Twenty five respondents participated in the pilot study. Hill (1998); Isaac and Michael (1995:101) suggested that samples ranging between 10 and 30 are practical for a survey research. Considering that the survey for the PhD students and Faculty members was the same, their data were analysed together using IBM SPSS. Out of the 22 questionnaires distributed to this group, 15 were returned giving a response rate of 68%. The Chief Librarian at TUC played a critical role in permitting the questionnaires to be randomly distributed to 15 Faculty members during a faculty meeting and for distributing the questionnaires to 7 PhD students during one of their class sessions. The respondents were requested to return the completed questionnaires to the Chief Librarian at the TUC Library; however, some follow-ups through phone calls had to be made to ensure high response rates.

The pre-test data was used to establish the reliability of the study as presented in section 4.9.2. Upon completion of the analysis of the data, the pilot study helped to establish how long it would take to fill up the survey. Those who filled immediately spent about 15-20 minutes. The personal interview with the Chief Librarian at his office lasted for 32.22 minutes, thus, a time of 30 minutes was established as an appropriate approximation for interviews. The survey questions were majorly found to be clear apart from a recommendation to provide a definition of RDM. This was included in the final questionnaire. The interviewee, on the other hand, proposed that the interview schedule should be sent to the University Librarians prior to the actual interview to allow them time to go through the questions and prepare. The researcher ensured that this was done in the actual study.

4.8 Data Analysis

Data analysis entails de-synthesising of data, information, or fact in order to respond to research questions. Analysing data from a mixed method study can be complex, as it requires the researcher to integrate findings from various tools in order to make sense out of it. In this study, data were collected using quantitative (questionnaires) and qualitative (interviews) methods; thus, were also analysed quantitatively and qualitatively. A side-by-side approach of analysis was adopted in this study. This involved firstly reporting the quantitative statistical results, then discussing the qualitative findings, and thereafter, merging findings from the two sets of approaches used in the study.

4.8.1 Quantitative Data Analysis

Quantitative data (close-ended) from the surveys were analysed using the IBM SPSS statistical package version 21. This involved creating of data files, checking and transforming the data, data interpretation, and analysis and finally, report writing. The SPSS is robust in generating various statistics to represent and explain data. Data transformation, which involves the conversion of qualitative data into quantitative variables then combining the two quantitative database (Creswell, 2014:223) was adopted for the open-ended questions in the questionnaires. The qualitative data in the questionnaires for PhD students and Faculty members was converted into quantitative variables, as it was minimal and not very descriptive; it was then coded in the SPSS system and then analysed alongside the close-ended questions.

4.8.2 Qualitative Data Analysis

The qualitative data from interviews were analysed using content analysis. According to Flick (2011:76), this technique supports the analysis of text material and is based on using categories derived from theoretical models, and "aims at classifying the content of texts by allocating statements, sentences, or words to a system of categories". Kumar (2014:297-298) asserts that content analysis involves the identification of main themes emerging from descriptions provided by research participants when responding to questions. After the identification, three ways can be applied to deal with them:

i. Examine verbatim responses and integrate them into the text of your report to either support or contradict your argument;
ii. Assign a code to each theme and count how frequently each has occurred; and

iii. Combine both methods to communicate your findings (Kumar, 2014:297-298).

This study embraced the third option of combining both methods by reporting verbatim in some cases and coding the qualitative results in other cases.

The steps provided by Leedy and Ormrod (2013:149) were adopted for this study. These included: i) identification of the specific content to be studied from the data that had been collected through interviews; ii) Specific characteristics to be studied were defined; this study was guided by the themes adopted from the eResearch Capability Model, which include the organisational structures and staff competencies; iii) the data was interpreted through scrutinising it against the set themes indicated in step two; iv) The final step involved discussion of findings based on the set research questions for this study, while integrating the findings with the results from the quantitative data instruments.

4.9 Validity and Reliability

Validity and reliability of research reflect the degree to which an error may occur in measurements (Leedy & Ormrod, 2014:91). While validity of research refers to the extent to which an instrument actually measures what it is envisioned to measure (Leedy & Ormrod, 2014:91; Oliver, 2010:73), reliability, on the other hand, refers to the extent to which a measuring instrument produces the same results when the entity remains constant (Leedy & Ormrod, 2014:91).

4.9.1 Validity

Kumar (2011:165) asserted that the validity can be established through justifying that the questions used relate to the objectives of the study. Validity is, loosely, the degree to which our statements approximate the truth. For this study, the validity of the data collection instrument was enhanced by deriving the open-ended questions from the set objectives especially in response to the first objective, which required primary data to be collected. Internal validity was observed by reviewing studies in the same field done by other researchers and adopting methodologies that have been applied in related studies such as those conducted by Tenopir *et al*. (2014); Carlson and Kneale (2011); Carlson *et al*. (2011); Thomas (2011); and Genoni, Merrick and Wislon (2006).

External validity is concerned with the extent to which the study can be generalised. "Generalizability refers to the capacity of the case to be informative about a general phenomenon, to be broadly applicable beyond the specific site, population, time, and circumstances studied" (Bryman, 2008:13). In this study, external validity was countered through conducting a multiple-case study through which a variety of universities (six in this case) were involved; thus, the results can be generalised to private chartered universities in Kenya. Generalisations to the population were also achieved through the study attempting to obtain a representative sample through the use of a high confidence level (95%) and a low margin of error (5%), whilst calculating the sample sizes (See section Table 1.4).

4.9.2 Reliability

Reliability can be achieved in different ways. One way of checking for reliability is by adopting instruments that have been used in similar studies. Mixed methods design has been selected as it has been applied in eResearch studies previously. For example, Muriithi, Horner and Pemberton (2016) used a mixed method research design in a multi-case study of four universities in Kenya in a study that sought to find the extent of diffusion of ICTs to support research collaborations in Kenya. Another study by Chiware and Mathe (2015) adopted structured interviews in their study of academic libraries' role in research data management services in the South African context. Structured interviews were used to capture data on eResearch from the University Librarians. This study adopted the use of qualitative and quantitative approaches as they have been applied in other similar studies.

"A reliable system of measurement or coding is consistent in that, each time it is used on the same data, it yields the same measure or code" (Perri & Bellamy, 2012:21). According to Boeije:

> *Reliability can be determined by calculating internal consistency and stability over time. Cronbach's Alpha coefficient is commonly used to measure internal consistency. The assumption of this procedure is that all items of an instrument together measure the whole construct. Therefore, each item must be related to the other items and each item measures part of what the other items measure as well* (2010:169).

Pre-testing of the questionnaire was done and Cronbach's Alpha coefficient was applied to test for reliability. Table 4.4 shows the number of cases that were tested after the pilot study while table 4.5 indicates the results after Cronbach's Alpha was applied (0.895). According to Sekaran

(2000), measures in a study are deemed reliable if they achieve a Cronbach's coefficient alpha of at least 0.7, however, 0.61 is also acceptable. The Cronbach's Alpha coefficient of 0.895 was, therefore, above the threshold. After improving on a few suggestions provided for the open-ended questions, the questionnaire that was then used in the actual study.

Table 4.3 Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

a. Listwise deletion based on all variables in the procedure.

Table 4.4 Reliability Statistics

Cronbach's Alpha	N of Items
.895	15

4.10 Ethical Considerations

Ethical issues are integral in a research process in order to avoid collisions between the researcher and participants (Gravetter & Forzano, 2016:99). This study observed some critical ethical considerations that included: Compliance with the University of KwaZulu-Natal (UKZN) research ethics protocol by which the researcher sought for ethical clearance that was approved (See Appendix 5); written permission was obtained from the six universities selected for the study and permission to collect data was granted (See Appendices 12-17); a research permit from the Kenya National Council for Science and Technology was sought to allow the researcher to conduct studies in the universities (See Appendix 9); participants were informed that their participation was voluntary and that their names would not be revealed (See Appendix 6). The researcher ensured that names were not reported in this thesis; Consent forms were provided to the participants that explained the purpose of the research study and their role to enable them to participate voluntarily. Survey participants signed an informed consent form prior to responding to the survey (See Appendix 6). The University Librarians signed the consent forms for audio recording once they agreed to be interviewed and audio recorded (See Appendix 7). Informed

consent “is the obligation to outline fully the nature of the data collection and the purpose for which the data will be used to the people or community being studied in a style and language that they can understand” (Boeije, 2010:45). “In every discipline, it is considered unethical to collect information without the knowledge of participants, and their expressed willingness and informed consent” (Kumar, 2014:285).

4.11 Summary

This chapter presented the research methodology for the study. The pragmatic research paradigm used to underpin this study was presented. A mixed methods approach which consists of quantitative and qualitative designs and a multiple-case study design that comprised six private universities were discussed. Using purposive sampling, PhD students, Faculty, University Librarians, Reference Librarians, and IR managers were selected as the units of analysis. A survey monkey calculator with a confidence level of 95% and a margin of error of 5% was used to determine the sampling size. Six University Librarians, 13 Reference Librarians, 7 IR Managers, 462 Faculty members, and 306 PhD students were targeted for the study. Survey questionnaires and semi structured interviews were adopted for quantitative and qualitative data respectively. SPSS version 21 was used for quantitative data analysis, while content analysis was selected for qualitative data analysis. Ethical research protocol of the UKZN was complied with.

The study offered some methodological limitations that included: limited prior research on the topic of eResearch which limited guidance on the choice of methodologies. Consequently, the researcher selected a mixed method approach within the pragmatic paradigm which was found sufficient for the exploratory study. Limitation in terms of clarifying concepts was also experienced when questionnaires were used to collect data from the researchers mainly because the target population was large (306 PhD students and 462 Faculty members respectively) and scattered in the six private universities under study. This was countered through the use of descriptive questions on the questionnaires (quantitative) and furthermore, research assistants were taken through the questions to enhance their ability to respond to any possible questions from the respondents. The next chapter discusses data analysis and presentation of the findings.

CHAPTER FIVE
DATA ANALYSIS AND PRESENTATION OF FINDINGS

5.1 Introduction

This study sought to address the question of how private university libraries in Nairobi County, Kenya are supporting eResearch in their institutions. At the core of this was to explore the extent to which libraries are working closely with researchers to integrate technologies into the entire research lifecycle with a particular focus on four phases namely: Formulation of ideas and research questions; Research grant; Managing information and data; and Publishing and sharing as illustrated in Figure 3.2 of this study. The identification of RDM activities and its challenges was part of the study. The question of the libraries' organisational structures, knowledge, and skills of librarians in relation to the delivery of eResearch support was also investigated.

The following research questions were examined: i. how do the organisation structures of the university libraries support eResearch? ii. What positions in the organisation structure and competencies are available for coordinating eResearch? iii. How is curation, analysis, and provenance (Metadata) of both basic data and information produced by research achieved? iv. What problems of data management, organisation, dissemination, and preservation exist and how can they be addressed? v. What procedures, tools, and policies are used to promote eResearch? vi. What is the inclination of library and academic staff towards eResearch?

The preceding chapter presented the research methodology for the study. The study collected both quantitative and qualitative data. Both open and closed-ended questions were presented to participants who included PhD students and Faculty members (researchers); Reference Librarians, and, Institutional Repository Managers using survey questionnaires (See Appendices 1-3). Qualitative data from University Librarians was obtained using interviews (See Appendix 4). Prior to analysis, the data in the questionnaires were prepared through coding each item in the questionnaire and this included identification and coding of missing data. IBM SPSS version 21 was used to generate tables, graphs, and statistics for data presentation. Qualitative data from the IR Managers were analysed using content analysis. Data from the interviews, on the other hand, were transcribed verbatim by converting them from audio-records into word-processed text

using themes derived from variables. These responses were used to complement the findings from the quantitative data.

The findings in Table 5.1 indicate the response rates for this study. "A response rate is a mathematical formula that is calculated by survey researchers and is used as a tool to understand the degree of success in obtaining completed responses from a sample" (Glaser, 2008:3). Survey questionnaires were administered to participants in the six universities (A - F). This included 462 questionnaires distributed to the Faculty with 395 returned, giving a response rate of 85.4%; 306 questionnaires were distributed to the PhD students of which, 223 were returned resulting in 72.8%; out of the 13 which were distributed to the Reference Librarians, 12 were returned giving a response rate of 92.3%; and 7 were distributed to Institutional Repository Managers out of which 5 were returned amounting to 71.4% response rate. Generally, the response rates were high ranging from 71-92% as illustrated in Table 5.1 below. Babbie and Mouton (2001) support the application of these response rates in a study as they indicate that a 70% response rate is considered acceptable. The high response rate was as a result of intensive follow-ups of respondents through various Librarians, and Research Assistants that were engaged through the research offices of the universities under study, as well as through personal and group face-to-face visits by the researcher. Apart from the questionnaires, all the six University Librarians targeted for interviews were reached and successfully interviewed, resulting in a 100% response rate. The average interview session was 30.3 minutes.

Table 5.1: Response rates for PhD students, Faculty, Reference Librarians and IR Managers

Respondent type	Questionnaires distributed	Questionnaires returned	Response rate (%)
Faculty	462	395	85.4
PhD	306	223	72.8
Reference Librarians	13	12	92.3
IR Managers	7	5	71.4

The results in this chapter are organised and presented based on the research questions, with each section guided by the themes derived from the variables that were obtained from the theoretical frameworks in chapter two (See Table 1.2). The themes include Organisation Structure; Staffing Competencies; Research Data Management; eResearch policies, processes, support, tools, collaborations; Perceptions and attitudes. The universities are hereby referred to as University A, University B, University C, University D, University E and University F in no particular order to enhance anonymity. In the case where specific participants are quoted, they are referred to as UL1, UL2, UL3, UL4, UL5, and UL6 in the case of University Librarians and, IR1, IR2, IR3, IR4, IR5 in the case of Institutional Repository Managers as the case may be in order to locate comments within appropriate contexts.

5.2 Biographical Information

This section presents demographic data from the respondents to understand their profile. The respondents included: Faculty members (Tutorial fellow, Assistant Lecturer, Lecturer, Senior Lecturer, Associate Professor and Professor); PhD students; and Reference Librarians (going by various names, see Figure 5.1) but are all be referred to as Reference Librarians in this report; IR Managers; and, lastly University Librarians.

5.2.1 Departments of Affiliation

The respondents were required to indicate the department in which they were affiliated. This study revealed that the PhD students and Faculty members belonged to 63 academic departments (See Appendix 18), with some indicating schools instead of departments. In a bid to enhance the sample sizes and to make the analysis simpler, the departments were categorised into twelve broad areas derived from the respondents' feedback as indicated in Table 5.2 and 5.3 below.

Table 5.2: Departments under study by university name *(n=571)*

	University Name						Total
	A	**B**	**C**	**D**	**E**	**F**	
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**
Business	32(5.6)	18(3.2)	67(11.7)	23(4.0)	8(1.4)	10(1.8)	**158(27.7)**
Theology & Biblical Studies	63(11.0)	6(1.1)	0(0.0)	7(1.2)	19(3.3)	25(4.4)	**120(21.0)**
Education	39(6.8)	2(0.4)	5(0.9)	0(0.0)	3(0.5)	21(3.7)	**70(12.3)**
Humanities & S Sciences	29(5.1)	1(0.2)	22(3.9)	0(0.0)	0(0.0)	0(0.0)	**52(9.1)**
Health Sciences	7(1.2)	10(1.8)	22(3.9)	7(1.2)	0(0.0)	3(0.5)	**49(8.6)**
Communication	5(0.9)	28(4.9)	2(0.4)	0(0.0)	0(0.0)	2(0.4)	**37(6.5)**
Sciences	16(2.8)	5(0.9)	14(2.5)	0(0.0)	0(0.0)	1(0.2)	**36(6.3)**
Development Studies	10(1.8)	7(1.2)	1(0.2)	0(0.0)	0(0.0)	4(0.7)	**22(3.9)**
Law	6(1.1)	2(0.4)	1(0.2)	0(0.0)	7(1.2)	0(0.0)	**16(2.8)**
Research & Development	2(0.4)	1(0.2)	2(0.4)	0(0.0)	0(0.0)	3(0.5)	**8(1.4)**
ODeL	1(0.2)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.2)	**2(0.4)**
Post Graduate Studies	1(0.2)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	**1(0.2)**
Total (%)	**211 (37.0)**	**80 (14.0)**	**136 (23.8)**	**37 (6.5)**	**37 (6.5)**	**70 (12.3)**	**571 (100.0)**

The results in Table 5.2 indicate that the bulk of the respondents were from the Business (158, 27.7%) and Theology departments (120, 21.0%). This is followed by Education (70, 12.3%), Humanities (52, 9.1%), Health Sciences (49, 8.6%), Communication (37, 6.5%), Sciences (36, 6.3%), and, Development Studies (22, 3.9%). The rest of the departments registered less than 20 participants as follows: Law (16, 2.8%), Research and Development (8, 1.4%), ODel (2, 0.4%), and, Post Graduate Studies (1, 0.2%). Out of the 618 surveyed, 47 (7.6%) did not respond to the question. Table 5.3 below provides a further breakdown of the departments of the PhD and Faculty members' by academic rankings.

Table 5.3: Departments under study by academic rankings *(n=571)*

	PhD Students	Tutorial Fellow	Assistant Lecturer	Lecturer	Senior Lecturer	Associate Professor	Professor	Total
	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)
Business	53(9.3)	12(2.1)	12(2.1)	49(8.6)	24(4.2)	1(0.2)	7(1.2)	**158(27.7)**
Theology & Biblical studies	59(10.3)	13(2.3)	8(1.4)	25(4.4)	8(1.4)	1(0.2)	6(1.1)	**120(21.0)**
Education	29(5.1)	4(0.7)	5(0.9)	18(3.2)	12(2.1)	2(0.4)	0(0.0)	**70(12.3)**
Humanities & Social sciences	18(3.2)	2(0.4)	8(1.4)	16(2.8)	4(0.7)	1(0.2)	3(0.5)	**52(8.4)**
Health Sciences	23(4.0)	1(0.2)	5(0.9)	9(1.6)	8(1.4)	0(0.0)	3(0.5)	**49(8.6)**
Communication	5(0.9)	8(1.4)	7(1.2)	11(1.9)	3(0.5)	2(0.4)	1(0.2)	**37(6.5)**
Science	6(1.1)	5(0.9)	9(1.6)	6(1.1)	7(1.2)	1(0.2)	2(0.4)	**36(6.3)**
Development Studies	4(0.7)	5(0.9)	4(0.7)	6(1.1)	1(0.2)	1(0.2)	1(0.2)	**22(3.9)**
Law	0(0.0)	6(1.1)	1(0.2)	4(0.7)	3(0.5)	0(0.0)	2(0.4)	**16(2.8)**
Research & Development	4(0.7)	0(0.0)	0(0.0)	2(0.4)	1(0.2)	0(0.0)	1(0.2)	**8(1.4)**
ODeL	1(0.2)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.2)	0(0.0)	**2(0.4)**
Post Graduate Studies	0(0.0)	0(0.0)	1(0.2)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	**1(0.2)**
Total (%)	**202(35.4)**	**56(9.8)**	**60(10.5)**	**146(25.6)**	**71(12.4)**	**10(1.8)**	**26(4.6)**	**571(100.0)**

As for the other categories of participants (twelve Reference Librarians, five IR Managers and the six University Librarians), the field data confirmed that they were all based in the library departments of their individual universities.

5.2.2 Academic Positions of Respondents

The PhD students and Faculty were asked to indicate their current academic positions. Out of the total of 618 who participated in the study, 223 (36.1%) were PhD students and 395 (63.9%) consisted of the Faculty members. Among the Faculty, the majority (156, 25.2%) were Lecturers, followed by Senior Lecturers (79, 12.8%), Assistant Lecturers (63, 10.2%), Tutorial Fellows (59, 9.5%), Professors (26, 4.2%), and lastly Associate Professors (12, 1.9%). Table 5.4 illustrates the current academic positions within each of the university.

Table 5.4: Academic positions for PhD students and Faculty *(n=618)*

Current academic rankings	University name						Total F(%)
	A	B	C	D	E	F	
	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)	
Doctorate student	75(12.1)	16(2.6)	79(12.8)	19(3.1)	4(0.6)	30(4.9)	**223(36.1)**
Lecturers	61(9.9)	29(4.7)	25(4.0)	8(1.3)	10(1.6)	23(3.7)	**156(25.2)**
Senior lecturers	20(3.2)	16(2.6)	23(3.7)	4(0.6)	6(1.0)	10(1.6)	**79(12.8)**
Assistant lecturers	24(3.9)	15(2.4)	13(2.1)	3(0.5)	3(0.5)	5(0.8)	**63(10.2)**
Tutorial fellows	21(3.4)	13(2.1)	5(0.8)	5(0.8)	9(1.5)	6(1.0)	**59(9.5)**
Professors	8(1.3)	5(0.8)	4(0.6)	4(0.6)	5(0.8)	0(0.0)	**26(4.2)**
Associate Professors	3(0.5)	0(0.0)	6(1.0)	0(0.0)	0(0.0)	3(0.5)	**12(1.9)**
Total (%)	**212(34.3)**	**94(15.2)**	**155(25.1)**	**43(7.0)**	**37(6.0)**	**77(12.5)**	**618(100)**

The Reference Librarians were asked to indicate their current positions at their university libraries. The results in Figure 5.1 indicate a wide range of titles despite the fact that they all serve as Reference Librarians at their respective university libraries. This study has adopted the title Reference Librarians for all them.

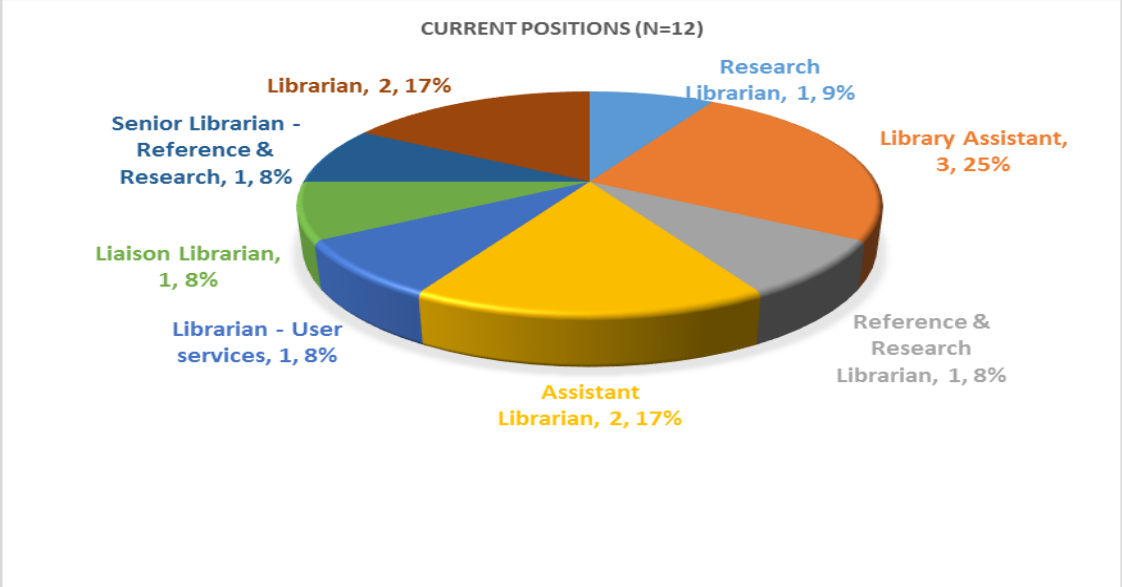

Figure 5.1: Current positions of Reference Librarians (n=12)

The IR Managers were asked to indicate whether they are referred to as such or if they go by the title systems librarians. The results indicate that 3 (60%) were titled IR Managers, while 2 (40%) were referred to as Systems Librarians. On the other hand, all the heads of the participating

university libraries had adopted the title 'University Librarians' and were, therefore, not asked to indicate their titles.

5.2.3 Gender, Duration worked, Highest qualification and Age

The researcher wanted the respondents to indicate their gender, duration worked, highest qualification, and age. Table 5.5 below illustrates the findings.

Table 5.5: Respondents' gender, duration worked in years, highest qualification, and age in years

Category	PhD students & Faculty F (%)	Reference Librarians F (%)	IR Managers F (%)	University Librarians F (%)
Gender				
Female	210(34.0)	8(66.7)	3(60.0)	4(66.7)
Male	408(66.0)	4(33.3)	2(40.0)	2(33.3)
Total (n)	**618(100.0)**	**12(100.0)**	**5(100.0)**	**6(100.0)**
Duration Worked	**(Faculty)**			
<5	131(33.2)	8(66.7)	N/A	0(0.0)
6-10	61(15.4)	1(8.3)	N/A	2(33.3)
11-15	10(2.5)	1(8.3)	N/A	1(16.7)
16-20	2(0.5)	0(0.0)	N/A	0(0.0)
>20	5(1.3)	0(0.0)	N/A	1(16.7)
Non responses	186(47.0)	2(16.7)	N/A	2(33.3)
Total (n)	**395(100.0)**	**12(100.0)**	**N/A**	**6(100.0)**
Highest Academic Qualifications				
Diploma	0(0.0)	1(8.3)	0(0.0)	0(0.0)
Bachelor's	2(0.3)	5(41.7)	2(40.0)	0(0.0)
Master's	413(66.8)	6(50.0)	3(60.0)	3(50.0)
PhD	197(31.9)	0(0.0)	0(0.0)	3(50.0)
Non responses	6(1.0)	0(0.0)	0(0.0)	0(0.0)
Total (n)	**618(100.0)**	**12(100.0)**	**5(100.0)**	**6(100.0)**
Age Categories				
20-30	49(7.9)	1(8.3)	0(0.0)	0(0.0)
31-40	214(34.6)	6(50.0)	4(80)	1(16.6)
41-50	214(34.6)	3(25.0)	1(20)	2(33.3)
Above 50	94(15.2)	0(0.0)	0(0.0)	2(33.3)
Non responses	47(7.6)	2(16.7)	0(0.0)	1(16.6)
Total (n)	**618(100.0)**	**12(100.0)**	**5(100.0)**	**6(100.0)**

a) Gender

Respondents were requested to choose from two options (male and female) to indicate their gender. Data presented in Table 5.5 indicate that more male (408, 66.0%) participated in the study compared to the female (210, 34.0%) in the case of PhD students and Faculty. Generally, the findings indicate that in all the universities, there were more male participants than the female ones. On the other hand, the sample of respondents from the libraries comprised of slightly more female than male in each category. The Reference Librarians involved 8 (66.7%) female and 4 (33.3%) male; the IR Managers were 3 (60%) female and 2 (40%) male, while the University Librarians who responded consisted of 4 (66.7%) female and 2 (33.3%) male.

b) Duration worked in the current positions

The respondents' duration of work is provided for in this segment. The findings in Table 5.5 indicate that the majority of the Faculty have worked in their current post in less than five years (131, 33.2%), followed by the periods 6-10 years (61, 15.4%), 11-15 years (10, 2.5%), more than 20 years (5, 1.3%) and, only 2 (0.5%) have worked between 16 to 20 years. One hundred and eighty-six (47.0%) Faculty members did not provide a response for this question. The Reference Librarians also indicated the duration worked in their current post. Table 5.5 indicates that the majority (8, 66.7%) of the Reference Librarians have worked in their current post for a period between 1-5 years. This is followed by 1 (8.3%) Reference Librarian in each of the periods 6-10 and 11-15 years. Two of them (16.7%) did not indicate the duration that they have worked. The six University Librarians were required to indicate on the interview schedules their duration of work in their current positions. Four indicated to have worked for the periods: 6, 10, 11 and 21 years respectively. Two (33.3%) did not indicate the duration worked.

c) Highest academic qualifications

With regard to academic qualifications, all the respondents were asked to state their highest academic qualifications. The findings in Table 5.5 show that the majority (413, 66.8%) of the PhD and Faculty members had a Master's Degree, 197 (31.9%) had a PhD, 2 (0.3%) had a Bachelor's degree, while 6 (1.0%) did not indicate their qualification. The findings further reveal that 6 (50.0%) of the Reference Librarians were Master's Degree holders, 5 (41.7%) had a Bachelor's while 1 (8.3%) had a Diploma. As for the IR Managers, 3 (60.0) had attained a

Master's Degree, while 2 (40.0%) were Bachelor Degree holders. The highest qualifications for the University Librarians include 3 (50.0%) for PhD and 3 (50.0%) with a Master's Degree.

d) Age categories

The age group for the respondents in all categories is presented in Table 5.5. The responses reveal that 214 (34.6%) of the PhD students and Faculty were in each of the categories 31-40 and 41-50, followed by 94 (15.2%) who are above 50 years, 49 (7.9%) fell in the age bracket of 20-30 years, while 47 (7.6%) did not indicate their age. The majority of them were, thus, between the ages of 31-50 years.

The findings for the Reference Librarians show that 6 (50.0%) were within the age group of 31-40 years, 3 (25.0%) were in the age group of 41-50 years, 1 (8.3%) fell in the range of 20-30 years, while 2 (16.7%) did not indicate their age. The age distribution for the IR Managers indicates that 4 (80%) were between the ages of 31-40, while 1 (20%) fell in the 41-50 years age range. As for the University Librarians, the findings indicate that there were 2 (33.3%) in each of the categories 41-50 and above 50, and 1 (16.6%) in the category of 31-40 years. One (16.6%) did not provide a response.

5.2.4 Year of Study for PhD Students

The study sought to know the year of study for the PhD students. The results shown in Figure 5.2 indicate that the majority of the students were in their second and first years (44, 20%) and (40, 20%) respectively, followed by third year (10, 4.4%), fourth year (8, 3.6%), fifth year (2.7%) and lastly, sixth and seventh years with a frequency of 2 (0.9%) each. An almost equal number of the PhD students (111, 49.8%) reserved comment on their year of study.

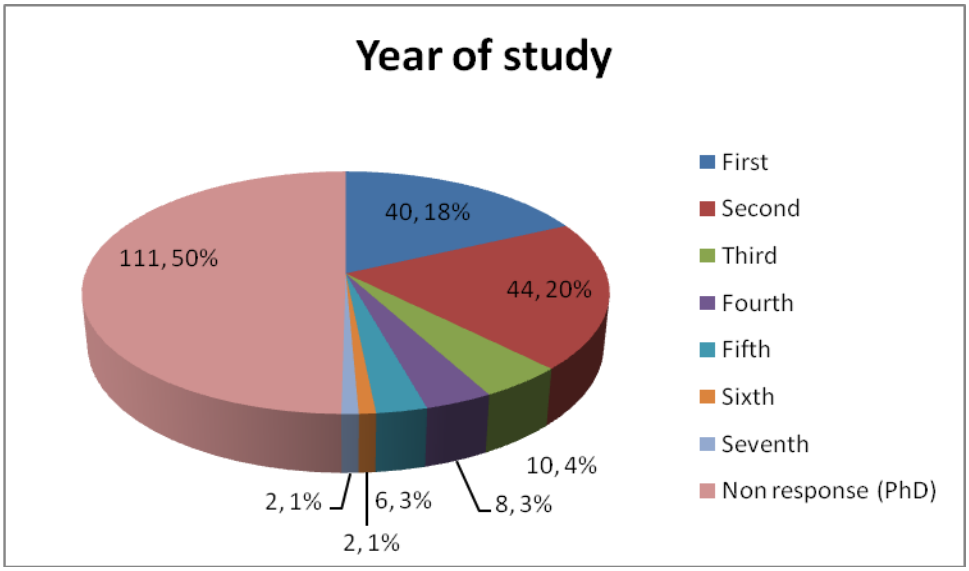

Figure 5.2: PhD students' current year of study (n=223)

5.2.5 What the Participants' Jobs Entail

The respondents were provided with an option of indicating what their jobs entail. A total of 217 (35.1%) responses listed various tasks that they do as indicated in Table 5.6 below.

Table 5.6: Job done by Faculty members (n=217)

Responsibilities	Current academic rank at the university						Total (% of cases)
	Lecturers	Professors	Tutorial Fellows	Senior Lecturers	Assistant Lecturer	Associate Professor	
Lecturing and Research coordination	16	4	4	15	8	3	50(23.0)
Lecturing	55	5	11	11	24	3	109(50.2)
Administration/HOD	12	2	2	6	2	2	26(12.0)
Mentoring and community service	0	3	1	2	0	1	7(3.2)
Coordinating departmental work	1	0	2	2	0	0	5(2.3)
Project supervision/research assistance	6	1	1	5	3	0	16(7.4)
Curriculum review/evaluating courses	2	1	0	1	0	0	4(1.8)

*Multiple responses possible

Table 5.7 below indicates the tasks carried out by the Reference Librarians and IR Managers. The findings indicate that the Reference Librarians work closely with library users to provide training, reference and research support, while the IR Managers support systems and manage institutional repositories.

Table 5.7: Responsibilities for Reference Librarians and IR Managers

Respondent type	University name	Code	Responses on what their jobs entail
Reference Librarians (n=9)	A	RL1	Supporting reference and research services
		RL2	Giving assistance to patrons on finding relevant resources for their research
		RL4	Assisting the library users in reference and research work
	B	RL5	ILC training, assigning EZProxy credentials, reference services, SDI, collection development through the establishment of titles to be acquired, circulation, an organisation of resources
	C	RL6	Helping users access information resources both print and electronic
		RL7	Creating linkages with users
		RL8	IL training, reference service and e-resources management
		RL9	Information and reference service
	F	RL12	User services/referral
IR Managers (n=5)	A	IR1	Implementation & maintenance of the IR
	B	IR2	Supervision and inputting data into IR, troubleshooting and educating users and depositors
	C	IR3	Managing the institutions IR and archives section
	D	IR4	Promote the access to the IR both on or off campus, constantly update the repository with current materials
	F	IR5	I am in charge of library systems

5.3 Structures for Coordinating eResearch in University Libraries

The PUL model entails the change of library organisational structures and enhancement of librarian's competencies if eResearch is to be fully supported by academic libraries (See section 2.3.2.1). This study sought to examine how the organisation structures of the university libraries' under study supported eResearch through interviewing the University Librarians.

- UL1 said that in university A, roles and specific job positions have been assigned to assist researchers in eResearch. A Research Librarian who is assisted by Research Assistants provides support to researchers through use of ICT-enabled techniques to support communication, enquiries over the net and emails, as well as searches on e-databases with literature searches transmitted to researchers online. "The structure itself is put in such a way that there are positions and secondly, the means".
- UL2 indicated that the library in university B has an automated network that enables engagement in supporting research. Two sections: Multimedia and dissemination of

reader services sections with networked computers, access to online databases, OPAC, and remote access to e-resources via EZProxy are measures taken by the library to enhance access to information.

- UL3 asserted that in terms of staffing, the library has a Reference Librarian and Liaison Librarian who engage with researchers and; hence, should be the one providing eResearch support.
- UL4 said that they have an E-resources Librarian and someone in charge of IR.
- UL5 added that they support,

  > *Aspects of eResearch because we don't have a librarian who is designated for eResearch. So ours is through the sections that are in place like reference and multimedia and the repository. When it comes to designation, we don't have titles such as multimedia librarians, ours are assistant librarians, librarians and the like (UL5).*

- UL6 reported that their structure supports eResearch to some extent in that next to the University Librarian are two staff who work with electronic aspects of the library: user services librarian in charge of training and ICT librarian, majorly helping with citation management, and training.

The study sought to discover from the University Librarians if there were individuals at their libraries or university that were responsible for eResearch management. Their responses highlighted below indicate that there are no specific individuals to serve that role.

- According to UL1, their current arrangement demands were that the Research Librarian be responsible for all research activities facilitated by the library and this includes coordinating work in the department, coordinating awareness creation and connecting researchers to appropriate people who can assist them in the library and university.
- UL2 said that it is not indicated in their current organogram. "*We don't have like what I believe in one day maybe like a Digital Librarian, we have an Archivist, Reader Services and one in charge of IR and e-library resource management*".
- UL3 indicated that the university has a Director of Research and that research is taken care of within the Graduate School.
- UL4 said the library takes care of it through the Liaison Librarian who liaises with Faculty in terms of e-resources usage and training.

- UL5 said the concept of eResearch is new, but they have Reference and Multimedia Librarians who empower and guide researchers on using e-resources. The UL further pointed out that "*I think we are limited in this aspect of eResearch*".
- UL6 said, "*Not with a clear designation, but basically, the ICT Librarian looks at e-resources both generated within the university, those we subscribe to and those that are open source*".

5.4 Positions, Staffing Competencies and eResearch Coordination

The second research question sought to establish existing positions in the structures, Reference Librarian's competencies ideal to support eResearch practices, and eResearch coordination in the private university libraries. The findings are presented in this section.

5.4.1 Positions in the Organisational Structures in Support of eResearch

In pursuance of the second research question, the University Librarians were asked to state the specific positions in the organisational structures aimed at supporting eResearch. The University Librarians indicated that they don't have support specifically for eResearch but they have librarians who support research activities. The findings as shown in Table 5.8 indicate reliance on Research, Reference and Liaison Librarians, and, the technological support from IR Managers and ICT Librarians.

Table 5.8: Specific positions in support of eResearch

Respondents	University name	Position	Frequency
UL2, UL4, UL5	B, D, E	IR manager	3
UL2, UL5	B, E	Reference Librarians	2
UL1	A	Research Librarian	1
UL1	A	Research and Reference Assistants	1
UL2	B	Multimedia Librarian	1
UL4	D	Liaison Librarian	1
UL6	F	Librarian, in charge of ICT	1

5.4.2 Reference Librarians' Knowledge and Skills for Supporting eResearch

A list of possible knowledge and skills relevant to support eResearch were provided to the Reference Librarians and they were asked to select the areas in which they had the skills. The

findings presented in Table 5.9 reveal that the majority had knowledge and skills of research methodologies (11, 91.7%), this was followed by IR Management and OA initiatives (10, 83.2%) each, next abilities and knowledge were in legal issues (8, 66.6%) and data descriptions (8, 66.5%), 7 (58.3%) pointed out to have an understanding of the research lifecycle, while 7 (58.2%) of the librarians indicated to have technical skills in data management. The least possessed knowledge and skills was recorded in the category of data curation (3, 25.0%).

Table 5.9: Knowledge and skills for Reference Librarians

Knowledge and skills	**University name**							
	A F (%)	**B F (%)**	**C F (%)**	**D F (%)**	**E F (%)**	**F F (%)**	**Total F (%)**	**Non-responses**
a. Data curation	1(8.3)	1(8.3)	0(0.0)	0(0.0)	0(0.0)	1(8.3)	3(25.0)	9(75.0)
b. Technical skills in data management	1(8.3)	1(8.3)	2(16.7)	1(8.3)	1(8.3)	1(8.3)	7(58.2)	5(41.7)
c. Research methodologies	4(33.3)	1(8.3)	3(25.0)	1(8.3)	1(8.3)	1(8.3)	11(91.7)	1(8.3)
d. Research lifecycle	2(16.7)	1(8.3)	2(16.7)	0(0.0)	1(8.3)	1(8.3)	7(58.3)	5(41.7)
e. Data description & documentation	1(8.3)	1(8.3)	3(25.0)	1(8.3)	1(8.3)	1(8.3)	8(66.5)	4(33.3)
f. IR management	3(25.0)	1(8.3)	3(25.0)	1(8.3)	1(8.3)	1(8.3)	10(83.2)	2(16.7)
g. OA initiatives	2(16.7)	1(8.3)	4(33.3)	1(8.3)	1(8.3)	1(8.3)	10(83.2)	2(16.7)
f. Legal & copyright frameworks	2(16.7)	1(8.3)	3(25.0)	0(0.0)	1(8.3)	1(8.3)	8(66.6)	4(33.3)
Total (% of cases)	**16 (133.3)**	**8 (66.4)**	**20 (166.7)**	**5 (42.0)**	**7 (58.3)**	**8 (66.4)**	**64 (533.3)**	**32 (266.7)**

*Multiple responses possible

5.4.3 Library Staffs' Skills and Competencies for Supporting RDM

The study sought to investigate from the University Librarians if there were any skills and competencies that the library staff members have which are relevant in supporting RDM services. Based on the findings below, it appears that three of the university libraries have library staff who are versed in data analysis.

> "*I know at least one who is attending classes on the use of SPSS in data analysis. But even from a guidance perspective, they are generally aware of the issues and they are*

able to guide or to refer students to the right people if there is a need for deep data analysis". (UL1)

"*The way you have explained it we are not actually doing it and so I am not sure whether they'd have the skills to support that and so maybe we need some training on that*" (UL3)

"*It can't be your typical librarian. Most of them have to have at least basic technological skills including database management, the use of the internet, data analysis tools and also have some knowledge of data mining and curation*". (UL4)

"*We have people who can do data analysis but it is self-trained. They can actually use SPSS*". (UL5)

5.4.4 Internal Capacity Building Programmes and Strategies to Develop eResearch Skills

The researcher sought from the University Librarians whether there were any internal capacity building programmes and strategies that could develop skills for providing eResearch services. The findings are provided below:

"*…we always have training on data retrieval or information retrieval services. We have […] people who are in training in areas of librarianship which includes how to provide current or modern support including eResearch services*". (UL1)

"*We have both internal and external trainings; on a needs basis*". (UL2)

"*Now that this is specific to eResearch it might not be possible to say but we have programs for capacity building. If there is a training we need for the staff we can actually initiate it and then the HR organizes it for us and knowing that this skill is actually needed maybe that is an area that we have to look at because we actually don't have it specifically for eResearch*". (UL3)

"*Most of them it is their personal daily profession courses on their own but the university also supports in case someone is interested in a professional course or a refresher course but the ones I have they came in with the skill*". (UL4)

"*We don't have*". (UL5)

"*Maybe not as of now, not explicitly as such*". (UL6)

5.4.5 External Opportunities for Developing Staff to Manage eResearch

When asked if they knew of any external opportunities that have been availed for developing staff to manage eResearch, the following responses were provided:

"…*when these things arise or when opportunities arise within the library profession fraternity, we are able to send our staff for exposure and training"* (UL1).

"*There is a budget for staff development and when we come across such opportunities I will always request and I send somebody, I nominate somebody they [university] should be able to fund them"* (UL5)

"*Yea, I have been seeing a few call-ups for some workshops and I believe they are out there but we have not taken advantage of them as of now*" (UL6).

5.5 Research Data Management

The third research question sought to establish how curation, analysis, and provenance (Metadata) of both basic data and information produced by research is achieved. In a bid to realise this, the study, thus, set to find out if private university libraries in Nairobi County, Kenya provide RDM support to its researchers. Through the lens of the research data lifecycle (See Figure 3.1), questions were framed to check what services are supported. All sets of participants (PhD students and Faculty, Reference Librarians, IR Managers and University Librarians) had their set of questions on RDM (See Appendices 1-4). The findings are presented in this section.

5.5.1 Data Creation

A list of processes for data creation was provided to the PhD students and Faculty and they were asked to indicate if their libraries provide them assistance in any of those practices. The results projected in Table 5.10 indicate that the highest support has been given to researchers in the area of locating existing data (276, 44.7%) and data collection (273, 44.2%), followed by planning data formats (221, 35.5%), planning of consent for sharing data (213, 34.5%) and data sharing (193, 31.2%). These findings indicate that researchers receive some level of support during data creation. However, the findings also indicate that majority of the respondents in the selected universities may not have been supported during data creation as indicated by those who did not select the procedures each of which registered above 55% of the respondents as not to have been provided with support.

Table 5.10: Data creation procedures *(n=618)*

Data creation	University name						Total selected	Not selected
	A	B	C	D	E	F		
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)		
Planning data formats	112 (18.1)	32 (5.1)	48 (7.7)	13 (2.1)	9 (1.4)	7 (1.1)	221 (35.5)	397 (64.2)
Planning consent for data sharing	99 (16.0)	15 (2.4)	52 (8.4)	24 (3.9)	15 (2.4)	8 (1.3)	213 (34.5)	405 (65.5)
Locating existing data	103 (16.7)	33 (5.3)	58 (9.4)	23 (3.7)	15 (2.4)	44 (7.1)	276 (44.7)	342 (55.3)
Collecting data	134 (21.7)	29 (4.7)	51 (8.3)	18 (2.9)	15 (2.4)	26 (4.2)	273 (44.2)	345 (55.8)
Data capturing	87 (14.1)	9 (1.4)	52 (8.4)	21 (3.4)	13 (2.1)	11 (1.8)	193 (31.2)	425 (68.8)
Total (% of cases)	**535 (86.6)**	**118 (19.1)**	**261 (42.2)**	**99 (16.0)**	**67 (11.0)**	**96 (15.5)**	**1176 (190.2)**	**1914 (309.7)**

*Multiple responses possible

A follow up question on DMPs shows that 392 (66.4%) selected 'yes' in Universities A (141, 23.9%), C (125, 21.2%), D (40, 6.6%), E (35, 6.0%), B (29, 5.0%) and F (22, 3.7%). On the other hand, 198 (32.6%) indicated selected 'no' in Universities B (63, 10.7%), A (60, 10.2%), F (49, 8.3%), C (23, 3.9%), E (2, 0.3%) and D (1, 0.2%) upon the PhD and Faculty members being asked if they had ever created a DMP for their research.

Table 5.11: Data management plans *(n=590)*

		Have you ever created a DMP for your research?					
		Yes		No		Total	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
University name	A	141	23.9	60	10.2	201	34.3
	B	29	5.0	63	10.7	92	15.2
	C	125	21.2	23	3.9	148	25.1
	D	40	6.6	1	0.2	41	7.0
	E	35	6.0	2	0.3	37	6.0
	F	22	3.7	49	8.3	71	12.5
Total F (%)		**392**	**66.4**	**198**	**32.6**	**590**	**100.0**

When the Reference Librarians were asked if they work closely with researchers to provide support during the creation of research data, findings suggest that 7 (58.3%) have been able to provide support, that is, Universities A (2, 16.7%), B (1, 8.3%), C (2, 16.7%), E (8.3%) and F (8.3%), while 5 (41.7%) did not select the option, that is, Universities A (2,16.7%), C (2,16.7%), D (1,8.3%).

5.5.2 Data Processing

The PhD students and Faculty were asked to select from a list of services related to data processing those that they felt their libraries have provided them with assistance. The findings in Table 5.12 indicate that the most support has been provided in data entry (241, 39.0%), followed by description of data (196, 31.7%), validation (195, 31.6%), planning for translation (181, 29.3%), transcription (147, 23.8%), cleaning (141, 22.8%) and anonymity (124, 20.1%). The findings also suggest that more than 61% of respondents in each of the listed categories have not been assisted with data processing procedures.

Table 5.12: Data processing procedures

Data processing	University name						Total selected	Not selected
	A	B	C	D	E	F		
	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)	F(%)
Data entry	116 (18.8)	20 (3.2)	47 (7.6)	17 (2.8)	13 (2.1)	28 (4.5)	241 (39.0)	377 (61.0)
Planning translation	85 (13.8)	14 (2.3)	50 (8.0)	18 (2.9)	12 (1.9)	2 (0.3)	181 (29.3)	437 (70.7)
Data transcription	69 (11.2)	10 (1.6)	46 (7.4)	4 (0.6)	12 (1.9)	6 (1.0)	147 (23.8)	471 (76.2)
Data validation	99 (16.0)	22 (3.6)	33 (5.3)	17 (2.8)	12 (1.9)	12 (1.9)	195 (31.6)	423 (68.4)
Data cleaning	66 (10.7)	9 (1.5)	41 (6.6)	11 (1.8)	10 (1.6)	4 (0.6)	141 (22.8)	477 (77.2)
Data anonymity	54 (8.7)	4 (0.6)	40 (6.5)	17 (2.8)	8 (1.3)	1 (0.2)	124 (20.1)	494 (79.9)
Data description	86 (13.9)	24 (3.9)	42 (6.8)	12 (1.9)	9 (1.5)	23 (3.7)	196 (31.7)	422 (68.3)
Total (% of cases)	**575 (93.0)**	**103 (16.7)**	**299 (48.4)**	**96 (15.5)**	**61 (9.9)**	**76 (12.3)**	**1225 (198.2)**	**3101 (501.8)**

*Multiple responses possible

In response to being asked whether they support researchers with data processing. The results show that a half of the Reference Librarians (6,50.0%) from Universities A (2,16.7%), C (2,16.7%), E (1,8.3%) and F (1,8.3%) have been involved in supporting researchers with data processing, while the other half (6,50.0%), that is, Universities A (2,16.7%), B (1,8.3%), C (2,16.7%) and D (1,8.3%) did not indicate if they had assisted researchers.

5.5.3 Data Analysis

The PhD students and Faculty were asked to select from the list of data analysis procedures the ones in which they have been provided with support by their university libraries. The findings in Table 5.13 indicate different levels of support provided in author publications (247, 40.0%), followed by support in data interpretation (192, 31.1%), then producing research output (186, 30.1%), and finally, preparing data for preservation (177, 28.6%). Despite these indications, the findings also reveal that a majority of the respondents (more than 60%) across all the data analysis procedures that did not indicate to have been supported by their libraries.

Table 5.13: Data analysis procedures

Data analysis	**University name**						**Total selected**	**Not Selected**
	A	**B**	**C**	**D**	**E**	**F**		
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**
Data interpretation	114 (18.4)	8 (1.3)	35 (5.7)	8 (1.3)	11 (1.8)	16 (2.6)	192 (31.1)	426 (68.9)
Production of research output	104 (16.8)	27 (4.3)	36 (5.8)	0 (0.0)	8 (1.3)	11 (1.8)	186 (30.1)	432 (69.9)
Author publications	112 (18.1)	49 (7.9)	34 (5.5)	9 (1.45)	7 (1.1)	36 (5.8)	247 (40.0)	371 (60.0)
Preparation of data for preservation	93 (15.0)	15 (2.4)	33 (5.3)	11 (1.8)	9 (1.5)	16 (2.6)	177 (28.6)	441 (71.4)
Total (% of cases)	**423 (68.3)**	**99 (15.9)**	**138 (22.3)**	**28 (4.5)**	**35 (5.7)**	**79 (12.8)**	**802 (129.8)**	**1670 (270.2)**

*Multiple responses possible

The study found that only 4 (33.3%) Reference Librarians from Universities A (2, 16.7%), C (1, 8.3%) and E (1, 8.3%) indicated to have provided data analysis support to researchers. A

majority (8, 66.6%) from the Universities A (2, 16.7%), B (1, 8.3%), C (3, 25.0%), D (1, 8.3%) and F (1, 8.3%) did not indicate if they had been involved in data analysis support.

5.5.4 Data Preservation

The PhD students and Faculty were asked to select from a list of data preservation procedures the ones in which they have been provided with support by their university libraries. The findings in Table 5.14 show that libraries have assisted some researchers in backing up and storage of data (284, 46.0%), followed by migration of data to suitable media (207, 33.5%), then help in data archiving (193, 31.2%) and meta-data creation (192, 31.1%), and lastly, migrating data to appropriate formats (186, 30.1%). A number of respondents ranging from 334(54.0%) to 432(69.9%) across the procedures did not select the services.

Table 5.14: Data preservation procedures

Data preservation	University name							Not selected
	A F (%)	B F (%)	C F (%)	D F (%)	E F (%)	F F (%)	Total F (%)	F (%)
Migrating data to appropriate formats	81 (13.1)	24 (3.9)	45 (7.3)	12 (1.9)	15 (2.4)	9 (1.5)	186 (30.1)	432 (69.9)
Migrating data to suitable medium	98 (15.9)	24 (3.9)	53 (8.5)	11 (1.8)	10 (1.6)	11 (1.8)	207 (33.5)	411 (66.5)
Data Back-up and storage	146 (23.6)	34 (5.5)	57 (9.2)	14 (2.3)	14 (2.3)	19 (3.1)	284 (46.0)	334 (54.0)
Meta-data creation	86 (14.0)	15 (2.4)	52 (8.4)	18 (2.9)	16 (2.6)	5 (0.8)	192 (31.1)	426 (68.9)
Data archiving	82 (13.2)	17 (2.8)	52 (8.4)	15 (2.4)	10 (1.6)	17 (2.8)	193 (31.2)	425 (68.8)
Total (% of cases)	**493 (79.8)**	**114 (18.4)**	**259 (42.0)**	**70 (11.3)**	**65 (10.5)**	**61 (9.9)**	**1062 (171.8)**	**2028 (328.1)**

*Multiple responses possible

The Reference Librarians were asked if they support researchers with preservation of their data. According to the findings, 6 (50.0%) from the Universities A (1, 8.3%), B (1, 8.3%), C (2, 16.7%), D (1, 8.3%) and E (1, 8.3%) indicated to have participated in this while 6 (50.0%) from Universities A (3, 25.0%), C (2, 16.7%) and F (1, 8.3%) did not respond.

The PhD and Faculty were provided with a list of possible data storage media and were asked to select the ones that they use to store their data. The results in Table 5.15 suggest that laptops were the most popular storage devices with 403 (65.2%) respondents, this is followed in order by portable hard drive (280, 45.3%), PC hard drive (272, 44.0%), USB stick (221, 35.8%), Cloud storage (204, 33.0%), library server (192, 31.1%) and external servers (180, 29.1%). A provision was made for the researchers to indicate other tools and only 2(0.3%) respondents from university C added that they store data on e-mail.

Table 5.15: Data storage medium *(n=618)*

			University name						
		A F (%)	**B F (%)**	**C F (%)**	**D F (%)**	**E F (%)**	**F F (%)**	**Selected F (%)**	**Not selected F (%)**
Where do you normally store your research data?	Library server	93(48.4)	14(7.3)	54(28.1)	14(7.3)	11(5.7)	6(3.1)	192(31.1)	426(68.9)
	PC hard drive	110(40.4)	30(11.0)	65(23.9)	21(7.7)	17(6.3)	29(10.7)	272(44.0)	346(56.0)
	USB stick	82(37.1)	28(12.7)	49(22.2)	15(6.8)	15(6.8)	32(14.5)	221(35.8)	397(64.2)
	Portable hard drive	106(37.9)	36(12.9)	70(25.0)	18(6.4)	21(7.5)	29(10.4)	280(45.3)	338(54.7)
	My laptop	160(39.7)	56(13.9)	80(19.9)	26(6.5)	20(5.0)	61(15.1)	403(65.2)	215(34.8)
	Cloud storage	77(37.7)	27(13.2)	45(22.1)	15(7.4)	12(5.9)	28(13.7)	204(33.0)	414(67.0)
	External servers	67(37.2)	6(3.3)	71(39.4)	17(9.4)	13(7.2)	6(3.3)	180(29.1)	438(70.9)
	Others (E-mail)	0(0.0)	0(0.0)	2(100.0)	0(0.0)	0(0.0)	0(0.0)	2(0.3)	616(99.7)
	Total (% of cases)	**695 (112.4)**	**197 (31.9)**	**436 (70.5)**	**126 (20.4)**	**109 (17.6)**	**191 (30.9)**	**1754 (283.8)**	**3190 (516.2)**

*Multiple responses possible

The study sought to understand from the IR Managers ways through which the university libraries ensure long-term preservation of data and information. The responses from four of the IR Managers as indicated below reveal that the four libraries use online systems to preserve data and information and more popularly the IR.

"*Creation of Dspace, IR system as well as storing the CDs and print copies of the research output*". (IR2)

"*Through the IR and also the archives where we digitize materials and upload on Portfolio archives system*". (IR3)

"*Archiving on IR (publications)" and "Use of entity relationship programs (Library Management Systems)*". (IR4)

"*Through the automation, dusting of resources, and repairing of worn-out resources*". (IR5)

The IR Managers were asked to respond to the open-ended question: *How is research data currently stored, shared and managed*? Figure 5.3 projects their responses.

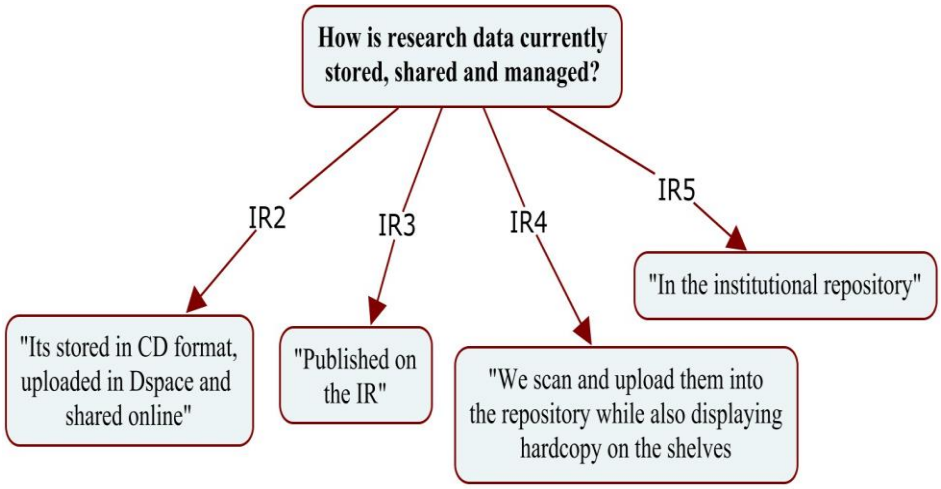

Figure 5.3 IR Managers opinions on data storage and sharing (n=4)

The PhD and Faculty were further asked if they had ever created any meta-data descriptions in their research. The study results indicated that a majority 413 (72.0%) in Universities A (151, 26.3%), C (116, 20.2%), B (41, 7.1%), D (40, 7.0%), F (34, 5.9%) and E (31, 5.4%) have been involved in creating meta-data descriptions, while a total of 161 (28.0%) from the Universities A (52, 9.1%), B (43, 7.5%), F (34, 5.9%), C (27, 4.7%) E (4, 0.7%), D (1, 0.2%) had not (See Table 5.16).

Table 5.16: Meta-data creation *(n=574)*

		Have you ever created any meta-data in your research process?					
		Yes		No		Total	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
University name	A	151	26.3	52	9.1	203	35.4
	B	41	7.1	43	7.5	84	14.6
	C	116	20.2	27	4.7	143	24.9
	D	40	7.0	1	0.2	41	7.1
	E	31	5.4	4	0.7	35	6.1
	F	34	5.9	34	5.9	68	11.8
Total F (%)		**413**	**72.0**	**161**	**28.0**	**574**	**100.0**

In following up on the support provided by libraries to researchers on metadata creation, IR Managers were asked to indicate how the library is involved in assisting researchers to create metadata for datasets in order to enhance re-use. The following responses were provided which generally suggest that some libraries train them, while others create the metadata on their behalf:

> "[*It is*] *created by librarians*" (IR1); "[*The library] trains them on how to enter the required metadata in DSpace system and on how to access the system*" (IR2); "*We [create metadata] for them*" (IR3) and, "*We train the researchers on how to create accounts and record metadata on various platforms*". (IR4)

5.5.5 Access to Data

The PhD students and Faculty were asked to select from a list of data access procedures the ones in which they have been supported by their university libraries. In the findings below (See Table 5.17) reveal that the highest support is reflected in data sharing (290, 46.9%) followed by data control (215, 34.8%), establishing copyrights (192, 31.1%), then promotion of data (145, 23.5%). However, it is evident in the results that the majority, ranging from 328 (53.1%) to 473 (76.5%) across the procedures, have not been assisted in the area of accessing research data.

Table 5.17: Data access procedures

Data access	A F (%)	B F (%)	C F (%)	D F (%)	E F (%)	F F (%)	Total selected F (%)	Not selected F (%)
Data sharing	148 (24.0)	36 (5.8)	51 (8.2)	15 (2.4)	15 (2.4)	25 (4.0)	290 (46.9)	328 (53.1)
Data control	94 (15.2)	33 (5.3)	51 (8.2)	14 (2.3)	14 (2.3)	9 (1.4)	215 (34.8)	403 (65.2)
Copyright establishment	95 (15.4)	10 (1.6)	53 (8.6)	12 (1.9)	13 (2.1)	9 (1.5)	192 (31.1)	426 (68.9)
Data promotion	50 (8.1)	11 (1.8)	51 (8.3)	15 (2.4)	15 (2.4)	3 (0.5)	145 (23.5)	473 (76.5)
Total (% of cases)	**387 (62.6)**	**90 (14.5)**	**206 (33.3)**	**56 (9.1)**	**57 (9.2)**	**46 (7.4)**	**842 (136.2)**	**1630 (263.7)**

*Multiple responses possible

The researcher sought to determine from the Reference Librarians if they support researchers to give access to their data. The findings indicate that 6 (50.0%) from Universities A (1, 8.3%), B (1, 8.3%), C (2, 16.7%), E (1, 8.3%) and F (1, 8.3) have been involved in promoting data access, while 6 (50.0%) from Universities A (3, 25.0%), C (2, 16.7%) and D (1, 8.3%) have not.

5.5.6 Data Re-use

The PhD students and Faculty were asked to select from a list of data re-use procedures the ones in which they have been supported by their university libraries. The findings in Table 5.18 shows that 242 (39.2%) have been supported in re-using data for new research, 225 (36.6%) have been assisted in re-using data in follow-up research, while 192 (31.1%) have been assisted to undertake reviews. The findings also show that more than 60% of the respondents in each category had not been guided on data re-use.

Table 5.18: Data re-use procedures

Data Re-use	A F (%)	B F (%)	C F (%)	D F (%)	E F (%)	F F (%)	Total selected F (%)	Not selected F (%)
Follow-up research	117 (19.0)	13 (2.1)	47 (7.6)	14 (2.2)	18 (3.0)	16 (2.5)	225 (36.4)	393 (63.6)
New research	108 (17.5)	40 (6.5)	49 (7.9)	13 (2.1)	14 (2.2)	18 (3.0)	242 (39.2)	376 (60.8)
Undertaking reviews	90 (14.6)	14 (2.3)	51 (8.2)	8 (1.3)	14 (2.3)	15 (2.4)	192 (31.1)	426 (68.9)
Total (% of cases)	**315 (51.0)**	**67 (10.8)**	**147 (23.8)**	**35 (5.7)**	**46 (7.4)**	**49 (8.0)**	**659 (106.6)**	**1195 (193.3)**

*Multiple responses possible

The Reference Librarians were asked if they support researchers with promoting their data for re-use. The results indicate that 7(58.3%) in the Universities A (1, 8.3%), B (1, 8.3%), C (25.0%), E (1, 8.3%) and F (1, 8.3%) have been involved in supporting them, while 5 (41.7%) in Universities A (3, 25.0), C (1, 8.3%) and D (1, 8.3%) have not.

To gain a general understanding of the university libraries' support to researchers towards the research data lifecycle, University Librarians were interviewed and asked to indicate how their libraries provide this support. Three of the respondents indicated that they do not have services particularly to support researchers' activities in the data lifecycle, while the other three respondents indicated the following:

> One of the Librarians indicated that their library has elements of training data management or research work such as e-reference service but further asserts that "*we are lucky that we host in the library building the Directorate of Research and, therefore, we are able to work with them to ensure that people who require attention or assistance we can refer them to them whether in terms of one-on-one and also we can refer them to the trainings that they have. So that is the way we provide some sort of support in data management*". (UL1)

"*I do not think we do unless the Reference and Liaison Librarian would say they do but I really doubt because all they do is they give information and they teach. I don't think that they are doing it right now*". (UL3)

"…*we do a lot of training to the users both student and faculty and then at the end we are not very much actively involved, but at the end, we come in with institutional repository we are able to organise whatever they have finally come up with*". (UL6)

5.5.7 Research Data Services Provided by the Libraries

A list of RDS was provided to the Reference Librarians and they were asked to select those which their libraries offer. Based on the results in Table 5.19, 10 (83.3%) of the respondents indicated that their libraries create institutional data repositories; 8 (66.7%) provide guidance on institutional policies; 7 (58.3%) are involved in digital archiving; 6 (50.0%) assist users with IPR and privacy issues; 5 (41.7%) varied libraries occur in each of the categories: training researchers on data management activities, helping with creation of DMPs and, helping with the creation of metadata. Lastly, only 4 (33.3%) have provided tools to support data mining and visualisation.

Table 5.19: Research Data Services provided by the university libraries

		University name							
		A F (%)	**B F (%)**	**C F (%)**	**D F (%)**	**E F (%)**	**F F (%)**	**Selected F (%)**	**Not selected F (%)**
RDS provided by the libraries	Creation and management of institutional data repositories	3 (25.0)	1 (8.3)	3 (25.0)	1 (8.3)	1 (8.3)	1 (8.3)	10 (83.3)	2 (16.7)
	Providing tools for data mining and visualisation	1 (8.3)	0 (0.0)	1 (8.3)	0 (0.0)	1 (8.3)	1 (8.3)	4 (33.3)	8 (66.7)
	Training researchers on RDM activities	1 (8.3)	1 (8.3)	1 (8.3)	0 (0.0)	1 (8.3)	1 (8.3)	5 (41.7)	7 (58.3)
	Guidance on institutional policies	3 (25.0)	1 (8.3)	2 (16.7)	0 (0.0)	1 (8.3)	1 (8.3)	8 (66.7)	4 (33.3)
	Helping with creating DMPs	1 (8.3)	1 (8.3)	0 (0.0)	1 (8.3)	1 (8.3)	1 (8.3)	5 (41.7)	7 (58.3)
	Helping with creation of metadata for data sets	1 (8.3)	1 (8.3)	1 (8.3)	1 (8.3)	0 (0.0)	1 (8.3)	5 (41.7)	7 (58.3)
	Assistance with data IPR and privacy issues	1 (8.3)	1 (8.3)	1 (8.3)	1 (8.3)	1 (8.3)	1 (8.3)	6 (50.0)	6 (50.0)
	Digital archiving	1 (8.3)	1 (8.3)	3 (25.0)	1 (8.3)	0 (0.0)	1 (8.3)	7 (58.3)	5 (41.7)
Total		**12**	**7**	**12**	**5**	**6**	**8**	**50**	**46**
(% of cases)		**(100.0)**	**(58.3)**	**(100.0)**	**(41.7)**	**(50.0)**	**(66.7)**	**(416.7)**	**(383.3)**

*Multiple responses possible

The University Librarians were asked to state the extent to which the library is involved in research data management (curation, analysis, and provenance). The responses below suggest minimal involvement by the university libraries in supporting data management.

> "*We have ICT-enabled workstations where students and faculty or whoever requires data analysis can sit and do the analysis. Some of these have been loaded with data analysis software. But it is a project in progress. In terms of curation, we can just talk of a plan whereby we can ask researchers to be able to provide us with data after use we can then store it for further use or re-use*". (UL1)
>
> "*I'd say that we do this through the IR […]. In the archives what we have is the facts but not in terms of the research data*". (UL2)

"*The part that I am sure of is maybe preservation because from the beginning I think that is with the research office so they are the ones who'd actually have that data. For us, we get the end product. That is, information*". (UL3)

"*No, the library is not involved. Raw data? No, we don't analyse, we don't preserve it in our repository. What we preserve is analysed data, so that is something new*". (UL5)

"*So far, not so much involved*". (UL6)

5.6 Challenges in the management, organisation, dissemination, and preservation of data

The fourth research question sought to establish if there were existing problems in relation to research data management, organisation, dissemination, and preservation. The findings are presented in this section.

The PhD students and Faculty were provided with a list of RDM challenges and were asked to select the ones they faced. Privacy and confidentiality of research data was a challenge to 328 (53.1%), 301 (48.7%) indicated that they have challenges in creating metadata, 299 (48.4%) are facing difficulties when it comes to locating of datasets and, 254 (41.1%) find data storage as a challenge. Within each challenge, an almost equal number of respondents did not select the challenge as indicated in Table 5.20. The respondents were also given a provision to indicate any other possible RDM challenges under "others (please specify)" and none was provided.

Table 5.20: RDM challenges faced by PhD and Faculty members *(n=618)*

RDM challenges	Selected (%)	Not selected (%)
Privacy and confidentiality issues associated with research data	328 (53.1)	290 (46.9)
Creating metadata	301 (48.7)	317 (51.3)
Locating datasets	299 (48.4)	319 (51.6)
Storage of data	254 (41.1)	364 (58.9)
Total % of cases	**1182 (191.3)**	**1290 (208.7)**

*Multiple responses possible

The study further sought to find out from Reference Librarians if there were any challenges faced when providing research data management services. The following represents their views:

The Reference Librarians from university A indicated that: *"We have not engaged in formal RDM services"* (RL1); *"Insufficient access"* (RL2); *"Some databases are a bit complicated and need much knowhow, the internet is guaranteed and the computer software and hard disk are not current for fast processing or downloading of work"* (RL3); *"Lack of administrative and academic support from the institutions. Lack of finances - cannot attend trainings off-campus, economic strains of institution who's going to pay for archiving and access, adopting new technologies etc"*. (RL4)

In university B, RL5 indicated "*Inadequate staff and skills, lack of willingness from the researchers to share*".

In university C, the challenges outlined include: "*Dealing with research students who don't understand what technologies they need to use; Finding time to work consistently with research centre thus creating a gap on any new concepts*" (RL6); "*Stereotypes, work overload, one may not deliver in time; lack of skill and knowledge; librarians could lack time to keep abreast of new tech; there are no policies around RDM; we may not see it as our work*" (RL7); "*Training, [it is a] new field - institutions of higher learning should develop a curriculum*" (RL8); "*Network failure*". (RL9)

RL10 in university D cited, "*A lot of consultation back and forth in order to establish suitable RDM policies acceptable across the universities; poor attendance to RDM training session offered to researchers*".

RL12 in university F stated that, "*it is a full-time job*" and "*equipment tools are inadequate*".

The IR Managers were asked to indicate the challenges that the library experiences while managing data. Three of them cited the following:

"*Copyright issues, plagiarism, fear of data being copied [and] awareness*" (IR2).

"*Poor attendance to RDM training sessions offered. A lot of consultations back and forth so as to establish suitable RDM policies acceptable across the universities*" (IR4).

"*Information overload*" (IR5).

The University Librarians were also interviewed and asked to outline any research data management challenges and barriers that the library faces. The majority indicated not to have RDM but cited potential challenges as highlighted below:

"*Developing the right skill set especially in RDM so that we can be able to provide adequate services*". (UL1)

"*Adaptation of e-publishing even within the university. Adaptation of OA publishing"*. *(UL1)*

"Lack of awareness among researchers and students where they can publish their work quality areas or quality publishers. Sometimes you see areas they have published in their works are really journals that are not peer-reviewed". (UL1)

"*…what we need is how to create awareness, how to sensitize, how to upgrade on knowledge of how to go about the eResearch*". (UL1)

"*I think availing of the data for research is one of the challenges*". (UL2)

"*Lack of understanding what it is all about and why do I have to give my own data, what for*? *Maybe someone will be worried that if I give it then someone is going to use it*". (UL2)

"*The issue of space for data storage and we'd need to look for external servers for high level securing of data*". (UL2)

"*Then of course budget*". (UL2)

"*I think researchers are protective of their data. I do not see how they would want to keep it in a library*". (UL3)

"*Once somebody has got the data and analysed it, most of the time it is not stored anywhere. Even mine if you ask me I don't know where it went. So there is that challenge of thinking that it is not important once you have already used it*". (UL3)

"*I think the issue of attitude*". (UL4)

"*Probably lack of support, I mean we'll even have to lobby the university management and I would imagine some platforms that would call for money and the library budgets are so slim*". (UL4)

"*There is a gap in terms of skills. Your typical librarian may not be able to hack some concepts. I believe that there are some desires to competencies so for the typical librarian there will be a need for capacity building*". (UL4)

"Slow internet connectivity and old computers will be a challenge". (UL5)

"*Attitude that is another thing, for me to give somebody raw data will be very difficult*". (UL5)

"*Need for more awareness and advocacy*". (UL5)

"*...I think maybe technological in terms of capacities unless we build technological capacities that will be able to store such data, but not only to store but also to make it more available when required...*". (UL6).

5.7 eResearch Procedures, Tools and Policies

The fifth research question sought to establish the procedures, tools, and policies that support eResearch. Guided by the eResearch Capability Model (See Table 1.2), the respondents were asked questions revolving around eResearch policies, processes, support, tools, and, collaborations. The findings are presented in this section.

5.7.1 Policies

The Reference Librarians were provided with a list of policies and were asked to indicate the policies that they have in place that would support eResearch. The results presented in Table 5.21 show that 8 (66.7%) Reference Librarians indicated that they have ICT policies and another 8 (66.6%) had referencing styles policies in universities A, B, C, D and F. Research policy was indicated to be available by 7 (58.3%) respondents in universities A, B, C, and F, open access policy by 6 (50.0%) in universities A, C and F, preservation policies by 5 (41.7%) in universities A, B, D and F, staff development by 4 (33.3%) in universities A, B and F, e-strategy by 2 (16.7%) in universities A and F, and finally, RDM policy by 1 (8.3%) respondent in university F. The study further shows that university F has all the policies based on the Reference Librarians' responses, university A has all except RDM policy, while the Reference Librarian for university E did not select any of the policies listed.

Table 5.21: Policies in support of eResearch *(n=12)*

			University name						
		A F(%)	**B F(%)**	**C F(%)**	**D F(%)**	**E F (%)**	**F F(%)**	**Selected F (%)**	**Non-responses F(%)**
Policies that support eResearch	a. Research policy	4(33.3)	1(8.3)	1(8.3)	0(0.0)	0(0.0)	1(8.3)	7(58.3)	5(41.7)
	b. RDM policy	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(8.3)	1(8.3)	11(91.7)
	c. ICT policy	3(25.0)	1(8.3)	2(16.7)	1(8.3)	0(0.0)	1(8.3)	8(66.7)	4(33.3)
	d. Staff development policy	2(16.7)	1(8.3)	0(0.0)	0(0.0)	0(0.0)	1(8.3)	4(33.3)	8(66.7)
	e. OA policy	2(16.7)	0(0.0)	3(25.0)	0(0.0)	0(0.0)	1(8.3)	6(50.0)	6(50.0)
	f. E-strategy	1(8.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(8.3)	2(16.7)	10(83.3)
	g. Referencing styles policies	2(16.7)	1(8.3)	3(25.0)	1(8.3)	0(0.0)	1(8.3)	8(66.7)	4(33.3)
	f. Preservation policies	2(16.7)	1(8.3)	0(0.0)	1(8.3)	0(0.0)	1(8.3)	5(41.7)	7(58.3)
	Total(% of cases)	**16 (133.3)**	**5 (41.7)**	**9 (75.0)**	**3 (25.0)**	**0 (0.0)**	**8 (66.7)**	**41 (341.7)**	**55 (458.3)**

*Multiple responses possible

In line with policies, the IR Managers were also asked about eResearch policies. The first query enquired about existing policies in their universities that support eResearch. Four responses were provided:

> "*Work in progress*" (IR1, university A)
>
> "*All published materials sponsored by the university as well on theses and dissertation are deposited in the library for IR storage and sharing*" (IR2, university B)
>
> "*Repository policy*" (IR3, University C)
>
> "*We are in the process of developing an ethical eResearch guide*" (IR4, university D).

When asked about strategies that their universities have to ensure long-term preservation of data and information in the repositories, responses provided by the IR Managers as outlined below generally indicated that long-term preservation policies are enshrined in IR policies.

> "*Flow of research output from creation to preservation is elaborated in the IR policy*". (IR2, university B)

"*IR policy in place*". (IR3, University C)

"*The IR is housed in a server platform for the library that preserves any documentation*". (IR4, university D)

"*Through a policy that compels every graduating student to submit a soft copy of his/her thesis or dissertation into repository*". (IR5, university F)

The University Librarians were also interviewed on eResearch policies in place. The researcher sought to establish from them if their library vision and mission encompass support for eResearch. The findings suggest that the integration of technologies in research is part and parcel of library ongoing activities, but it is not explicitly spelt out in the visions and missions. The responses are outlined below:

"*Not in a specific way but in the current delivery of service we use ICT or we use electronic means. So maybe it doesn't specify but as a library modern service we use really electronic or ICT-based techniques to support research. Maybe we need to update our policies*". (UL1)

"*Yes, it is a requirement even from the CUE. In their last visit because we had to review so our vision and mission statement reflects that*". (UL2)

"*For our vision, we talk of academic excellence globally so somehow it is there but the mission specifies research is there. And when we are talking about research it is not just the traditional, yea it is there. It is covered*". (UL3)

"*Probably we might not use the exact words that you are using but in our vision and mission there is something about scholarly eResearch and probably we could have elements…so it's actually captured in our vision and mission…*". (UL4)

"*At the moment the mission is silent about …it's just about the provision, dissemination, and preservation. It doesn't indicate the integration of technologies on research; I think we do it unknowingly…*". (UL5)

"*I think in the mission part of it there is a mention I believe on…but of course specifically just looking at academic excellence and I think in the time that we are living in we can't talk of academic excellence and leave out aspects of eResearch*" (UL6).

Upon being asked about the availability of policy frameworks that support eResearch. The findings from the University Librarians suggest that there are no particular eResearch policy frameworks in the libraries. The responses that emerged were:

"*We have a policy for reference services which specifies the kind of service that we can provide… we have a draft policy on IR to guide on how we can create or accumulate resources, e-thesis, and dissertations deposit and how it can be accessed. The university also has a policy on plagiarism…We have a policy on research and publications which again stipulates how research can be undertaken and what safeguards are there and a lot has to do with the way we use electronic means to achieve the ends*". (UL1).

"*Not specifically for eResearch*". (UL3).

"*I think informally, not formally. We don't have eResearch coming out. It is not pronounced as eResearch. It is not in the policy of the library… It is silent in the policy maybe we need to revise our policy with your study*" (UL5)

"*Currently no*". (UL6)

The researcher further probed the University Librarians to indicate how the library's strategic plans address eResearch support. Two responses were provided as presented below:

In our strategic plan, "*we stipulate the things that we want to implement in terms of, and some of them touch on eResearch which include strategic goals for training to provide the skills or to build the skill set required for eResearch. It also provides for a strategic goal to do with systems, what systems we need to implement and which also touch on eResearch support. It also touches on targets by library staff with the aim of what extent our staff are supporting eResearch at the user level or patron level*". (UL1)

"*I think it is an area we have not given a deliberate thought*". (UL5)

5.7.2 Research Process

Four phases were used to investigate eResearch support within the research lifecycle. The findings are presented in the subsections below.

5.7.2.1 Formulation of Ideas and Research Questions

Using a three-point Likert Scale (Agree=2, Disagree=1 and Not aware=0), the PhD students and Faculty were asked to select the most appropriate scale in relation to the statements that were provided to them relating to the support that university libraries can provide to researchers during the first phase of the research lifecycle (See Figure 3.1). The results are shown in Table 5.22.

Table 5.22: Support provided by libraries in the first phase *(n=618)*

	Statements	Not Aware		Disagree		Agree		Non-responses		Mean	SD
		F	%	F	%	F	%	F	%		
A	The library provides up-to-date citation databases	51	8.3	50	8.1	497	80.4	20	3.2	1.75	.601
B	The library subscribes to a wide range of e-resources	39	6.3	70	11.3	496	80.3	13	2.1	1.76	.561
C	The library provides easy access to the institutional repositories	71	11.5	53	8.6	473	76.5	21	3.4	1.67	.677
D	The library provides assistance in finding research collaborators	94	15.2	80	12.9	410	66.3	34	5.5	1.54	.756
E	The library has online research consultancy services	110	17.8	78	12.6	399	64.6	31	5.0	1.49	.791

From the findings, 497 (mean 1.75) of the respondents indicated that their libraries provide up-to-date citation databases, 496 (mean 1.76) agreed that their libraries subscribe to a wide range of e-resources, 473 (mean 1.67) indicated that they had easy to access institutional repositories enabled by their libraries, 410 (mean 1.54) are assisted in finding research collaborators, while 399 (mean 1.49) indicated the existence of online research consultancy services in their libraries. These results suggest that the university libraries provide significant support to researchers when they are formulating research ideas and questions.

The Reference Librarians were provided with a list of statements with regard to supporting researchers to formulate ideas and research questions and were asked to select those that apply in their university libraries. The results presented in Table 5.23 show that 10 (83.3%) of the respondents indicated that they do provide up-to-date citation databases in universities A, B, C, E and F. When asked if their libraries have a wide range of e-resources, 11 (91.7%) indicated that they did in all the universities. Provision of easy access to IRs was reported to happen by 10 (83.3%) in universities A, B, C, D and F. When asked if they offered online research consultancy services for researchers, 8 (66.7%) affirmed in universities A, C and F.

Table 5.23: Support provided to researchers when formulating ideas and research questions

		University name							
		A	**B**	**C**	**D**	**E**	**F**	**Selected**	**Non-responses**
Research process	a. The library provides up-to-date citation databases	3	1	4	0	1	1	10	2
		25.0%	8.3%	33.3%	0.0%	8.3%	8.3%	83.3%	16.7%
	b. The library provides access to a wide range of e-resources	3	1	4	1	1	1	11	1
		25.0%	8.3%	33.3%	8.3%	8.3%	8.3%	91.7%	8.3%
	c. The library provides easy access to the institutional repositories	3	1	4	1	0	1	10	2
		25.0%	8.3%	33.3%	8.3%	0.0%	8.3%	83.3%	16.7%
	d. The library has online research consultancy services for researchers	4	0	3	0	0	1	8	4
		33.3%	0.0%	25.0%	0.0%	0.0%	8.3%	66.7%	33.3%
Total (% of cases)		**13 (108.3)**	**3 (25.0)**	**15 (125.0)**	**2 (16.7)**	**2 (16.7)**	**4 (33.3)**	**39 (325.0)**	**9 (75.0)**

*Multiple responses possible

5.7.2.2 Research Grant

Using a three-point Likert Scale (Agree=2, Disagree=1 and Not aware=0), the PhD and Faculty were asked to select the most appropriate scale in relation to the statements that were provided to them relating to the support that university libraries can provide to researchers during the second phase of the research lifecycle (See Figure 3.1). The results are shown in Table 5.24.

Table 5.24: Support provided by libraries in the second phase *(n=618)*

	Statements	**Not aware**		**Disagree**		**Agree**		**Non-responses**		**Mean**	**SD**
		F	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
f	The library assists in analysing the impact of my research	107	17.3	117	18.9	365	59.1	29	4.7	1.44	.781
g	The library assists with publication citation analysis and other metrics to support grant proposals	112	18.1	110	17.8	376	60.8	20	3.2	1.44	.789
h	The library provides advisory on research funding opportunities	100	16.2	119	19.3	377	61.0	22	3.6	1.46	.765

Based on the findings in Table 5.24, 377 (mean 1.46) affirmed that their libraries have provided them with advisory on research funding opportunities, 376 (mean 1.44) are assisted with publication citation analysis and other metrics to support grant proposals, and 365 (mean 1.44) indicated that they have been assisted by their libraries to analyse the impact of their researches.

The Reference Librarians were asked to indicate if their libraries provide support in the areas provided by the statements in Table 5.25. The findings show that 6 (50.0%) of the Reference Librarians from universities A, C, D and E indicated that they assist researchers with publication citation analysis and other metrics to support grant proposals. On the other hand, only 3 (25.0%) from universities A and F have provided advisory on research funding opportunities.

Table 5.25: Support provided to researchers in research grant application *(n=12)*

Statements		University name						Selected	Non-responses
		A	B	C	D	E	F		
Research grant	a. The library assists researchers with publication citation analysis and other metrics to support grant proposals	2	0	2	1	1	0	6	6
		16.7%	0.0%	16.7%	8.3%	8.3%	0.0%	50.0%	50.0%
	b. The library provides advisory on research funding opportunities	2	0	0	0	0	1	3	9
		16.7%	0.0%	0.0%	0.0%	0.0%	8.3%	25.0%	75.0%
Total (% of cases)		**4(33.3)**	**0(0.0)**	**2(16.7)**	**1(8.3)**	**1(8.3)**	**1(8.3)**	**9(75.0)**	**15(125.0)**

* Multiple responses possible

5.7.2.3 Managing Information and Data

In an attempt to establish how information and data are managed, the respondents were presented with questions about IRs that included: self-archiving, publishing, motivation and IR management. The findings are discussed in the sections below.

a. Self-archiving in IRs

The PhD students and Faculty were asked if they are able to self-archive their research output in the IRs. The results in Figure 5.4 indicate that 322 (54.0%) have the ability to self-archive, followed by 140 (24.0%) who indicated that they required more information about self-archiving in IRs and, 131 (22.0%) were not able to self-archive their research in IRs.

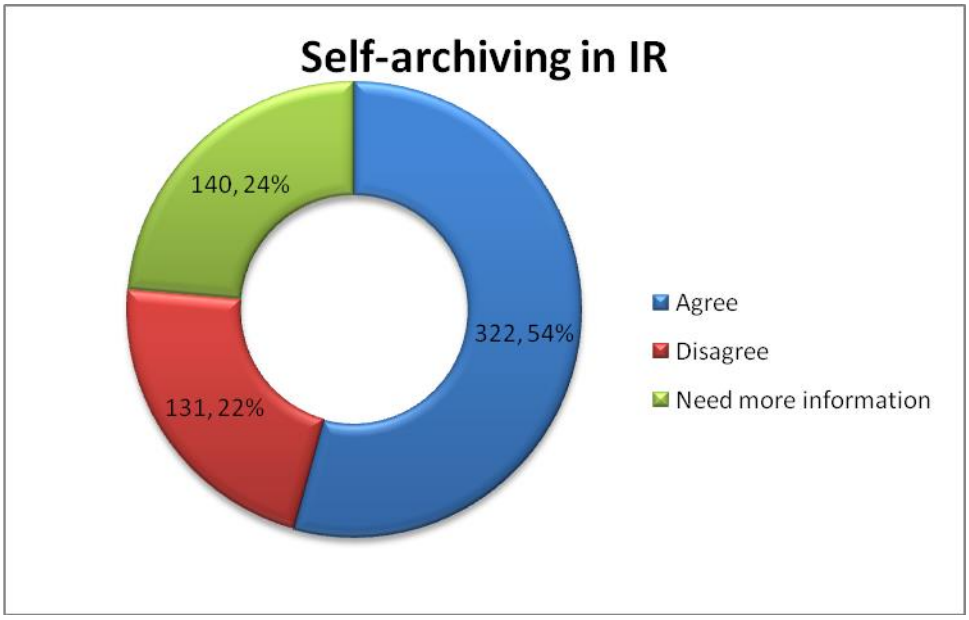

Figure 5.4: Self-archiving in IRs (n=593)

In line with the above mentioned, the IR Managers were asked to state the measures that they have put up to enable researchers to self-archive their research output into the repositories. In the findings presented below, three of the respondents indicated that their libraries do the self-archiving while two respondents stated that they provide training and awareness to encourage researchers to contribute to the IR but were unclear as to whether it involves self-archiving.

> "*Training researchers and encouraging them to provide the library with their publications*". (IR1)
>
> "*Creation of awareness to researchers in order to motivate them and enable them to contribute to the repository*". (IR2)
>
> "*We do the archiving for the researchers*". (IR3)
>
> "*Currently I am the one in charge of uploading the research into the repository*". (IR4)
>
> "*We are in the process of implementing self-archiving*". (IR5)

b. Publishing in IR

The PhD students and Faculty were asked if they found it helpful to publish in their University's IRs. The majority (369, 63.0%) were affirmative, 114 (19.0%) indicated that it was not helpful, while 103 (18.0%) had never deposited in an IR as illustrated in Figure 5.5

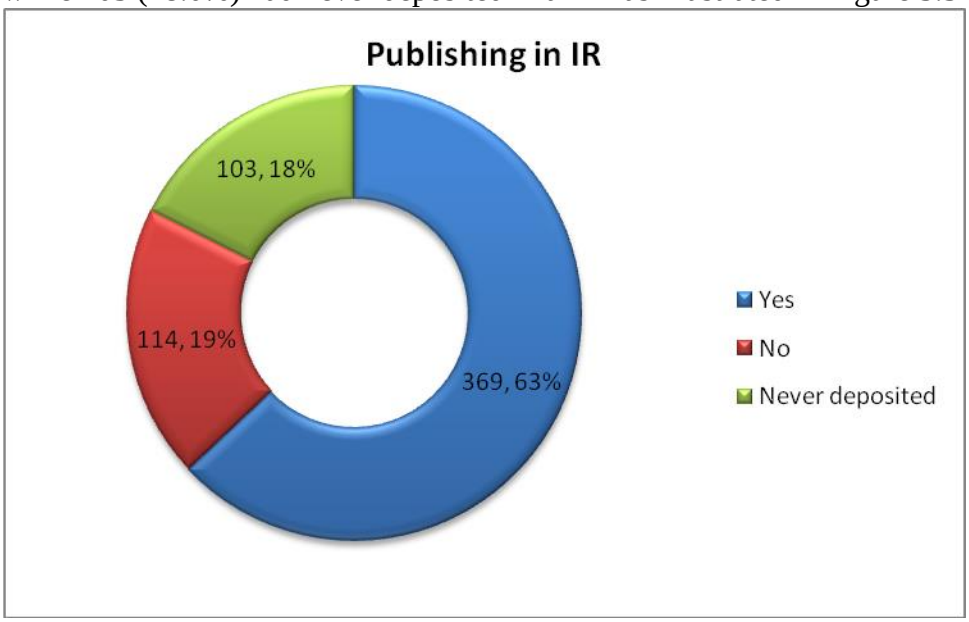

Figure 5.5: Publishing in IRs (n=593)

c. Motivation for Depositing in IRs

The PhD students and Faculty were presented with a list of possible reasons that would motivate them to publish in their university's IRs and were asked to select those statements that applied to them. The findings in Table 5.26 show that 370 (59.8%) need more information about IRs, 336 (54.4%) need more information about copyright and plagiarism, 332 (53.7%) needed to know how IR will support their scholarly activities, 322 (52.1%) need training in submission procedures, 298 (48.2%) require assistance with uploading of materials in the IR, 276 (44.7%) need assistance to clear up with copyright issues related to their work, while 42 (6.8%) indicated that the library ought to be prompt in uploading content in IRs**.**

Table 5.26 Motivation for depositing in IR (n=618)

Statements	**University name**						**Selected**	**Not selected**
	A	**B**	**C**	**D**	**E**	**F**		
	F (%)	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**	**F (%)**
a. Given more information about the benefits of a repository	154 (24.9)	43 (6.9)	81 (13.1)	20 (3.2)	21 (3.4)	51 (8.3)	370 (59.8)	248 (40.1)
b. Given more information about copyright and plagiarism	100 (16.2)	58 (9.4)	101 (16.3)	27 (4.4)	24 (3.9)	26 (4.2)	336 (54.4)	282 (45.6)
c. Provided with training in the submission procedures	121 (19.6)	42 (6.8)	76 (12.3)	25 (4.0)	17 (2.8)	41 (6.6)	322 (52.1)	296 (47.9)
d. Given more information about how a repository could assist me with my scholarly communication endeavours	132 (21.4)	27 (4.4)	86 (13.9)	23 (3.7)	21 (3.4)	43 (6.9)	332 (53.7)	286 (46.3)
e. Provided with assistance with submitting my material into the repository	105 (16.9)	35 (5.7)	77 (12.5)	25 (4.0)	16 (2.6)	40 (6.5)	298 (48.2)	320 (51.8)
f. Given assistance in clearing up copyright issues with my work	100 (16.2)	29 (4.7)	77 (12.5)	22 (3.6)	20 (3.2)	28 (4.5)	276 (44.7)	342 (55.3)
g. If the library is prompt in uploading in the repository	6 (0.9)	0 (0.0)	8 (1.3)	3 (0.5)	2 (0.3)	23 (3.7)	42 (6.8)	576 (93.2)
Total % of cases	**718 (116.2)**	**234 (37.9)**	**506 (81.9)**	**145 (23.5)**	**121 (19.6)**	**252 (40.8)**	**1976 (319.7)**	**2350 (380.3)**

*Multiple responses possible

d. Online research support

Using a three-point Likert Scale (Agree=2, Disagree=1 and Not aware=0), the PhD and Faculty were asked to select the most appropriate scale in relation to the statements that were provided to them relating to the support that university libraries can provide to researchers during the third phase of the research lifecycle (See Figure 3.1). The results are shown in Table 5.27.

Table 5.27: Support provided by libraries in the third phase *(n=618)*

	Statements	Not aware		Disagree		Agree		Non-responses		Mean	SD
		F	%	F	%	F	%	F	%		
I	The library has guides for citation styles	53	8.6	63	10.2	486	78.6	16	2.6	1.72	.615
J	The library has guides on research data management	167	27.0	49	7.9	374	60.5	28	4.5	1.35	.892
K	The library has online modules on research data management	111	18.0	78	12.6	408	66.0	21	3.4	1.50	.789

The findings indicate that 486 (mean 1.72) agreed that the library has guides for citation styles, 408 (mean 1.50) affirmed to the library having online modules on research data management, while 374 (mean 1.35) indicated that the library has guides on research data management.

The Reference Librarians were asked to select from the list provided areas in which they offer support to researchers in the third phase of the research life cycle. Results in Table 5.28 show that 11 (91.7%) of the respondents across all the universities do provide guides for citation styles, slightly below half, that is, 5 (41.7%) in four universities (A, C, E and F) have guides on RDM, and, only 2 (16.7%) from two universities (A and C) indicated to have provided online modules on RDM.

Table 5.28: Support provided to researchers in managing information and data *(n=12)*

Statements		University name						Selected	Non-responses	Total
		A	B	C	D	E	F			
Managing information and data	a. The library has guides for citation styles	3	1	4	1	1	1	11	1	12
		25.0%	8.3%	33.3 %	8.3%	8.3%	8.3%	91.7%	8.3%	100.0
	b. The library has guides on RDM	2	0	1	0	1	1	5	7	12
		16.7%	0.0%	8.3%	0.0%	8.3%	8.3%	41.7%	58.3%	100.0
	c. The library has online modules on RDM	1	0	1	0	0	0	2	10	12
		8.3%	0.0%	8.3%	0.0%	0.0%	0.0%	16.7%	83.3%	100.0

e. University Librarians' perspective on IR issues

The University Librarians were asked to indicate how their libraries handle copyright issues related to electronic data and information management. The responses obtained were as follows:

> "*We ensure that all activities in the library are within the copyright laws. For instance, we don't allow people to download resources for others and that they only download what they require. We do this through training and sensitisation on copyright issues in the use of data and e-resources*" (UL1)
>
> "*We ensure that any data that comes in we watermark […] most of the research that comes in, the university already has a policy in terms of copyrighting research works donated by the university if someone has been funded by the university to publish, they submit to us*" (UL2)
>
> "*…for copyright we only put up the notices at the photocopiers and that training so we hope that that takes care. But when it comes to what they actually do with it at some point we cannot just go beyond just informing them*". (UL3)
>
> "*…we educate faculty on copyright issues even when it comes to e-resources, Faculty and students. So for us, it is more of enlightening them on what is expected, ethical issues, legal issues and all that when it comes to use*". (UL4)
>
> "*We only create awareness on copyright issues […] and we always talk about copyright issues during the IL sessions and orientation. So we create that awareness but we don't know whether they do it, it's something we cannot control. We handle the training part*". (UL5)

"*We were involved as a library in [drafting] the consent for use of both electronic and print research output… the form was designed by the library*" (UL6).

The interviewees were queried on how their libraries ensure long-term preservation of digital scholarly work.

"*We have implemented digital repository where we have started uploading electronic thesis and dissertations and research projects in electronic format...Secondly, we have crafted a policy to guide in the digital repository to guide the people on the format, on the regulations, procedures for depositing…Thirdly, in recent times we have in collaboration with the university, implemented an anti-plagiarism software and we are now the ones facilitating scanning of the final copies before defense and before examination*" (UL1).

"*Using Dspace to preserve digital scholarly work. We do have a preservation policy*". (UL2)

"*…we have it in the repository and we try to get as much as possible the faculty to give us their articles. The ones that are protected they just give us the abstracts at least so that we have it on our repository*". (UL3)

"*We do preserve information but we also do a bit of digitization… the IR is our archive for the internal publications but we also have backups for data or for documents that are brought to the library to be uploaded*". (UL4)

"*…we are beginning now to populate [our IR]. The policy was approved recently so we are putting content…. It is not accessible within nor outside the university. We are still working on it… We have just created communities in the repository… our challenge is we don't have a scanner to scan the printed thesis but we are working on that to purchase one. So we have abstracts now and a few researches and a few conference papers, a few books, actually it is still in its infant stage*". (UL5)

"*Basically by the management of the institutional repository it is under the library*". (UL6)

The interviewees were asked to comment on the status of their institutional repository and how it supports eResearch. There was a general indication of the repositories being at infancy stages as expressed in the responses below:

"*We implemented Dspace some time ago but the university [just] bought an anti-plagiarism software. So we have collected electronic copies of e-thesis and dissertations*

in CDs… Secondly, we have the policy. It is awaiting approval to provide guidance. So we can say that we are at the beginning but I would say that it is something that we are committed to facilitating". (UL1)

"*We started like five years ago and we put a lot of data and the server collapsed so we lost all the data. So we have started all over again and one of the things as I said our librarian in another campus is the one who is in charge of this. So basically we are talking about some of the challenges…At the moment we are able to get all the thesis from all the students who are graduating at the university submit soft copies through the research department because I did ask for that in view of ensuring that we have a good eResearch database… that was approved by the university… The challenge is that currently the server that we are using we still do not have a dedicated server so we are hoping that, this is what we are working on now so that we can get a dedicated server with cloud computing so that we are able to save this data for long and in a more secure way. The IR is not yet open*". (UL2)

"*It's pretty new, we started in 2015 so we are at the stage of just collecting… we get the electronic version so that we can upload but when it comes to what our faculty are doing out there we are still collecting. We are still not yet where the UON is*". (UL3)

"*I think we put up our IR in 2014 and this is the fourth year, the usage was very low initially and we also didn't have that much content but it has really grown. The fact [is] that it is not adding bibliometrics, the faculty are also very careful about bringing in quality content. So it has…become very popular. There was resistance initially because there were issues of you'll ruin my work… but because we also have an agreement with whoever is depositing that has changed the perception and the management is really supportive*". *(UL4)*

"*I'd say it is fairly in the initial stages but, yea we require that research work… thesis and dissertation, we require that they give that to us so that we man the IR and make it available to users*". (UL6)

f. Institutional Repositories Management

A range of questions with regard to the management of the repositories was posed to the IR Managers. The findings are presented in this section.

i. Central, persistence and reliability for scholarly works

The IR Managers were asked to state how their libraries ensure a centralised, persistent, and reliable storage for scholarly output. Their responses as presented below show that they relied on their IR but did not indicate how persistence is achieved.

"*All the content is uploaded by qualified librarians*". (IR1)

"*After the research is done, it's received by the research department and copies sent to the library for storage and management*". (IR2)

"*All scholarly output is centrally uploaded on the IR and categorized in different communities*". (IR3)

"*By consistently uploading materials to our institutional repository, users are able to access them at any time*". (IR4)

"*Through an IR*". (IR5)

ii. Measures for data security

When asked about the measures that the libraries have in place to ensure data security for the repositories, the IR Managers outlined the following:

"*Firewall and backups*" (IR1); "*Watermarking the full text research output, controlled access and restricting access to some data (intranet access only)*" (IR2); "*Done in conjunction with ICT where database server is well in place and daily back-up is done*" (IR3); "*All users are required to log in order to access the repository*" (IR4); "*Through use of access rights*" (IR5).

iii. Type of materials in IRs

The IR Managers listed the type of digital materials that are published in their IR. The findings in Table 5.29 show that thesis and dissertations are the most popular materials in the IRs (universities A, B, C, and F) followed by exam papers (university A and B), and, university publications (university A and D).

Table 5.29: Types of digital materials that are published in the IRs

Respondent	University name	Materials published
IR1, IR2, IR4	A, B	Exam papers
IR1	A, D	University publications
IR1, IR2, IR3, IR5	A, B, C, F	Thesis and dissertations
IR3	C	Yearbooks
IR3	C	Newspapers
IR3	C	Newsletters
IR4	D	Working papers
IR4	D	Technical reports

iv. Categories of IR in the universities

The IR Managers were provided with three options on categories of IRs and were asked to select the option that suits their IRs. The illustration in Figure 5.6 shows that four of the IR Managers from universities B, C, D and F indicated that their IRs are open access and publicly available while one of the IR Managers from university A stated that their IR is accessible only within the institution.

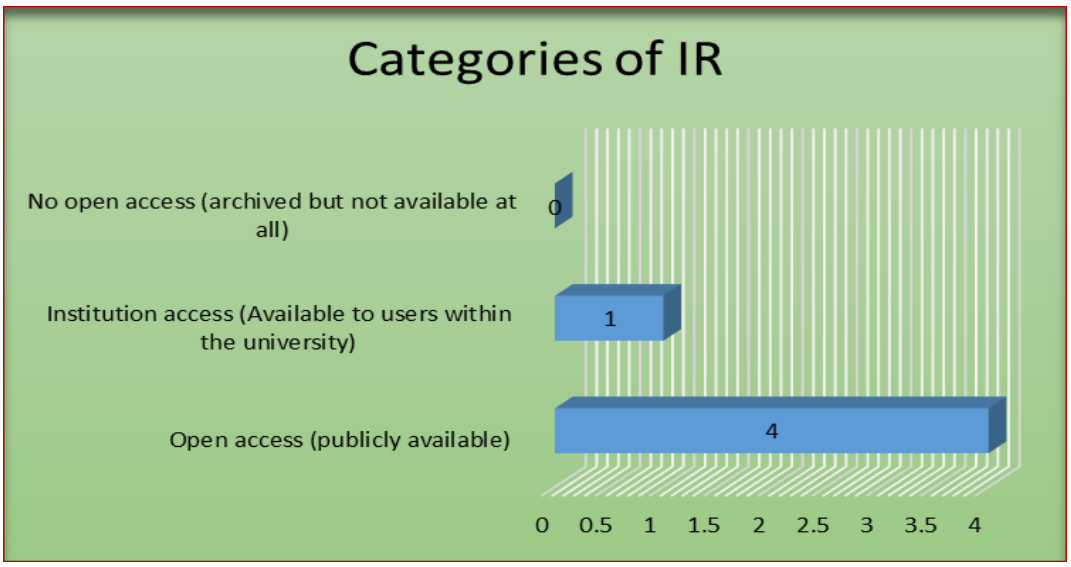

Figure 5.6: Categories of institutional repositories

v. IR for data storage and preservation

The IR Managers were asked to indicate the extent to which the libraries use the institutional repositories to store and preserve research data. Three responses were provided with only one

indicating clearly that data is not stored in the repositories. The responses were as follows: "*Fair level*" (IR2); "*no raw data stored*" (IR3) and, "*to a great extent*" (IR4).

vi. Persistent identifiers

The IR Managers were asked to indicate which persistent identifiers they use in the repositories. The findings showed that 3 (60.0%) in universities A, B and D use DOI, while 2 (40%) from universities C and F use handles.

5.7.2.4 Publishing and Sharing

Using a three-point Likert Scale (Agree=2, Disagree=1 and Not aware=0), the PhD and Faculty were asked to select the most appropriate scale in relation to the statements that were provided to them relating to the support that university libraries can provide to researchers during the fourth phase of the research lifecycle (See Figure 3.1). The results are shown in Table 5.30.

Table 5.30: Support provided by libraries in the fourth phase *(n=618)*

	Statements	Not aware		Disagree		Agree		Non-responses		Mean	SD
		F	%	F	%	F	%	F	%		
l	I am aware of open access as a publishing option	122	19.7	132	21.4	338	54.7	26	4.2	1.36	.803
m	The library does provide guides on online publishing options	123	19.9	115	18.6	360	58.3	20	3.2	1.40	.807
n	The library provides advisory on appropriate e-journals to publish with	151	24.4	93	15.0	346	56.0	28	4.5	1.33	.857
o	I do get online alerts on call for papers from the library	78	12.6	149	24.1	376	60.8	15	2.4	1.49	.714
p	The library provides advise on copyright issues related to publishing	124	20.1	88	14.2	385	62.3	21	3.4	1.44	.814

Table 5.30 shows that 385 (mean 1.44) of the respondents agreed that they are advised on copyright issues relating to publishing, 376 (mean 1.49) receive online alerts on call for papers through their libraries, 360 (mean 1.40) agreed to the statement that libraries provide them with

guides on publishing options, 346 (mean 1.33) indicated that the library provides them with advisory on appropriate e-journals to publish with, while, 338 (mean 1.36) assert that they knew about open access publishing.

Reference Librarians were asked to indicate by selecting from the list if their libraries have supported researchers during the publishing and sharing phase of the research process. The findings in Table 5.31 show that all university libraries as indicated by the 12 (100.0%) respondents create awareness on copyright issues related to publishing to their researchers. Nine (75.0%) in universities A, B, C and F do provide advocacy and awareness on open access publishing, 6 (50.0%) in universities A, C and F provide guides on online publishing options. Similarly, they provide advisory on appropriate e-journals to publish with, lastly, only 4 (33.3%) in universities A, C and F indicated to have provided researchers with online alerts for call for papers.

Table 5.31: Support provided to researchers in the publishing and sharing phase *(n=12)*

Statements		University name						Selected (%)	Non-responses	Total
		A (%)	B (%)	C (%)	D (%)	E (%)	F (%)			
Publishing and sharing	a. The library has provided advocacy and awareness on open access publishing	3	1	4	0	0	1	9	3	12
		(25.0)	(8.3)	(33.3)	(0.0)	(0.0)	(8.3)	(75.0)	(25.0)	100.0
	b. The library does provide guides on online publishing options	1	0	4	0	0	1	6	6	12
		(8.3)	(0.0)	(33.3)	(0.0)	(0.0)	(8.3)	(50.0)	(50.0)	100.0
	c. The library provides advisory on appropriate e-journals to publish with	1	0	4	0	0	1	6	6	12
		(8.3)	(0.0)	(33.3)	(0.0)	(0.0)	(8.3)	(50.0)	(50.0)	100.0
	d. The library provides to researchers online alerts for call for papers	1	0	2	0	0	1	4	8	12
		(8.3)	(0.0)	(16.7)	(0.0)	(0.0)	(8.3)	(33.3)	(66.7)	100.0
	e. Researchers are made aware of copyright issues related to publishing	4	1	4	1	1	1	12	0	12
		(33.3)	(8.3)	(33.3)	(8.3)	(8.3)	(8.3)	(100.0)	(0.0)	100.0

5.7.3 Support

The eResearch Capability Model asserts that eResearch support includes information, processes and people enabling effective research in the digital environment. Specifically, at the VUW, the focus was on knowledge (awareness on eResearch policies, services and outcomes), assistance with the various aspects of the research process, capability in terms of training and technical support (Whakamuri, Whakaaro & Me Aro, 2014:26). In order to establish the various levels of eResearch support available to researchers, questions on support regarding training opportunities were posed to researchers and Reference Librarians. On the other hand, questions with regard to support related to scope, library staff, university support, and external opportunities were posed to the University Librarians through interviews. The findings are presented in this section.

5.7.3.1 Researchers Opinions on the eResearch Training Opportunities Available for them

The PhD students and Faculty were presented with a list of possible trainings that the university libraries can provide to enhance eResearch and were asked to select those that applied to them. The findings in Table 5.32 show that 358 (57.8%) indicate that the library has training on proper referencing, 337 (54.4%) indicate availability of training on selecting reference management tools, 331 (53.6%) pointed out searching strategies, 285 (46.1%) acknowledge training on legal and compliance obligations, 278 (44.9%) statistical data analysis tools, 271 (43.7%) RDM, while 231 (37.2) recognised trainings on research metrics and impact. These findings, while indicating that some researchers have received some eResearch training from the libraries, it also indicates a considerable number of respondents who did not select that the libraries have trainings.

Table 5.32: Training opportunities availed to researchers *(n=618)*

Statements	A F (%)	B F (%)	C F (%)	D F (%)	E F (%)	F F (%)	Total F (%)	Not selected F (%)
a. Search strategies to enhance online resource discovery	115 (18.6)	56 (9.0)	62 (10.0)	19 (3.1)	18 (3.0)	61 (9.9)	331 (53.6)	287 (46.4)
b. Research metrics and impact	79 (12.8)	36 (5.8)	64 (10.3)	19 (3.0)	18 (2.9)	15 (2.4)	231 (37.2)	387 (62.6)
c. Selection of reference management tools	122 (19.7)	49 (7.9)	76 (12.3)	23 (3.7)	21 (3.4)	46 (7.4)	337 (54.4)	281 (45.5)
d. Research data management	100 (16.1)	36 (5.8)	73 (11.8)	21 (3.4)	23 (3.7)	18 (2.9)	271 (43.7)	347 (56.1)
e. Statistical data analysis tools	111 (17.9)	26 (4.2)	79 (12.8)	22 (3.6)	21 (3.4)	19 (3.0)	278 (44.9)	340 (55.0)
f. Proper referencing	120 (19.4)	55 (8.9)	76 (12.2)	23 (3.7)	23 (3.7)	61 (9.9)	358 (57.8)	260 (42.1)
g. Legal and compliance obligations	111 (17.9)	34 (5.5)	73 (11.8)	22 (3.6)	22 (3.6)	23 (3.7)	285 (46.1)	333 (53.9)
Total (% of cases)	**758 (122.7)**	**292 (47.2)**	**503 (81.4)**	**149 (24.1)**	**146 (23.6)**	**243 (39.3)**	**2091 (338.3)**	**2235 (361.7)**

*Multiple responses possible

5.7.3.2 Training opportunities offered by the libraries

The Reference Librarians were provided with a list of training opportunities and were asked to indicate the ones that are offered to researchers in their institutions. The results in Table 5.33 show that all the respondents (12, 100%) approved that their libraries offer training on proper referencing, 11 (91.5%) from universities A, B, C, E and F have training on search strategies, 11 (91.5%) across all the universities indicated to train on selection of reference management tools, 10 (83.2%) provide training on open access and IRs in universities A, B, C, D and F, 6 (50.0%) train on research metrics and impact in universities A, B, C and F, 4 (33.3%) train on statistical analysis tools in universities A, C and F, and, 3 (25.0%) offer RDM training in universities A, B and F.

Table 5.33: eResearch training offered by the university libraries *(n=12)*

Statements	A F (%)	B F (%)	C F (%)	D F (%)	E F (%)	F F (%)	Selected F (%)	Non-responses F (%)
a. Search strategies to enhance online resource discovery	4 (33.3)	1 (8.3)	4 (33.3)	0 (0.0)	1 (8.3)	1 (8.3)	11 (91.5)	1 (8.3)
b. Research metrics and impact	3 (25.0)	1 (8.3)	1 (8.3)	0 (0.0)	0 (0.0)	1 (8.3)	6 (50.0)	6 (50.0)
c. Selection of reference management tools	3 (25.0)	1 (8.3)	4 (33.3)	1 (8.3)	1 (8.3)	1 (8.3)	11 (91.5)	1 (8.3)
d. Research data management	1 (8.3)	1 (8.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (8.3)	3 (25.0)	9 (75.0)
e. Statistical data analysis tools	2 (16.7)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	1 (8.3)	4 (33.3)	8 (66.7)
f. Proper referencing	4 (33.3)	1 (8.3)	4 (33.3)	1 (8.3)	1 (8.3)	1 (8.3)	12 (100.0)	0 (0.0)
g. Open access and IRs	3 (25.0)	1 (8.3)	4 (33.3)	1 (8.3)	0 (0.0)	1 (8.3)	10 (83.2)	2 (16.7)
Total (% of cases)	**20 (166.7)**	**6 (50.0)**	**18 (150.0)**	**3 (25.0)**	**3 (25.0)**	**7 (58.3)**	**57 (475.0)**	**27 (225.0)**

*Multiple responses possible

The University Librarians were asked to indicate the model of research support (centralised or decentralised?) adopted by their libraries. All of them indicated that they have decentralised research support as provided in their feedback outlined below:

> "*I'd say our support is decentralised whereby we have a department for research and customer services but we have desks distributed throughout the library whereby people can go there directly and be able to consult with the relevant officers. Some can even walk directly into the University Librarians office. So it is really decentralised but we do good data collection to know whether we are achieving our performance targets across the board*". (UL1)
>
> "*We are decentralised*". (UL2)
>
> "*We involve other stakeholders. There is no way that we can do it on our own. Our Liaison Librarian works closely with the researchers. She does a lot even when we have the annual conference she is part of it*". (UL3)
>
> "*Works with the research office and ICT departments*". (UL4)

"*We are decentralized because we create awareness through the Deans or HoDs about the e-resources that we have, and we tell them about the e-resources in fact right now we are promoting our e-resources. I sit in the senate and other meetings of the university and I tell them to use our e-resources and to ensure that in their reading list they have included e-resources. But to us now it is a resource it is not eResearch*". (UL5)

"*Basically just working with other departments*". (UL6)

The University Librarians were asked to indicate the scope of support that the libraries provide for eResearch. Based on the research phases, they highlighted their support as presented in Table 5.34. The findings indicate that the libraries are making effort to support research especially in provision and training on e-resources and publishing in IR. There is also some support for data processes in collaboration with research departments.

Table 5.34: Scope of eResearch support by the university libraries

Respondent, University	Research Phase	Support
UL1 A	Formulation of ideas	-Supports students to formulate research proposals (ideas and research problems).
	Grant support	-Senior library staff can endorse researchers looking for grants; Provision of references to research grant-giving organisations.
	Managing information and data	-Facilities for data analysis are available. -Referrals to the research office provided.
	Publishing and sharing	-Promotion of OA publishing using the IR. -Collaborating with the university press to implement e-publishing.
UL2 B	Formulation of ideas	-Enables access to e-resources as a basic library function and provides training on this.
	Grant support	-Validates grant proposals on behalf of the university and research office before they are sent out.
	Managing information and data	-Managing content in the IR.
	Publishing and sharing	-Offer training in digital resource management.
UL3 C	Grant support	-Information on grants is prepared and sent to researchers but the library is not involved in the actual process for grant applications.
	Publishing and sharing	-The library supports publishing and dissemination.
UL4 D	Formulation of ideas	-The library comes in strongly at the stages when researchers are starting research through capacity building and providing e-resources; IL training. -Support is provided when concepts and proposals are prepared.
	Grant support	-The library is consulted about research grants but we work with the research directorate on that.
	Managing information and data	-Collaborates with research office to support data collection and analysis.
	Publishing and sharing	-We support on open access publishing.
UL5 E	Formulation of ideas	-E-resources training. -Provision of resources through the databases.
	Grant support	-Alerts on funding opportunities are done by the office of the DVC.
	Managing information and data	-We don't do data management.
UL6 F		-Basically, the part that we come in strongly is at the training.

Upon being queried about the extent to which the library staffs members collaborate with researchers to enhance eResearch, the University Librarians said the following:

> "*First of all, we work together in collaboration with the research department in training [and] providing consultation. Two, we participate in forums where issues of research are being discussed so that we can have an input from a library perspective or share our own ideas. Even we encourage our staff in the library to publish on the issues related to research; especially the current research techniques including approaches such as eResearch*". (UL1)
>
> "*I think to a very good extent. It's amazing that the schools, the departments, the deans, the faculty have very high confidence in us, the library... A supervisor will come in and they have forgotten what we trained them, like in using turn it in, they will invite us [to support them] in the departments…It has been very good*". (UL2)
>
> "*That one you'll need to get from the Reference Librarian…that is her area. In most cases, we just have one person who is responsible for something*". (UL3)
>
> "*I think that comes in from the previous question in the different stages of research. I think it amounts to the same thing…partnerships. We do work closely*…". (UL4)
>
> "*Yes, they do although it is not documented. Like the Reference Librarian works a lot with researchers of all levels, undergraduate, postgraduate especially with the e-resource issues. They direct researchers on where they can get resources for their topics and help them on how to use the OPAC, how to look for information in the library, how to do term papers, how to search for a book. You know, they come and they don't know how to access. That collaboration is also informal. It is not something documented but I would like after your study maybe to enhance that, to let that come out. It will even change the image of the library in the university*". (UL5)
>
> "*To quite some good extent because apart from just training in the use we also participate in exposing them to resources, electronic resources they may not have known but also when it comes to citation management, electronic, we also take them through the various programs that are available for citation management. That way we believe we assist the researchers*". (UL6)

The University Librarians were also asked about the support that researchers get on issues relating to the responsible conduct of research and research ethics. The findings suggest that the

library's support has been majorly on creating awareness on plagiarism through IL training and integrating it in policies. University A is, however, also engaged in creating awareness on predatory publishing.

> "*We are key to the implementation of the anti-plagiarism policy, research policy, publication policy and we advise them on what the policy requires and how it can be fulfilled. And from a professional perspective to publish and we advise them on how to avoid these false or fake publications or organization. How to look for quality publishers and how to go about with creating their work, formatting their work, and submitting their work and generally the publication workflow so that they can be informed, including assisting them to find the right journals*". (UL1)
>
> "*Like for instance when we are doing the training [we cater for] issues of copyright and plagiarism. One of the things I do…because I am in the research bureau meeting where I advise and I ensure that policies include issues of copyright and plagiarism. I advise the university, for instance ...because the university publishes publications, they do not know. How do you make sure that work is not copyrighted? and I was able to offer that kind of guidance to the university …so this one we do through training on copyright and policy*". (UL2)
>
> "*Training...there is actually... there is ethical and fair use, that is what we offer*" (UL3).
>
> "…*in our IL curriculum, that is where we cover the issues of ethics, ethical issues of information and legal issues*". (UL4)
>
> "*Ok, we don't teach research as a library but during the IL sessions or orientation we only create awareness on copyright issues, plagiarism...they should not copy other people's work and paste. We only highlight that. Informally, two colleagues who've mastered Zotero and one on Mendeley so when they go to class to teach they teach as a very basic*". (UL5)
>
> "*Basically the two areas that we bring out very clear as we interact with them, one is the aspect of copyright but also the aspect of plagiarism which is an ethical angle of research. The support they get is in training on how to properly use other people's work but then also generally how to avoid unintentional plagiarism*". (UL6)

The University Librarians were asked to state the level of support that the university provides for eResearch. Their responses included:

"*…the university supports the acquisition of electronic resources that are very instrumental in supporting eResearch. The university also supports the library in terms of approval of the right kind of policies to support eResearch. So the university is very supportive of this. Maybe consciously not for eResearch but in general as we implement them we have eResearch in mind…we do have a budget for acquisition of e-resources; supporting infrastructure like PCs; supporting necessary systems like our LMS which is part of the eResearch infrastructure and so on and so forth*". (UL1)

"*…I'd say like all universities we have to subscribe to online databases… it is a set amount even in the budget it is very clear… the university is supporting that. Probably what I am saying and what I have been saying is that we have to have a good reason to ask for more money*". (UL2)

"*…So we actually have a budget for technology, whatever software we want, we also have for subscriptions which are separate from the books…*". (UL3)

"*The university is very supportive. They provide the budget, they provide money for e-readers, training, workshops, our faculties are also trained. For us, the management is really keen on even transitioning students towards the eResearch and e-learning because they know that e-learning will not be successful if the library dimension is not taken care of… the university is very supportive in terms of budgeting, goodwill, infrastructure*". (UL4)

"*The university actually provides the information resources, the e-resources and there is that platform, you know we pay the subscription every year through the library and the university also promotes networking with local universities in research… the university supports [budget], for the e-resources, for example, the university always makes sure that this money is paid, it is about half a million every year and computers also in the multimedia centres are provided. I think we are so basic*". (UL5)

"*Well, one I would say is in terms of, eResearch would specifically require maybe something like software that would help the researchers. I think one of the support I would say is University's commitment to ensuring that we have an anti-plagiarism software. That commitment for me is a gesture of support. Budget- Yea, some bits of funds for subscriptions and for trainings. If the staffs identify an aspect of training that*

would be helpful to eResearch there is a budget for training that would be catered for". (UL6)

In wanting to determine if there was awareness on national or international eResearch frameworks, University Librarians were asked to indicate any that were available to their university to support eResearch. Some of the respondents indicated a few national bodies such as CUE, KENET and KLISC that have supported aspects of eResearch but there was generally limited knowledge on existing eResearch frameworks.

"*First of all at the national level, we know that the government has gone 'e' whereby, for instance, whereas previously you'd have to go and buy or purchase the constitution of Kenya. Now some of these resources can be accessed online. So I guess that is a positive step. At the national level, previously we even had IFLA, CUE is setting standards, we have KENET, very good networks*". (UL2)

"*You know unless you are working with the researchers you'd really not know what they have but I know we get a lot of partnerships with other universities and then the researchers themselves have links to...unless we check but I am sure they are there. It is only that this is now university wide so you'd have to get this information from the research office. I get a lot of information because I am in the faculty communication and I see a lot of stuff from the research, they have them yes but I have not really concentrated on them. The research just does its own things and the library does their own things but our link is the Liaison Librarian. Liaison is actually the one who's to link the library to the research, faculty. So if the research office is agreeable then we'd work with them in RDM...*". (UL3)

"*Probably there is no publicity of the bodies here in Kenya but I know that SA, USA, Canada and UK I know there are bodies that support. Then locally I think INASP has also really supported especially in capacity building and IR, in fact they are the ones who've really build capacity in terms of the librarians and towards the installation of IR*". (UL4)

"*Maybe I know of only national like KLISC is one of them. We collaborate with KLISC, that is how we get our e-resources then there is…we have [a] national research consortium. Researchers in Kenya have come together and private universities and they share their expertise just like KLISC. Collaborations is there. It was formed about five*

years ago and our university is an active member...it's called Institute of Research Development and Policy". (UL5)

"*Currently, not really*". (UL6)

5.7.4 Tools

This section presents findings on eResearch tools. Questions were framed to respondents to address existing online tools in support of collaborations, data lifecycle and research lifecycle.

5.7.4.1 Tools for Enhancing Collaborations

Through an open-ended question, the Reference Librarians were asked to indicate online tools that the library has provided to enable researchers to find collaborators. Five RLs from three universities responded as presented below:

University A: RL1 said that "*Researchers are advised to subscribe to Mendeley, Zotero, Academia.edu, Research Gate but not in a formalised way*".

RL3: "*Google scholar, Zotero for collecting, organising, citing and sharing research scientific journal finder*".

RL4: "*Real time - can be used as a meeting room which allows collaborations 24/7, free online (wifi, eresources etc), Google docs*".

University B: RL5 said that it is "*done by the research department of the university*."

University C: RL8: "*ResearchGate, ORCID; Search engines*".

The University Librarians were asked if there were any platforms in place to enhance online collaborations among researchers both within and outside the university. The findings as expressed by the ULs show that there is some level of awareness about social networks that are being used by some researchers, but there is little involvement by the libraries to be part and parcel of the process of integration of these technologies for collaborations by the researchers. The results are presented below:

"*We support the use of social media. We have our social media platforms where students and faculty can access us. Two, we have implemented a virtual conferencing facility we call it a walk-in studio whereby our patrons can exchange ideas with others who are in remote locations. We also have a teleconferencing facility whereby discussions can take place across distances. We have of course very good Wifi and wired network which facilitates that sort of … we do allow students to come with their laptops so that they can*

connect to our resources and network and they can be able to access the internet while within...we also have in place remote access EZ-Proxy through which users are able to access our electronic resources from remote locations". (UL1)

"*We slightly use social media like Facebook which we interact a lot in that we post information that we receive and so on. We have the YouTube, I recall that the library has used the YouTube through our knowledge ambassadors forum. But we also have Zotero, you know about Zotero where we can share data and we actually teach on use of Zotero*". (UL2)

"*Would it be like an access to Scopus. Currently, we use SCOPUS but then it is just for us to know how our researchers are doing. It is up to them if they want to use it to link up. We have not really gone out of our way to do that*". (UL3)

"*Of course there are many...I know our faculty are on platforms such as Research Gate, because most of them when they are sending their publications they send me a link to look at like Research Gate and you find out what they have published. I can't remember the names but I know there are platforms that they are using*". (UL4)

"…*Research Gate...they are there, and maybe Wiki*". (UL5)

"*We don't have as of now*". (UL6)

5.7.4.2 Tools Supporting Activities in the Research Lifecycle

The PhD students and Faculty were provided with statements in relation to support offered by libraries in providing essential tools for eResearch and they were required to select from a three-point Likert scale. The most appropriate answer. The results in Table 5.35 show that 418 (67.6%) affirm that their libraries have online tools that facilitate finding collaborators, while 69 (11.2%) disagreed and 107 (17.3%) did not know if their libraries have, resulting in a mean of 1.48. In regard to the libraries providing statistical tools for data analysis, 379 (61.3%) agreed, 107 (17.3%) disagreed, while 107 (17.3%) did not know with a mean of 1.54. When asked if they had access to data management plans, 368 (59.5%) affirmed, 99 (16.0%) disagreed while 121 (19.6%) did not know if they had access which led to a mean of 1.58. Finally, on whether there were tools for online collaborations, 309 (50.0%) agreed, 145 (23.5%) disagreed and 141 (22.8%) were not aware, thus a mean of 1.72. These findings suggest that there are tools to support eResearch but not all researchers are aware of their availability. The Cronbach's Alpha

for the four items was 0.812 suggesting a high inter-item reliability. George and Mallery (2003) rate a Cronbach's Alpha of > .8 as good.

Table 5.35: Tools provided by libraries to enhance eResearch *(n=618)*

	Statements	Agree		Disagree		I don't know		Total		Non responses	Mean	SD
		F	%	F	%	F	%	F	(%)	F (%)		
a	The library has online tools that enable researchers to find collaborators	418	67.6	69	11.2	107	17.3	594	96.1	24(3.9)	1.48	.781
b	The library provides tools for online collaborations among researchers	309	50.0	145	23.5	141	22.8	595	96.3	23(3.7)	1.72	.823
c	The library provides statistical tools for data analysis	379	61.3	107	17.3	107	17.3	593	96.0	25(4.0)	1.54	.781
d	I have access to ready to use DMPs	368	59.5	99	16.0	121	19.6	588	95.1	30(4.9)	1.58	.810

*Cronbach's Alpha = 0.812

Case Processing Summary

		N	%
Cases	Valid	618	100.0
	Excluded[a]	0	.0
	Total	618	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.812	.812	4

The Reference Librarians were told to indicate if their libraries provide statistical tools for data analysis. The findings in Table 5.36 indicate that only 2 (16.7%) respondents from university A

indicated that they provide the tools. The majority (9, 75.0%) indicated that their libraries do not provide across all the universities, while 1 (8.3%) did not respond to the question. These results suggest that most of the libraries under study do not provide statistical tools except for university A where the respondents gave varied views with a half of them affirming and another half indicating not to provide.

Table 5.36: Data analysis tools

			University name						Total
			A	B	C	D	E	F	
Tools for data analysis	Yes	F	2	0	0	0	0	0	2
		%	16.7	0.0	0.0	0.0	0.00	0.0	16.7
	No	F	2	1	3	1	1	1	9
		%	16.7	8.3	25.0	8.3	8.3	8.3	75.0
	Missing	F	0	0	1	0	0	0	1
		%	0.0	0.0	8.3	0.0	0.0	0.0	8.3
	Total	**F**	**4**	**1**	**4**	**1**	**1**	**1**	**12**
		%	**33.3**	**8.3**	**33.3**	**8.3**	**8.3**	**8.3**	**100.0**

The Reference Librarians were asked to further list the tools that they provide for data analysis if they indicated 'yes' in the previous question. Two respondents from university A indicated that some researchers are advised to use Survey Monkey and SPSS (RL1), and, RL2 noted that the library provides "literature search requisition forms, quick reference research forms". Despite only respondents from university A indicating to have the tools, other respondents also suggested how researchers are taken care of. RL5 from university B indicated that they provide SPSS but through the ICT office. Two respondents from university C noted that: the tools are provided in collaboration with the research centre (RL6) and, RL8 said that "the training room hosts SPSS, and NVIVO".

The University Librarians were asked if there were any tools created by the library to support data management. Their views are outlined below:

> "…*we are thinking of how can we do open data which is nationally taking route and we are thinking of how we can implement it at the university level so that data which is generated from research can be re-used and well curated for further use but maybe we need to adopt international frameworks and customise them or domesticate them at our university level*". (UL1)

"*We have a repository…Internet and networking*". (UL2)

"*The research office does the training on tools such as SPSS and I think library staffs have even attended the training*". (UL3)

"*There is no data management, we are not involved. Raw data, people collect their data and manage it*". (UL5)

"*For now as I mentioned we have not really participated in RDM so we may not have particular tools towards the same. But I believe as we get involved more in research…I think the other one gives a perspective of where we have been as a university. It is only in the last three years that we have established a research centre and so I believe with time the issue of data management will be coming on board*". (UL6)

5.7.4.3 Tools for Updating on New Research

The PhD students and Faculty were provided with a list of alerting tools and were asked to indicate if they had access to such tools that would update them on new research. The findings in Table 5.37 show that 202 (32.7%) have had access to table of content alerts, 195 (31.6%) have used conference alerts, 156 (25.2%) have used other alerting tools while 130 (21.0%) have accessed RSS feeds. The findings suggest that a majority of the respondents have not used alerting tools to get updated on new research.

Table 5.37: Tools to update researchers on new research *(n=618)*

				University name						
			A	**B**	**C**	**D**	**E**	**F**	**Selected**	**Non-responses**
Tools for updating on new research	Alerts	F	69	7	34	15	10	21	156	462
		%	11.2	1.1	5.5	2.4	1.6	3.4	25.2%	74.8%
	Table of contents	F	91	21	56	17	13	4	202	416
		%	14.7	3.4	9.0	2.8	2.1	0.6	32.7%	67.3%
	RSS feeds	F	54	16	32	14	8	6	130	488
		%	8.7	2.6	5.2	2.3	1.3	0.9	21.0%	79.0%
	Conference alerts	F	73	18	56	18	14	16	195	423
		%	11.8	2.9	9.0	2.9	2.3	2.6	31.6%	68.4%
Total			**287**	**62**	**178**	**64**	**45**	**47**	**683**	**1789**
%			**46.4**	**10.0**	**28.8**	**10.36**	**7.2**	**7.6**	**110.5**	**289.5**

*Multiple responses possible

Similarly, the Reference Librarians were provided with the same list of alerting tools that can enhance updates on new research and they were asked if they have recommended the tools to the researchers. The findings in Table 5.38 show that 6 (50.0%) Reference Librarians from universities A, C and F have recommended conference alerts, 4 (33.3%) from university A and C have recommended unspecified alerts, 3 (25.0%) from universities C, D and F have recommended RSS feeds, and 2 (16.7%) from universities A and C have recommended table of contents alerts. These results reveal that not all Reference Librarians have been able to recommend alerting tools to their researchers.

Table 5.38: Tools recommended to researchers to update them on new research *(n=12)*

			University name							
			A	**B**	**C**	**D**	**E**	**F**	**Total**	**Non-responses**
Tools for updating on new research	Alerts	F	2	0	2	0	0	0	4	8
		%	50.0	0.0	50.0	0.0	0.0	0.0	33.3	66.7
	Table of contents	F	1	0	1	0	0	0	2	10
		%	50.0	0.0	50.0	0.0	0.0	0.0	16.7	83.3
	RSS feeds	F	0	0	1	1	0	1	3	9
		%	0.0	0.0	33.3	33.3	0.0	33.3	25.0	75.0
	Conference alerts	F	1	0	4	0	0	1	6	6
		%	16.7	0.0	66.7	0.0	0.0	16.7	50.0	50.0
Total			**4**	**0**	**8**	**1**	**0**	**1**	**15**	**33**
%			**33.3**	**0.0**	**66.6**	**8.3**	**0.0**	**8.3**	**125**	**275**

*Multiple responses possible

5.7.4.4 Tools for Maximising Research Impact

The PhD students and Faculty were presented with a list of tools that can aid in maximising their research impact and were asked to select the ones in which they have created an online profile. The findings in Table 5.39 show that 300 (48.5%) have created online profiles on Google Scholar, 293 (47.4%) on Academia.edu, 218 (35.3%) on Research Gate, 174 (28.1%) on ResearcherID, 161 (26.1%) on Mendeley, 147 (23.8%) on Scopus Author Identity, 127 (20.6%) on ORCID, and 117 (18.9%) on SSRN. The researchers were also provided with an option to indicate any other tool that they were using and none was provided.

Table 5.39: Online tools for maximising research impact for researchers *(n=618)*

			University name							
			A	**B**	**C**	**D**	**E**	**F**	**Total**	**Non-selections**
Tools for maximising research impact	Google scholar	F	120	38	63	23	16	40	300	318
		%	19.4	6.1	10.2	3.7	2.6	6.5	48.5	51.5
	ResearcherID	F	62	25	52	19	13	3	174	444
		%	10.0	4.0	8.4	3.1	2.1	0.5	28.1	71.8
	Scopus Author Identity	F	49	6	56	18	16	2	147	471
		%	7.9	1.0	9.0	3.0	2.6	0.3	23.8	76.2
	ORCID	F	48	9	45	14	11	0	127	491
		%	7.8	1.4	7.2	2.3	1.8	0.0	20.6	79.4
	Research Gate	F	79	27	63	17	16	16	218	400
		%	12.7	4.4	10.1	2.8	2.6	2.6	35.3	64.7
	Academia.edu	F	114	39	65	22	21	32	293	325
		%	18.4	6.3	10.5	3.6	3.4	5.2	47.4	52.6
	Mendeley	F	58	14	51	19	13	6	161	457
		%	9.4	2.3	8.2	3.1	2.1	1.0	26.1	73.9
	SSRN	F	39	7	44	13	13	1	117	501
		%	6.3	1.1	7.1	2.1	2.1	0.2	18.9	81.1
Total			**569**	**165**	**439**	**145**	**119**	**100**	**1537**	**3407**
%			**92.1**	**26.7**	**71.0**	**23.5**	**19.3**	**16.2**	**248.7**	**551.3**

*Multiple responses possible

The Reference Librarians were provided with a similar list and were asked to select the ones in which they have assisted researchers to create online profiles. The results in Table 5.40 show that 7 (58.3%) in universities A, C and E have recommended Mendeley, 6 (50.0%) in universities A, C and F have recommended Google Scholar, 5 (41.7%) in universities A, C, D and F have recommended ResearchGate, 5 (41.7%) in universities A, D and F have recommended Academia.edu, 3 (25.0%) in universities A and F have recommended ResearcherID, 2 (16.7%) in universities A and C have recommended ORCID. When provided with an option to indicate other tools, only 1(8.3%) indicated LinkedIn. None of the respondents has recommended Scopus Author Identity and SSRN. These results suggest minimal support to researchers to adopt online research impact tools.

Table 5.40: Research impact tools recommended to researchers *(n=12)*

			University name							
			A	**B**	**C**	**D**	**E**	**F**	**Total**	**Non responses**
Tools for maximising research impact	Google scholar	F	3	0	2	0	0	1	6	6
		%	25.0	0.0	16.7	0.0	0.0	8.3	50.0	50.0
	ResearcherID	F	2	0	0	0	0	1	3	9
		%	66.7	0.0	0.0	0.0	0.0	8.3	25.0	75.0
	Scopus Author Identity	F	0	0	0	0	0	0	0	0
		%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	ORCID	F	1	0	1	0	0	0	2	10
		%	8.3	0.0	8.3	0.0	0.0	0.0	16.7	83.3
	Research Gate	F	1	0	2	1	0	1	5	7
		%	8.3	0.0	16.7	8.3	0.0	8.3	41.7	58.3
	Academia.edu	F	3	0	0	1	0	1	5	7
		%	25.0	0.0	0.0	8.3	0.0	8.3	41.7	58.3
	Mendeley	F	1	0	4	0	1	1	7	5
		%	8.3	0.0	33.3	0.0	8.3	8.3	58.3	41.7
	SSRN	F	0	0	0	0	0	0	0	0
		%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Others (LinkedIn)	F	0	0	1	0	0	0	1	11
		%	0.0	0.0	8.3	0.0	0.0	0.0	8.3	91.7
Total			**11**	**0**	**10**	**2**	**0**	**5**	**29**	**55**
%			**91.7**	**0.0**	**83.3**	**16.7**	**0.00**	**41.7**	**241.7**	**400.0**

*Multiple responses possible

5.7.4.5 Tools for Measuring Research Impact

The PhD students and Faculty were provided with a list of online tools for measuring research impact and were asked to select the ones that they have used. The findings in Table 5.41 shows that 251 (40.6%) have used journal impact factors, 227 (36.7%) have used citation counts, 221 (35.7%) have used author identity, 197 (31.8%) have used social networks, 140 (22.6%) have used altmetrics, 134 (21.6%) have used H-index. Based on the results, the number of respondents who have used online tools to measure their research impact ranges from 21.6% - 40.6% of the targeted population. Thus, a significant number of researchers have not used these tools.

Table 5.41: Tools to measure research impact *(n=618)*

			University name							
			A	**B**	**C**	**D**	**E**	**F**	**Total**	**Non-selections**
Tools for measuring research impact	Citation counts	F	107	13	48	20	22	17	227	391
		%	17.3	2.1	7.8	3.2	3.5	2.8	36.7	63.3
	Journal impact factors	F	110	37	52	19	15	18	251	367
		%	17.8	6.0	8.4	3.0	2.4	3.0	40.6	59.4
	H-index	F	51	5	36	21	19	2	134	484
		%	8.2	0.8	5.8	3.4	3.1	0.3	21.6	78.3
	Altmetrics	F	42	9	52	21	15	1	140	478
		%	6.8	1.5	8.4	3.4	2.4	0.1	22.6	77.3
	Author identity	F	79	29	57	23	17	16	221	397
		%	12.8	4.7	9.2	3.7	2.7	2.6	35.7	64.2
	Social networks	F	72	17	55	23	16	14	197	421
		%	11.6	2.7	8.9	3.7	2.6	2.3	31.8	68.1
Total			**461**	**110**	**300**	**127**	**104**	**68**	**1170**	**2538**
%			**74.6**	**17.8**	**48.5**	**20.6**	**16.8**	**11.0**	**189.3**	**410.7**

*Multiple responses possible

5.7.4.6 Tools for Storing Digital Files

PhD students and Faculty were asked to indicate where they store their digital files among the listed tools. The findings in Table 5.42 indicate that a majority (404, 65.3%) store on their personal computers, this is followed by 212 (34.3%) who use external servers, 211 (34.1%) use the university server and 188 (30.4%) use library servers.

Table 5.42: Tools for storing digital files *(n=618)*

			University name							
			A	B	C	D	E	F	Total	Non-selections
Tools for storing digital files	Personal computer	F	173	59	71	22	16	63	404	214
		%	28.0	9.5	11.5	3.6	2.6	10.1	65.3	34.6
	University server	F	68	22	53	24	23	21	211	407
		%	11.0	3.5	8.6	3.9	3.7	3.4	34.1	65.9
	Library server	F	77	10	58	21	20	2	188	430
		%	12.5	1.6	9.4	3.4	3.2	0.3	30.4	69.6
	External servers	F	86	13	59	18	21	15	212	406
		%	14.0	2.1	9.5	2.9	3.4	2.4	34.3	65.7
Total			404	104	187	85	80	101	1015	1457
%			65.3	16.8	30.2	13.8	12.9	16.3	164.2	235.8

*Multiple responses possible

The IR Managers were asked to indicate data storage tools that the libraries have for the researchers. Only two of the respondents indicated the following:

"*Databases created in IR*" (servers) (IR2)

"*Institutional repository, databases, cabinet*" (IR5)

The IR Managers were further asked to indicate the software that the library is using to manage digital works. Three types of software were identified with Dspace emerging as the most popularly used software outweighing the others as illustrated in Figure 5.7. Dspace is used in universities A, B, C and F. University C uses both Dspace and Portfolio Archiving System, while university D uses Adobe Experience Manager.

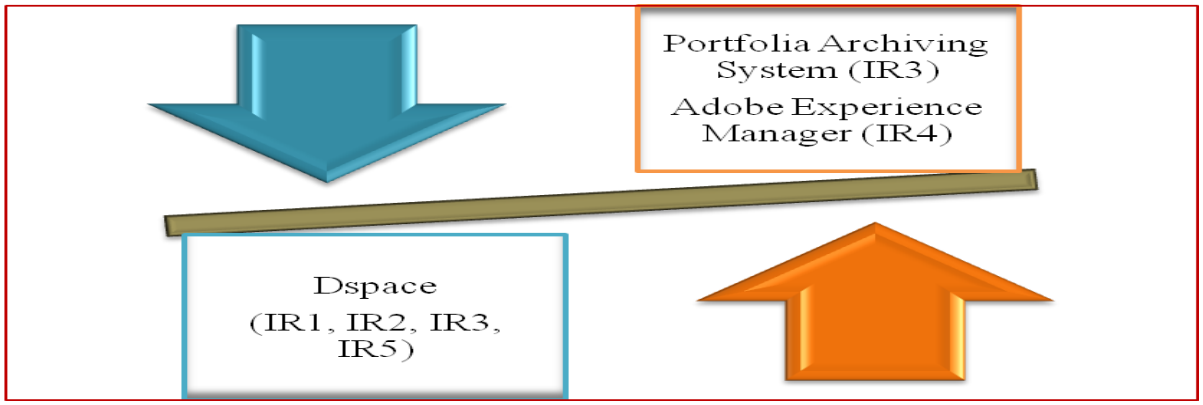

Figure 5.7 Software used to manage digital works in the libraries

The University Librarians were further asked to indicate the technological infrastructure available to the library to enhance eResearch.

> "*We have data analysis software that is accessible within the library, SPSS. We have DSpace digital repository, open source software for management of digital thesis and dissertation. We have a good LMS which facilitates very fast and quick access to resources*". (UL1)
>
> "*Dspace for IR and publishing…*". (UL3)
>
> "*We have IR*". (UL4)
>
> "*Repositories, multimedia, computers, network*". (UL5)

The study sought to establish awareness of external high-performance computing technologies available to the libraries for data management.

> "*The library hosts the university servers and these ones are accessible with an arrangement from ICT they are accessible for those who want to store. We are also working with KENET to implement high computing data centre which is available for use by the university on a collaboration mode. So we hope through the library, we can provide access for our faculty and students*". (UL1)
>
> "*We are talking with the university ICT about having a dedicated server that should have higher performance ability because what we are now creating for the university requires that level*". (UL2)
>
> "*KENET but they don't have the data. Do they? They just have the technology. I don't think that they store data…the government is the one that should have like e-citizen where someone would have all those documents. Something like that but for us, apart from the repository that we have to …but we have e-portfolio that is supposed to be like an archives system that we'd now store anything else that we do not put in the repository… we can actually store it there. It is pretty new so we are still trying to see what we can put there. It is safe and we have EDLS*". (UL3)
>
> "*Maybe there are HCT tools for data management but I don't know but not in the library*". (UL4)

5.7.5 Collaborations

The PhD students and Faculty were asked to indicate ways through which their libraries facilitate internal and external collaborations among researchers. Results in Table 5.43 show that 29 (4.7%) of the respondents suggested avenues that the library provides that they deemed facilitated them to collaborate with other researchers within their institutions. The findings suggest limited exposure to online collaborative tools.

Table 5.43: Collaborations amongst internal researchers

Ways collaborations are facilitated internally	Frequency	Percent
Though conferences	4	.6
Through advertisements	3	.5
Call for paper awareness	3	.5
Access to information	3	.5
Good stock of current materials to be used within the library	3	.5
Through facilitation	3	.5
Through alerts	2	.3
Through sharing research information to current researchers	2	.3
Through organising research training in the campus	2	.3
Through the provision of a conducive learning environment	2	.3
Through publishing	1	.2
Through funding of research	1	.2
Total	**29**	**4.7**

*Multiple responses possible

Table 5.44 below indicates that 19 (3.1%) indicated how their libraries facilitate them to collaborate with researchers outside their universities. Similarly, the findings show limited facilitation by the libraries to enthuse adoption of technologies in external collaborations.

Table 5.44: Collaborations with external researchers

Ways collaborations are facilitated externally		Frequency	Percent
	Through sharing publications	5	.8
	Through online platforms with other universities	4	.6
	Not sure/NA	3	.5
	We pass the information	2	.3
	Advertise and sent out alerts	2	.3
	Through an exchange programme	2	.3
	Provide links to search networks internationally	1	.2
Total		**19**	**3.1**

*Multiple responses possible

5.8 Perceptions and Attitudes

PhD students and Faculty were asked if they were willing to share their research output. The results in Figure 5.8 below indicate that the majority (511, 83%) are willing to share their research output, 63 (10%) are not willing, while 44 (7%) did not respond to the question. One respondent explained that, "*research information should be shared*".

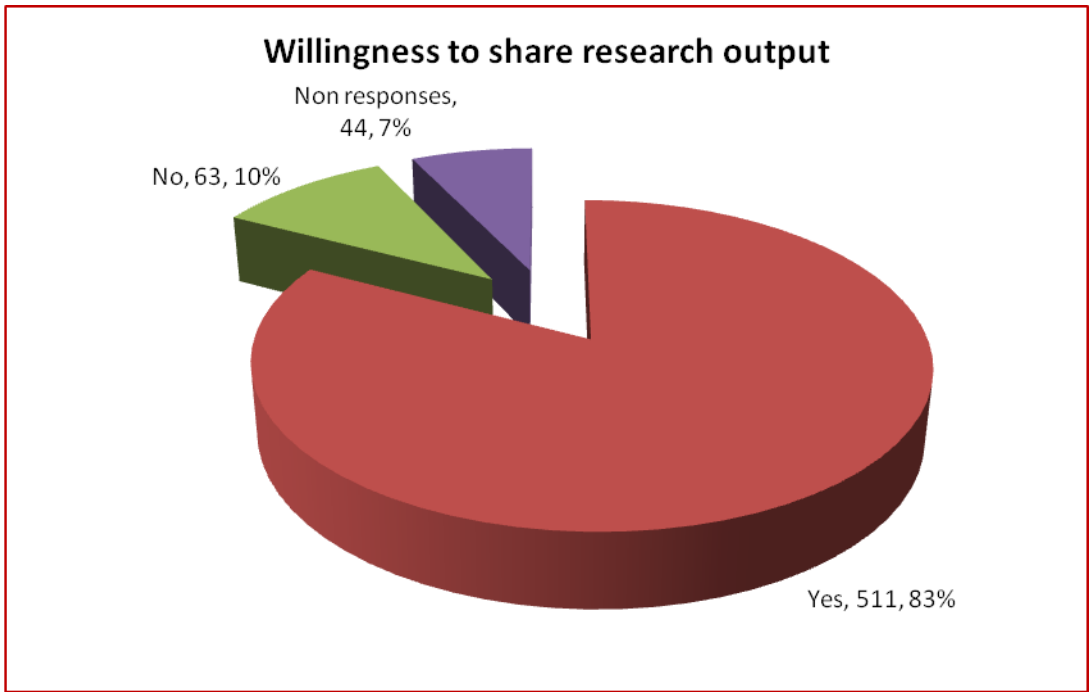

Figure 5.8: Willingness to share research output (n=618)

The PhD students and Faculty were asked if they would be willing to use a centralised university repository managed by their university libraries to deposit their digital materials. Figure 5.9

illustrates that 425 (74%) were willing, 115 (20%) would need more information about submitting in an IR, while 32 (6%) were not willing. The findings show that the majority would deposit their research in their university's IRs.

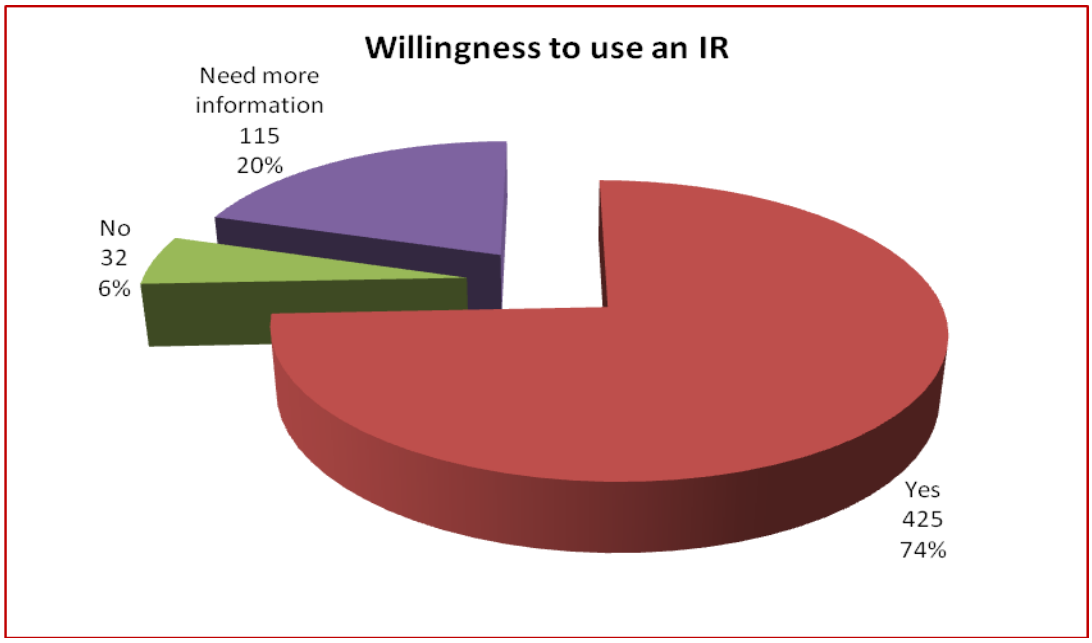

Figure 5.9: Willingness to use the university's IR (n=572)

The PhD students and Faculty were asked if they supported the integration of technology in every phase of a research process. Results in Table 5.45 show that the majority (479, 77.5%) support the adoption of technologies as part of research, 13 (2.1%) indicated that it is unavoidable, while 46 (7.4%) would not like the idea.

Table 5.45: Perceptions on adopting technologies in the entire research lifecycle *(n=618)*

		Frequency	Percent
	Very much/It is unavoidable	13	2.1
	Yes/I support	479	77.5
	No	46	7.4
	Total	538	87.1
Missing	System	80	12.9
Total		**618**	**100.0**

The Reference Librarians views about researchers adopting technologies in every phase of their research process were sought. The findings in Table 5.46 show that the Reference Librarians' perceptions towards eResearch are by and largely positive.

Table 5.46: Reference Librarians views on eResearch

University	Respondent	Responses
A	RL1	They should adopt technologies to enhance OA initiatives and faster means of sharing data.
	RL2	It is important because this will enable them to retrieve or revisit data easily even after the process is over.
	RL3	They will be able to access relevant and up to date information on their own
	RL4	When conducting any research, selecting an appropriate approach and method is a critical issue.
B	RL5	"It's the best way to go."
C	RL6	"Research is now being embraced in most universities and technology will help in fast dissemination of information"
	RL7	"They should save on time and effort"
	RL8	"It is critical that they learn how to use the available technology"
	RL9	"It would be good but caution should be applied when adopting certain technology"
D	RL10	"For any research institute, this is very crucial if it shall promote the university's efforts to keep abreast on all matters research related."
F	RL12	"I encourage the use of technologies in our research."

The Reference Librarians were asked their opinion about what their libraries can do in order to support researchers in the integration of technologies in their research process. The responses are presented below:

> "*Should come up with strategies to work closely with researchers to help and advise on appropriate methodologies".* (RL1, university A)
>
> "*Create awareness of the library and information resources available*". (RL2, university A)
>
> "*Organise trainings with different academic departments*". (RL3, university A)
>
> "*Conducting frequent trainings on how to maximise the online services provided, keeping the researchers up to date with new research tools*". (RL4, university A)
>
> "*Training, helping them create researcher profiles using appropriate tools, preserving and promoting the data*". (RL5, university B)

"*Create awareness through workshops and frequent trainings*". (RL6, University C)

"*Acquire the technologies, train, embed in the research, create a tech culture*". (RL7, University C)

"*Continuous learning and in-house training will help in building capacity*". (RL8, University C)

"*Establish support service*". (RL9, University C)

"*The library should champion the use of technologies in the integration of research alongside the research department of the university*". (RL10, university D)

"*Increase bandwidth and new equipped computer lab*". (RL12, university F)

The Reference Librarians were asked the extent to which librarians need to work closely with researchers from the time they select their topics to the publishing stage. Their opinions are presented below which majorly indicate that they support partnerships with researchers in the entire research process.

"*Writing all the way to publishing and dissemination*" (RL1, university A).

"*Some researchers have low-level information literacy skills so they need assistance/guidance from librarians*". (RL2, university A)

"*During the entire process of identification of topic, resources, writing and publishing*". (RL3, university A)

"*Help them select a researchable topic as well as assisting them on how to access electronic resources to assist them in their research. Should also be trained on referencing, data analysis tools etc*". (RL4, university A)

"*Identifying appropriate information resources for helping in the creation of research data, processing the data, helping in managing citations, promoting their data*". (RL5, university B)

"*In all stages; librarians are expected to be not only disseminators but also creators of knowledge*". (RL6, University C)

"*They should partner throughout the process*". (RL7, University C)

"*From the onset of the project*". (RL8, University C)

"*To a higher extent*". (RL9, University C)

"*At the point of data collection till the publishing stage, the library should occasionally work with the researchers*". (RL10, university D)

"*The librarian should be informed and involved in all the stages of the research*". (RL12, university F)

The PhD students and Faculty were asked to indicate their opinions about the importance of managing research data. The views of 20(3.2%) of the respondents are presented in Table 5.47 below.

Table 5.47: Opinions on the importance of managing research data

	Frequency	Percent
Freely available	4	.6
We cannot do without technology	3	.5
Repurposed	3	.5
For easy access	3	.5
It can be re-used	2	.3
To be online for anyone to utilise	2	.3
Easy to retrieve for future	2	.3
Informing people	1	.2
Total	**20**	**3.2**

*Multiple responses possible

The Reference Librarians were similarly asked to indicate their views about managing research data. The following views were provided that showed Reference Librarians having a fair understanding of the relevance of managing research data and willingness to learn and apply.

"*It will enable validating research and sharing data for re-use to avoid duplication*" (RL1, university A).

"*There's need to raise the level of awareness in relation to e-resources and data management*" (RL2, university A).

"*You are able to access the most current publication addressing the current issues and internet with a variety of literatures*" (RL3, university A).

"*Research data should be openly available with a few restrictions as possible*" (RL4, university A).

"*Important so that the research data can be re-used and for promotion*" (RL5, university B).

"*Research data should be managed by University Librarians and research centre for easier access by users*" (RL6, University C).

"*It is a new skill that every librarian should learn*" (RL8, University C).

"*It's a good practice*" (RL9, University C).

"*Managing research data is important to enhance quick reference to available data and to minimise research replication*" (RL10, University D).

"*It is very critical for the good output*" (RL12, University F).

The University Librarians were asked their views about the attitude of PhD students and Faculty towards eResearch. Their responses are as follows:

"*I would say there is a positive attitude. People are upbeat about the application of ICT in research, of course there are people who still believe that they should deposit their thesis in print formats, but in principle there is acceptance. Even before we started this project we realized that there were faculty who were collecting thesis and dissertation from students in electronic format and they are willing to share them with us. So we say it is possible. What needs to be done is to have a structured approach so that we can all be clear on the tools, framework, policies so that we move together*" (UL1).

"*Generally the attitude is good. With the actual application, the doctorate students' attitude is very positive. You see now for the archives…mostly the archives the faculty require things academic. I do not say that it is negative but I said compared, the students are more but the uptake is very encouraging. And I think again the way the university wants everyone to go towards even e-learning. I'd give 90% to students and 70% to faculty*" (UL2).

"*Initially I think when anything is new people are a bit [reluctant] but I think they are warming up to it and many faculty and doctorate students have started publishing for their own visibility*" (UL3).

"*I think the attitude has changed. Initially, most of them were still old school and were published in hard copy journal and even if we were even to get an article from them they'd tell you to go and scan but now they are moving towards e-publishing and the OA opportunities are there and are really giving them a platform for visibility but also there is still a number that wants to go the traditional way. And then it does not just come naturally to some of them, people want proof, there is a phobia. If you actually look at the older faculty, professors, there is a lot of phobias. Students I think are on board, it is*

much easier for students but there is also a category of older students who struggle with this e-thing" (UL4)

"*They are positive and they are quite involved and faculty, a number of them are pursuing their Doctorate also at the moment because of the CUE requirement maybe that has contributed, that is not the main thing and those who have already obtained Doctorate degrees they are currently involved in conducting research in their fields the university supports research and has a budget for research...*" (UL5).

"*That is a very subjective question…but I think I see a lot of excitement from the student part but I think from the faculty part there is a lot of reservation. Yea, there is some fears are more pronounced from the faculty…same is experienced with IR. Well I guess for people to release their work to be put up there but also even following that is to know that it will be on open source, people can download it, yea that sends shivers down the spine of the faculty*" (UL6).

In terms of preference between print and electronic resources among the researchers, the University Librarians stated the following:

"*Generally, they prefer e-resources. In the past, we have had people talk to us about how they have been able to access thesis and dissertations from other universities and they have wondered why our thesis have not been online which means there is a preference for that. These days we don't need to send them to other universities to access the resources as they can access them electronically. However, the problem is with the quality. Many students and faculty are still relying on the general search engines to retrieve and locate information. The usage of official databases that have been peer reviewed is limited, lack of awareness and also people are not willing to invest substantial time in doing searches or in doing consultations. When you look at their presentations you don't see a lot of the e-resources. In a way, there is a gap. We need to find out what their sources of information are and how they are using their e-resources so that we can be able to come up with a strategy*" (UL1).

"*I'd say for faculty it would be 50-50. You know for the doctorate because of the nature to research currency and so on, they do both. Again it depends on the level of IT literacy*" (UL2).

"*I'd say electronic resources... for a doctorate and faculty e-resources would be the best but there are a few who'd still insist on print even for using periodicals. We have identified a few who'd insist they want the hard copy but a number of them are comfortable using e-resources so long as they know how to access them*" (UL3).

"*Most lecturers would prefer print, the other scholars would prefer electronic. PhD students most of them would prefer 'e' but there is an older generation that would still ask us to buy hard copy books. So it is a mixture*" (UL4).

"*They prefer print. Some of them, I cannot really be sure of this because you know I don't have the facts. What we have provided are e-resources and we also buy books so I cannot say which one is…there are some who prefer or some use both. I think that is something that someone can research on. Because what I am saying now is just my observation, it is not through research*" (UL5).

"*Faculty mostly prefer print, students are more open to either*" (UL6).

5.9 Summary

This chapter analysed and presented the findings of the data that was gathered through questionnaire surveys and semi-structured interviews. The main themes covered included: organisation structures, staffing competencies, research data management, policies, processes, support, tools, collaborations, perceptions, and attitudes which were derived from the theoretical models of the Purdue University Libraries and the eResearch Capability, as well as the research questions. Findings were presented on response rates which ranged from 71-92% and were found to be effective; biographical data which helped to highlight the respondents' profile; organisational structures available in the libraries under study; library staffing competencies available to support eResearch; support provided to researchers in RDM and the challenges; and finally, perceptions and attitudes towards eResearch.

The findings revealed that the university libraries studied did not have specific individuals assigned to support eResearch. It was established that the organisation structures in the libraries did not accommodate eResearch but the libraries had individuals supporting limited aspects of eResearch such as e-resource access and IR management. The study also established that there was insufficient skills and competencies to support eResearch, furthermore, there was limited internal and external opportunities to train librarians and researchers on the relevant skills that

enhance eResearch practices. None of the university libraries had institutionalised RDM services but minimal support in the areas of data collection and analysis had been offered to researchers by individual Reference Librarians. The lack of appropriate policies tools and procedures was also established as a hindrance to effective eResearch support. Overall, the findings suggested that there was minimal support provided by the university libraries to PhD students and Faculty members mainly because of limited competencies and eResearch policies. The next chapter discusses and interprets the findings.

CHAPTER SIX
INTERPRETATION AND DISCUSSION OF FINDINGS

6.1 Introduction

This chapter provides the interpretation and discussion of the findings using extant literature and theory. According to Mugenda and Mugenda (2012:161), interpretation is a process that involves the understanding, explaining and making sense out of analysed data. During this process, the researcher engages in examining analysed data, checking for relationships, qualifying and explaining findings and checking if the results are transferable or generalisable to other populations, contexts, and situations. Stangor (2015:312) notes that a discussion chapter reviews main findings and provides interpretation of their meaning and integrates them with other research. Annesley (2010) also adds that the discussion connects to the introduction by way of the research questions posed and the literature reviewed. Rather than simply repeating or rearranging the introduction, the discussion of the findings provides a basis for advancing the research problem from where it was left at the end of the introduction.

The purpose of this study was to investigate eResearch support in private university libraries in Nairobi County, Kenya. The study addressed the following research questions: How do the organisation structures of the university libraries support eResearch? What positions in the organisation structure and competencies are available for coordinating eResearch? How is curation, analysis, and provenance (Metadata) of both basic data and information produced by research achieved? What problems of data management, organisation, dissemination, and preservation exist and how can they be addressed? What procedures, tools, and policies are used to promote eResearch? What is the inclination of library and academic staff towards eResearch? The respondents for this study included PhD students, Faculty members, Reference Librarians, IR Managers and University Librarians drawn from six private chartered universities in Nairobi County, Kenya namely: the Catholic University of Eastern Africa, Daystar University, United States International University, Pan Africa Christian University, Africa International University and Africa Nazarene University.

Using questionnaires and interviews (See Appendices 1-4), questions were posed to determine eResearch support provided by the university libraries that were selected for the study. The findings were presented in the previous chapter. This chapter interprets and discusses the findings based on the research questions that were investigated in this study. This chapter covers: demographic profile of the respondents; structures for coordinating eResearch; competencies for eResearch coordination; research data management and its challenges; procedures, tools and policies in support of eResearch and, perceptions towards eResearch.

6.2 Biographical Information of the Respondents

Demography is a research feature that entails researchers examining the quantifiable data of a particular population (Vogt & Johnson, 2011). Even though the demographic profiling was not part of the objectives of this study, respondents' characteristics were relevant during sampling of the target population and were, therefore, sought. The study sought to determine the respondents' departments of affiliation, academic rankings for researchers, positions for library staff, gender, work duration, highest qualifications, age in years, year of study for PhD students, and responsibilities for library staff. The subsections below discuss the findings.

6.2.1 Departments of Affiliation

The study revealed that the majority of the respondents were affiliated to the Business (158, 27.7%) and Theology (120, 21.0%) departments (See Table 5.2). University C and A which had the highest number of the Business department respondents (67, 11.7%) and (32, 5.6%) respectively have established Schools of Business which could have contributed to this number of respondents. They high number of respondents for Theology could be attributed to the fact that five of the six surveyed universities are Christian-based and invariably offer Theology programs. The study, however, did not seek to establish if library support for eResearch was more inclined towards particular disciplines.

6.2.2 Academic Positions and Responsibilities of Respondents

The results in Table 5.4 indicate that the majority of the respondents among the 395 Faculty members surveyed held the rank of Lecturers (156, 25.2%) with the least being Professors (26, 4.2%) and Associate Professors (12, 1.9%). This finding is not unexpected and is similar to a report by Mukhwana *et al.* (2016:66) which indicated that the majority of staff in Kenyan

Universities were in the rank of Lecturers (39%), followed by Assistant Lecturers (32%), Senior Lecturers (13%), Professors (10%) and Graduate Assistants (6%). All of the 395 Faculty members are teaching staff reflecting the core business of the universities. Besides this, 217 respondents were found not to only lecture, but also had other responsibilities as illustrated in Table 5.6 that included coordinating research and departmental activities, mentorship, community services, project supervision and curriculum review.

The study also sought to understand the positions or designations of the Librarians. It was revealed that there was a wide range of titles given to the Reference Librarians in the different Universities (See Figure 5.1). This could be attributed to the fact that there is a national standard for designating job titles of librarians. The same was reflected with the IR Managers with 3(60%) being referred to as IR Managers, while 2 (40%) were Systems Librarians. Despite these differences in titles for Reference Librarians and IR Managers, their responsibilities as highlighted in Table 5.7 suggest that their roles are generally similar in the different libraries that they serve, that is, supporting reference and research services, as well as IR management respectively. The title "University Librarian" as adopted by the heads of the libraries and other titles for other library staff based on academic qualifications, is provided for in the standards and guidelines for University Libraries in Kenya (Commission for Higher Education, 2012:18).

6.2.3 Gender Distribution

It was clear in this study that the male PhD students and Faculty members dominated the number of female who took part in this study. The majority of these respondents collectively were male (408, 66%), while female were in the minority (210, 34%). This confirms the gender disparity in Kenyan universities. A report by Mukhwana *et al.* (2016:69) indicated academic staff by gender in universities in Kenya had more male than female academic staff in both public and private universities in Kenya. The study showed that there were 2791 (65%) male staff and 1514 (35%) female staff in private universities. It is further indicated that private chartered universities were more gender responsive compared to other university categories.

According to Lichuma (2017:2), there are several gains for women reflected in the 2010 constitution of Kenya. The constitution pronounces "equality in leadership with 33% as the critical mass preferred for women". This is in line with the one third gender rule provided for in

the same constitution. The findings of the current study and report by Mukhwana (2016) suggest that private universities have made good effort in meeting the gender rule. The study, however, did not seek to find out whether gender influenced eResearch in the private universities that were surveyed.

6.2.4 Duration Worked in Years

A majority of the Faculty (131, 33.2%) in the six Universities had worked for less than five years, and the same was reflected for the Reference Librarians with the majority (8, 66.7%) having worked for minimal years in the current jobs. However, 186 (47.0%) of the Faculty members opted not to answer the question, thus, it could not be established how long they had worked in their current posts. The impact of length of work experience in relation to eResearch was not analysed for this study.

6.2.5 Highest Qualifications

The results revealed that the majority of the respondents were Master's Degree holders (413, 66.8%) followed by PhD (197, 31.9) as indicated in Table 5.5. According to Nganga (2014), CHE provided a directive that only PhD holders should be allowed to teach at universities in Kenya as lecturers. Since the majority of academic staff members working in the universities have a Master's degree, this directive has not been complied with for shortage of PhD holders.

The study also revealed as indicated in Table 5.5 that 5(41.7%) of the Reference Librarians had a Bachelor's degree, which according to Commission for Higher Education (2012:18) places them at the rank of Senior Library Assistant. Given the need to have this group of staff working close with faculty in research, it is imperative that they acquire a Master's Degree to understand research nuances better. As for the University Librarians, the study established that 3(50.0%) had a Master's Degree and 3 (50.0%) had a PhD degree. The Commission for Higher Education (2012:18) requires that the University Librarian should be holders of a PhD degree. Thus, these results suggest that some universities are yet to recruit University Librarians with a PhD qualification. This is attributed to shortage of librarians in the country with a PhD qualification.

6.2.6 Age in Years

Demographic data analysis in Table 5.5 shows that most of the PhD students and Faculty were in the age bracket of 31-40 and 41-50 respectively, with each of the respondents in either category posting 214 (34.6%). Majority of the Faculty may not have started or could still be doing their PhD programs. According to Amutabi (2017), many students graduating with PhDs in Kenya are in their 50s and 60s as evidenced in graduation ceremonies in Kenya. Table 5.5 reveals that the majority of both the Reference Librarians and the IR Managers respectively working at the university libraries were youthful with their ages ranging from 31-40.

6.3 Structures for Coordinating eResearch in University Libraries

Through interviews with the University Librarians, the study sought to examine organisation structures that are available in university libraries to support eResearch. In the findings (See section 5.3), the University Librarians mentioned availability of roles in their structures such as a Research Librarian, Reference Librarians, E-resources Librarian, User Services Librarians and IR Managers who are tasked with supporting researchers at the universities. A study by Keller (2015) indicated that these kinds of roles in the libraries, though useful, fall short of job profiles that can efficiently support eResearch. This can be confirmed by the job roles that were indicated in this study by the librarians (See Table 5.7) which did not have a clear indication on eResearch support. When further asked about the existence of specific individuals in charge of eResearch management (See section 5.3), the majority of the respondents indicated that the Reference and IT librarians have the responsibility to support research activities and that would include integration of technologies in research. The general findings indicated that eResearch was a new concept and thus, no clear designation was in place to serve that role. This came out in the remarks provided by some of the respondents (See section 5.3) such as: "*I think we are limited in this aspect of eResearch*" (UL5) and, "*not with a clear designation but basically, the ICT Librarian looks at e-resources*..." (UL6).

Furthermore, University Librarians did not vividly express the structure of their organograms, but they were detailed on available sections such as reference and multimedia which were mentioned to support IT-related services. This is comparable to what Frances, Fletcher and Harmer (2011:4-5) termed as traditional ways of structuring academic libraries which are not well suited for eResearch support. The overall findings show that there is limited eResearch

support but the extent of such support could not be established. The libraries were found to have hierarchical structures which Kesselman and Watstein (2009:396-397) found ineffective for an eResearch support. There were also no formal structures aimed at supporting eResearch. These findings suggest the need for transforming the libraries' service to support eResearch which is consistent with the PUL model (See section 2.3.2) which underscores the need for libraries to restructure librarians' roles and service in order to facilitate eResearch.

6.4 Positions, Competencies and eResearch Coordination in University Libraries

The second research question sought to establish positions and staffing competencies and knowledge for Reference Librarians that are essential to support eResearch coordination at the library. In order to understand if any of the libraries had specific positions in their organisational structures for supporting eResearch, the University Librarians were interviewed. The findings (See Table 5.8) show that the libraries depended on Reference Librarians, Research Librarians, Liaison Librarians, and IR Managers to support aspects of eResearch. There were no specific positions designated to eResearch. This confirms Keller's (2015) view that academic libraries have relied on Reference Librarians to offer research support. However, in the context of eResearch, their roles need to also embed the eResearch process. Keller's study (2015), for instance, revealed that Australian University libraries have created positions for eScholarship and RDM specialists who are directly involved in eResearch within the library. This was also the case at the PUL where new roles were assigned to the subject librarians to enhance their ability to work closely with researchers. Furthermore, other positions such as an Interdisciplinary Research Librarian were created to champion eResearch specifically (See section 2.3). The findings in this study, therefore, suggest that the positions assigned to librarians who are involved in supporting research do not reflect eResearch support. This is also evident in the responses provided by the Reference Librarians with regard to their core responsibilities (See Table 5.7) which generally reveal basic support to eResearch compared with the benchmarks expressed in section 3.6.

Several studies such as Keller (2015:81); Simons and Searle (2014:2); Frances, Fletcher and Harmer (2011:5-7); Heidorn (2011:669); Shearer and Argaez (2010:11); Kesselman and Watstein (2009:391); Denison, Kethers and McPhee (2007:4) have expressed the importance of librarians acquiring both soft and hard skills to effectively support virtual research

collaborations, data management and scholarly communications effectively, which are fundamental to eResearch (See section 3.3.1). The findings in this study (See Table 5.9) showed that 11 (91.7%) of the Reference Librarians acknowledged to have knowledge of research methodologies. Shearer and Argaez (2010:12) and, Luce (2008:48) emphasise on close working collaborations between librarians and researchers to enhance the research process. Similarly, at the PUL (See section 2.3.2) such collaboration in research between Reference Librarians and Faculty was important as it was discovered that researchers lacked the time and skill to practice eResearch. Close working relationships between Reference Librarians and researchers from the commencement of their research to publishing and dissemination would require Reference Librarians to acquire knowledge and skills in research methodologies and an understanding of the research lifecycle. This study, however, found that despite the majority of the Reference Librarians having knowledge of research methodologies, only 7 (58.3%) of them indicated to have knowledge of the research lifecycle. It is vital for Reference Librarians who work with researchers to know all the phases of the research lifecycle to effectively identify and support integration of technologies into research practices. The role of University Librarians in the research lifecycle has been presented in section 3.6 of this thesis.

Compliance with OA mandates and legal issues can present intricate issues to researchers who require support from their libraries. Lewis (2010:11-18) posits that libraries have a responsibility to create awareness and advisory on OA and legal implications in research. Zhao (2014:3-4) in contrast argues that academic librarians have an understanding of OA and legal issues, thus, can provide literacy's in ethical scholarly publishing. Simons and Searle (2014:1) noted that librarians can also facilitate knowledge and skills in these areas. The results presented in Table 5.9 found that 10 (83.2%) of the Reference Librarians had knowledge and skills of IR management and OA, thus, reflecting a positive capability of supporting researchers towards open scholarly communications endeavours. On the other hand, 8 (66.6%) were aware of legal and copyright issues. With the increasing mandates for researchers to publish in OA repositories, libraries have a responsibility to enhance librarians' competencies in these areas to support eResearch efficiently.

Possession of technical skills is important for the management of large and complex distributed databases (Simons & Searle, 2014:2) and web management and customisation of systems (Frances, Fletcher & Harmer, 2011:5-7). Technical skills are increasingly becoming crucial to librarians especially with the increasing need to facilitate data management. This study established that 8 (66.5%) understood data description, 7 (58.2%) had some competency in technical skills related to data management and only 3 (25.0%) had knowledge in data curation confirming limited competencies to support RDM. Skills development in RDM has been found critical to support the data lifecycle (Heidorn, 2011:669; Shearer and Argaez, 2010:11). RDM skills are, however, found to be limited in the library context. This is attributed to the fact that RDM is still at an infancy stage of development in university libraries. This was confirmed by the University Librarians who indicated that some of their staff members had data analysis skills (See section 5.4.3), but there were limited competencies to support all the processes in the data lifecycle. Given the complex nature of RDM, a lack of competencies in data management will impede data sharing and reuse of data.

On the question of competencies, this study has established that Reference Librarians had knowledge and skills in some areas of RDM and not others. From the reviewed literature, wide ranges of competencies are required to support eResearch (See section 3.3.1). This makes it difficult for the librarians to acquire all the skills needed in RDM. An engagement of all the library staff especially between Reference and Liaison librarians will, therefore, be crucial if eResearch is to be fully supported with the university libraries. Furthermore, given the changing researchers' needs, previous studies such as Cox *et al*. (2017:22); Brown, Wolski and Richardson, 2015:229); Simons and Searle (2014:8); Shearer and Argaez (2010:11) have proposed continuous training of librarians.

Through the University librarians, the study established that there are no particular internal programmes at the universities aimed specifically at enhancing skills for eResearch (See section 5.4.4). With regard to external opportunities, the general indication from the University Librarians was that library staff members have been previously sent for trainings and workshops, but not specifically for eResearch; and in case of opportunities arising that require eResearch

training, they will send them for such training (See section 5.4.5). These findings suggest limited opportunities for librarians in university libraries in eResearch training.

6.5 Research Data Management in Universities

The study sought to assess how curation, analysis, and provenance (metadata) of both basic data and information produced by researchers are achieved to support eResearch. The variable research data management in the eResearch Capability Model (See Table 1.1) was investigated. In particularly, the study investigated support provided by university libraries to the researchers in the entire research data lifecycle (See Figure 3.1) in order to establish RDM support at the universities.

It is important for libraries to be involved in the data creation phases of researchers because they can advise and provide guidance on appropriate formats and descriptions which can not only aid in saving researchers time, but also enhance output. The involvement of librarians is particularly important at the earlier stages of research (Bracke, 2011:66; Heidorn, 2011:668) because it is at this early stage that researchers are expected to create DMPs, which are required by funding agencies if grant support is required. University libraries' roles are to support researchers in the creation of DMPs through training, consultancy and/or provision of online tools (See section 3.3.2, a). The findings in Table 5.10 show that more than 55% of the PhD students and Faculty across all the six Universities have not been supported in the planning of data formats and consent for data sharing, locating of existing data, collecting data and data capturing which are important procedures in data creation. However, unexpectedly, a majority (392, 66.4%) across all the Universities had created DMPs (See Table 5.11).

The study did not establish if the libraries supported researchers in the creation of the DMPs but the findings provided by the Reference Librarians when they were asked if their libraries support researchers in the data creation phase also suggest that not all of them are involved (See section 5.5.1). Moreover, in Universities such as A and C, some respondents agreed to have supported researchers in DMPs creation, while others who could not confirm having offered data creation support.

Processing of data is an important stage in the data lifecycle as it involves transitioning data into a form that can be manipulated and analysed, while ensuring respondents privacy (See section

3.3.2, b). The findings (See Table 5.12) show that the Universities under study provided some support to researchers in the data processing stages with the majority of the PhD students and researchers having been assisted with data entry (241, 39.0%), while the least support was in helping to enhance researchers' data anonymity (124, 20.1%). The findings suggest that though some support to researchers was provided, it was evident that the majority of the respondents had not been supported by their libraries (more than 61% in each of the procedure). The responses from the Reference Librarians also reflected this gap as only 6(50.0%) from Universities A, C, E and F respectively claimed to have provided data processing support to the researchers (See section 5.5.2).

Results on data analysis (See Table 5.13) indicate that more than 60% of the PhD students and Faculty had not been supported by their libraries to interpret data, produce research output, create authorship, and prepare data for preservation suggesting limited libraries' support in data analysis procedures. This was confirmed by the responses from the Reference Librarians that indicated only 4 (33.3%) from Universities A, C and E respectively had supported researchers in data analysis (See section 5.5.3).

Data preservation ensures permanency of data stored in a repository and consequently, re-use. The study established that while close to half of the respondents (284, 46.0%) were assisted with data storage, a majority (ranging from 66.5% - 69.9%) were not assisted with the other data preservation procedures (See Table 5.14). The findings from the Reference Librarians also indicated that only six of them from Universities A, B, C, D and E respectively had been involved in helping researchers with data preservation aspects (See section 5.5.4).

Backup and storage of data are critical components of data preservation, yet according to Strasser (2015:11), it is often neglected by researchers. A follow up question on data storage medium used by the PhD students and Faculty revealed that the majority (403, 65.2%) stored their data on laptops, while others stored their data on portable hard drive (280, 45.3%) and PC hard drive (272, 44.0%), (See Table 5.15). These findings confirm Pinfield, Cox and Smith's (2014) assertion that researchers are using locally based storage solutions for data which poses data security risks. The findings further suggest that much of the data may not be easily found and shared, as it is not centrally stored by university libraries, rather, by individual researchers. University libraries are expected to play a critical role in the preservation of data. Four IR

Managers from Universities B, C, D, and F respectively confirmed to have online systems for data and information storage, predominantly an IR, but it was unclear how these were used for long term data preservation (See section 5.5.4). From the results in Table 5.14, only 193 (31.2%) of respondents indicated they have been supported in data archiving. Furthermore, responses in Table 5.15 indicated that only 192 (31.1%) of the researchers from the six universities had used library servers for data storage. These findings suggest an underutilisation by researchers of the central storage facilities established in the libraries or lack of awareness about the existence of these facilities.

Through a follow up question on Meta-data creation which is crucial for data description in order to enhance re-use, the majority of the PhD students and Faculty (413, 72.0%) suggested to have provided descriptions for data (See Table 5.16). This is a huge contrast to the responses they had given in Table 5.14, where only 192 (31.1%) had indicated to have been supported by their libraries in meta-data creation. These results suggest that some researchers on their own accord are aware of data descriptions.

The findings from the IR Managers on the libraries' roles in supporting researchers' metadata creation indicated that some of the libraries in Universities A and C respectively were responsible for creating Metadata on behalf of the researchers, while other libraries such as B and D respectively trained researchers on metadata creation (See section 5.5.4). The study did not establish whether training researchers on metadata creation by University libraries such as B and D increased their data creation ability compared to University libraries A and C that created metadata on behalf of their researchers. The results further revealed that, some researchers were not aware of and neither were they assisted with metadata description by the librarians. Koltay (2016:98) asserts that appropriate descriptions using ideal metadata standards are critical in data management. Luce (2008:45) stated that, metadata management is an already established task in library communities and consequently, university libraries must take more responsibility in metadata management if data were to be re-used.

Libraries have a critical role to play in ensuring the promotion, accessibility and sharing of research data (Yu, 2017:792; Koltay, 2016:99; Shearer & Argaez, 2010:7). In the phase of data access, the findings showed that the libraries have only supported less than 46.9% of the PhD students and Faculty in the areas of sharing, controlling and promoting of data, and in

establishing appropriate copyright (See Table 5.17). With the majority not having been supported, data reproduction, verification, and re-use is also hindered. Only 6(50.0%) Reference Librarians indicated to have been involved in promotion of data access (See section 5.5.5). This study, therefore, reveals a lack of strategy in the library to facilitate researchers' data access.

The final phase of the data lifecycle requires that data is re-used to enhance repurposing (See section 3.3.2, f). The findings suggested that more than 60% of the PhD students and Faculty had not been facilitated by their libraries to re-use data. The results from the Reference Librarians also indicated that only 7 (58.3%) had engaged in the promotion of data re-use (See section 5.5.6). These results indicate that as much as some of the respondents have been supported, much of the data produced in the universities is not being re-used. This could be attributed to improper management of the processes in the data lifecycle as suggested in the results in this study.

University libraries are expected to support RDM. Macquarie University (2016:8) indicated that the value of data lies in its proper management. Pinfield, Cox and Smith (2014:2) assert that appropriate systems, structures, policies, infrastructures and services are needed for libraries to take advantage of opportunities presented by technologies to support data curation. Luce (2008:44) noted the need for libraries to be involved in the early stages of the research by creating policies for data description, management, access, and sharing.

Studies from the African continent placed South Africa ahead in RDM in Africa. This is attributed to the fact that South Africa provides funding, national frameworks, creates awareness, and builds capacity, and skill development. In addition, the country has advanced data repositories, and promotes stakeholder involvement, advocacy, and change in curriculums for librarians, and policy creation by libraries (See section 3.3.3). The findings in this study suggest that there are no structures or policies in place to achieve curation, analysis, and provenance in the data lifecycle in the universities surveyed in this study in Kenya. Despite some evidence that the libraries have been involved in supporting researchers in data management, it was unclear how this was done in the context of eResearch. From the findings, some librarians seemed to offer support while others did not. Similarly, not all the PhD students and Faculty could confirm to have been supported in RDM. These findings are similar to the study by Cox *et al*. (2017:2-3)

that indicated that university libraries have started to play a role in RDM, but the nature and extent of their participation have remained unknown.

In the eResearch Capability Model, data management involves the collection, curation, analysis and provenance of both basic and information produced by research. An assessment of the data element at VUW revealed that the lack of policy left the decision on what to do with data with individual researchers resulting in the inability to access and share it (See section 2.3.1, vi). Similarly, this study has revealed that the lack of formalised structures has led to a lack of appropriated RDM services in the Universities. The study found that a majority of the PhD students and Faculty have not been supported by their university libraries with the processes in the research data lifecycle and as a result, researchers have the discretion to use their data including whether or not to store it centrally for re-use.

The six University Librarians who were interviewed indicated that their libraries do not have services specifically geared towards supporting RDM though in some instances the services is offered by the Reference and Liaison Librarian (See section 5.5.7). This could explain why some Reference Librarians indicated to have supported researchers with some aspects of the data lifecycle as presented in section 5.5.1 to 5.5.6. The support could, therefore, be said to be ad hoc and dependent on the Reference Librarians ability rather than being supported by standard structures and policies.

It is evident; therefore, that roles and responsibilities for data stewardship are not established in the universities surveyed as described by Brown, Wolski and Richardson (2015:225); Shearer and Argaez (2010:3). Furthermore, a study by Heidorn (2011:665) found that there is limited knowledge about RDM and lack of establishment on who is responsible for advancing it (See section 3.3.1). As a result, the third phase of the research lifecycle (See Figure 3.2) that consists of data management is not well supported and this hinders eResearch at the universities studied.

6.6 Challenges in the Management, Organisation, Dissemination, and Preservation of Data

The findings in Table 5.20 indicate that 53.1% of the PhD students and Faculty faced the challenges of handling ethical issues associated with data management. Studies by Cox and Pinfield (2013:299); Heidorn (2011:668); Lewis (2010:11) highlighted ethics as a challenge in

data management citing privacy issues of participants, security, sensitivity of some data and the trust to be placed in those seeking to preserve data (See section 3.5). It is thus important that the issues of ethics have to be considered at all the stages from data collection to preservation and re-use if researchers' trust in data management has to be earned. The issue of ethics was also confirmed by one of the University Librarians' when responding to the question of data management challenges. UL2 stated that, "*I think availing of the data for research is one of the challenges.*" UL2 reiterated, a "*lack of understanding what it is all about and why do I have to give my own data, what for*? *Maybe someone will be worried that if [they] give it then someone is going to use it*".

Other challenges faced by the researchers as revealed by the study included creation of metadata, locating datasets and data storage with about 41.1% to 48.7% of the respondents citing these aspects (See Table 5.20). This current study established that while libraries create metadata for its researchers, the majority were not aware of metadata creation support as a library service. The study also established that libraries did not use their repositories for data storage. This could have an impact on the low numbers posted by the PhD students and Faculty on data storage as their libraries are not providing data storage services. The majority of the PhD students and Faculty (more than 46.9%) did not indicate the challenges they faced (See Table 5.20). A possible explanation to this might be that these respondents do not manage data within the eResearch context. As a result, they may have not been in a position to identify RDM challenges.

From the library perspective, the University Librarians indicated that they did not have formal RDM in the libraries even though the IR Managers and Reference Librarians were involved in providing some minimal support to researchers in various aspects of RDM as presented in section 6.5 of this study. One of the Reference Librarians also supported the view by saying that *"we have not engaged in formal RDM services"* (RL1). Nevertheless, Reference Librarians from five universities (A, B, C, D and F respectively) identified challenges to RDM to include: insufficient access to data, poor technological infrastructure, lack of university support, lack of funding, inadequate skills for librarians, unwillingness to share data by researchers, lack of awareness among researchers, lack of RDM policies and lack of curriculum on RDM. On the other hand, two of the IR Managers from universities B and D respectively identified challenges

to managing data as: ethical issues, lack of trust, awareness and interest from researchers and lack of policies (See section 5.6).

University Librarians stated that they did not have RDM services in their libraries but highlighted likely challenges to RDM to include the lack of knowledge about RDM and appropriate skill set among librarians, lack of awareness among researchers, inaccessibility of data, lack of storage space, lack of funding and institutional support, trust, attitude and inappropriate technological infrastructure (See section 5.6).

The challenges identified in this study by both the researchers and the librarians relate to the variety of challenges as discussed in literature (See section 3.3.4) such as lack of data management as a result of lack of time as noted by Deninson, Kethers and McPhee (2007:9); insufficient training (Heidorn, 2011:668); lack of motivation (Koltay, 2016:95); lack of formal structures and policies (Yu, 2017:793); insufficient library support, ethical and storage issues (Cox & Pinfield, 2013; Heidorn, 2011); and lack of trust in systems and infrastructures (Denison, Kethers & McPhee, 2007:9). It is evident from this study, therefore, that researchers who are engaged in RDM and those who are not are met with a wide range of challenges that are impeding RDM practices at the universities. Consequently, the university libraries are faced with the challenge of RDM due to lack of strategies.

6.7 eResearch Procedures, Tools and Policies

To determine the procedures, tools, and policies for promoting eResearch and in order to respond to the fifth research question, the respondents were polled on eResearch policies, processes, support, tools, and, collaborations. These variables were derived from the eResearch Capability Model (See Table 1.2***).*** The findings are presented in section 5.9 and discussed below.

6.7.1 Policies

At the VUW, policies were found to be conventional and not aligned to the eResearch environment, thus, it became difficult to build capability across eResearch elements. It was established that RDM policies were also lacking, thus, affecting the sharing, distribution and archiving of research data. The need to assess and amend university policies to be more eResearch focused was found necessary to create an appropriate eResearch environment (Whakamuri, Whakaaro & Me Aro, 2014:18).

The findings obtained from the Reference Librarians revealed that only one University (F) indicated to have all the listed policies related to eResearch (See Table 5.21), while one other University (E) indicated to have none. RDM policy was not available at five of the universities. This could explain the lack of structured RDM as discussed in section 6.6 and by the eResearch Capability Model at the VUW. The IR Managers indicated that the libraries had IR policies which supported storage and sharing at Universities B and C respectively. Moreover, long-term preservation policies were also included in the IR policies at Universities B and C respectively. Only two Universities were indicated to have eResearch policies as an on-going process (IR1 and IR4) (See section 5.7.1).

The University Librarians indicated that technologies played a critical role in research. In addition, they noted that their libraries' vision and mission, strategies and frameworks have provisions for supporting some level of eResearch though was not quite explicit. Two of the respondents suggested a need to update the policies to clearly reflect eResearch as stated in their responses; *"...maybe we need to update our policies*" (UL1) and, *"we don't have research coming out as eResearch. It is not in the policy of the library… It is silent in the policy maybe we need to revise our policy with your study*" (UL5) (See section 5.7.1). Table 6.1 provides a summary of the policies that were available in the six universities.

Table 6.1: Summary of policies available in the universities under study

Policies	University A	University B	University C	University D	University E	University F
Copyright	×	✓	×	×	×	×
eStrategy	✓	×	×	×	×	✓
ICT	✓	✓	✓	✓	×	✓
IR policy	✓	✓	✓	×	✓	✓
Open Access	✓	×	✓	×	×	✓
Plagiarism	✓	✓	×	×	×	×
Preservation	✓	✓	×	✓	×	✓
Publication	✓	×	×	×	×	×
Referencing	✓	✓	✓	✓	×	✓
Reference services	✓	×	×	×	×	×
Research	✓	✓	✓	×	×	✓
RDM	×	×	×	×	×	✓
Staff development	✓	✓	×	×	×	✓

It was evident from the responses provided by the University Librarians that eResearch policies were yet to be established in the institutions surveyed. It was also very clear from the findings that because of lack of focused eResearch policies, library staff could not identify specific policies that support eResearch. The lack of standardised eResearch policies impeded on libraries from offering full support to researchers. As Hart and Kleinveldt (2011:37) proposed, there is a need for university libraries to review its policies to align with researchers current scholarly needs and to be able to accommodate all aspects of eResearch.

6.7.2 eResearch Processes

In the eResearch Capability Model, process is defined as the support provided in the various stages of a research lifecycle from the initial conception to the output of the results (Whakamuri, Whakaaro & Me Aro, 2014:19). Considering that the adoption of eResearch has a significant impact on all the stages of a research lifecycle, this study adopted the variable of process from the eResearch Capability Model to assess the support provided to researchers in all the phases specifically looking at idea formulation, research grant, managing information and data, and publishing and sharing (See Figure 3.2). The essence of this approach was to get the general idea of the libraries' extent of support in the research lifecycle.

6.7.2.1 Libraries' Support in the Formulation of Ideas and Research Questions Stage

Libraries' support in the first phase of the research cycle when researchers are formulating ideas is crucial, as there is a need for a wide range of resources. In the context of eResearch, this would include availability of e-resources through databases and IRs to enhance literature searches and provision of online research support.

The results in Table 5.22 clearly indicate that the university libraries have made significant effort to support researchers in the first phase of the research process with more than 64% of the respondents affirming to have been supported. The highest level of support by the libraries (above 80%) was evidenced in provision of up-to-date citation databases and subscriptions to a wide range of e-resources with the least service being experienced in online research consultancy (64.6%). These findings were further confirmed by the Reference Librarians (See Table 5.23) with the majority (more than 83%) indicating that their libraries do provide up-to-date citation databases, a wide range of e-resources and easy access to IRs. Only three libraries indicated to have online research consultancy for their researchers (A, C, and F respectively) indicating a

need for creation of this services in some of the University libraries (B, D, and E respectively) in order to enhance online consultations with researchers.

The study did not establish the extent of usage of the e-resources, thus, could not ascertain if the resources were underutilised as indicated in the studies by Egberongbe (2011); Gannon-Leary, Bent and Webb (2008). However, given the numbers involved, it was evident that the level of awareness of e-resources was high. Nevertheless, there is a need for university libraries to intensify information literacy skills as proposed by Imsong and Kharbudon (2016:33) as well as Wema and Manda (2013:2) to enhance e-resources usage. This is because some researchers disagreed that the libraries do not have the stated resources and services, while others stated that they were not aware that certain resources existed in the libraries surveyed (See Table 5.22).

6.7.2.2 Libraries' Support in Research Grants

It is evident from the results presented in Table 5.24 that slightly above half of the PhD students and Faculty (ranging between 59% and 61% respectively) have been supported by their libraries in analysing their research impact, citation and other metrics analysis and in advise on research funding opportunities. The results from the Reference Librarians (See Table 5.25), however, show that not all of them have been engaged in helping researchers with citation and metrics analysis; only 3 (25%) from two of the universities agreed to have provided advise on research funding opportunities. It is, therefore, not clear from these findings, who provides research grant support to the researchers in the libraries. These findings are similar to the one found in the report by RIN and RLUK (2011:28) who established that libraries are increasingly supporting research grant seeking and application, but for the most part responding to researcher requests rather than from formal policies. Downing (2009:111) noted that due to the increasing grant-seeking support required by the researchers from libraries, it was necessary for university libraries to dedicate a librarian in charge of grants or embed this function in the existing subject specialist librarians' roles.

6.7.2.3 Libraries' Support in Managing Information and Data

In the third phase of the research lifecycle, researchers require support in managing information and data. In the context of eResearch, this entails the use of technologies. This study sought to establish the role of university libraries in managing researchers' information and data particularly using IRs.

The study established that almost a half of the PhD students and Faculty have the ability to self-archive their research output in their IRs (See Figure 5.4). In contrast, the IR Managers provided a general indication that the libraries do the archiving on behalf of the researchers (See section 5.7.2.3 a). This could explain why the rest of the respondents either disagreed to having self-archived or needed more information on self-archiving. It is also possible that some of the respondents who indicated agreed to self-archiving either did not understand the concept or they could be archiving in other repositories other than their university libraries' IR. The study did not establish the reasons for libraries taking up the role of archiving on behalf of the researchers but probably there are no self-archiving policies in the universities surveyed.

The findings further established that some of the respondents did not find publishing in IR as helpful while some had never deposited into it (See section 5.9.2.3 b). This finding suggests a need for creating more awareness if OA has to be advanced. When the respondents were asked to select from a list of statements that would motivate them to deposit in IRs, the results showed that researchers needed help with a wide range of issues including help in submission and ethical issues; although most selected that they needed to understand the benefits of IR (See Table 5.26). The study of Cullen and Chawner (2011:460) also found that researchers were reluctant to embrace IR because of "lack of interest, lack of knowledge, or through concern over the purpose and function of repositories. In addition, more than 40% of the respondents in this study did not select any of the motivators to deposit in IR which could be attributed to a lack of understanding or awareness of IR. The results also show that only a few complained about delays in uploading of their work into the IR by their libraries.

In terms of online support, the results showed that the majority (486, 78.6%) of the PhD students and Faculty have been provided with guides on citation styles, which are critical when researchers are to use online resources. This result was confirmed by the Reference Librarians with 11 (91.7%) of them asserting that they have provided this service to their researchers. In terms of availability of RDM guides, 374 (60.5%) of the PhD students and Faculty agreed that their libraries have them, but according to the Reference Librarians responses, this was only available in Universities A, C, E and F respectively. However, not all the Reference Librarians in University A and C agreed that this service was available indicating a lack of awareness. Finally, with regard to online modules for RDM, 408 (66.0%) of the PhD students and Faculty stated that

they have access. However, the findings from the Reference Librarians contradicted this as only 2 (16.7%) from Universities A and C respectively indicated that their libraries had RDM modules. These findings show a disparity among the Reference Librarians in terms of understanding of RDM and the services being provided to the researchers (See section 5.7.2.3 d).

According to the University Librarians, copyright issues related to information management are underscored when they participate in the creation of copyright policies and when offering researchers training and advocacy as expressed in their comments (See section 5.7.2.3 e). Given that 336 (54.4%) of the PhD students and Faculty indicated a need for more information on copyright and plagiarism, and another 276 (44.7%) indicated they have challenges with copyright in order to contribute to the IRs (See Table 5.26), it is evident that the libraries need a more focused approach in handling copyright issues to enhance the use of IRs by the researchers.

The University Librarians indicated that long term preservation is ensured through the use of their IRs, but some challenges were cited. For example, in University D the lack of a scanner to digitise print resources was a problem. In general, all the libraries' repositories were said to be at infancy stages of development as expressed in their comments:

> "*...we can say that we are at the beginning..."* (UL1); "*We started like five years ago and we put a lot of data and the server collapsed so we lost all the data. So we have started all over again...*" (UL2); "*It's pretty new, we started in 2015 so we are at the stage of just collecting…*" (UL3); "*I'd say it is fairly in the initial stages...* (UL6) (See section 5.7.2.3 e).

In terms of managing the IR from the repository Managers' perspectives, it was confirmed that they use repositories for information management, but could not clearly stipulate how long term preservation of the resources is achieved in the repositories (See section 5.7.2.3 f, i). However, a follow up question on this indicated that both Digital Object Identifiers (DOI) (university A, B and D respectively) and handles (university C and F respectively) were used to ensure persistency of the information in the repositories (See section 5.7.2.3 f, vi). The study also found that IR Managers had put up measures such as use of firewalls, regular back up, watermarking resources, and use of controlled access to enhance data security in the repositories (See section 5.7.2.3 f, ii). The study further established that thesis, dissertations, and exam papers were the most popular resources in the IRs (See section 5.7.2.3 f, iii). The majority of the repositories in

universities B, C, D and F respectively were found to be publicly available (See section 5.7.2.3 f, iv), thus enhancing OA.

The study could not be ascertain whether the institutions used their repositories to store data as some IR Managers did not respond to the question relating to this aspect; two of them indicated the IR was to some extent used to store data, while only one stated "*no raw data stored*" (IR3) (See section 5.7.2.3 f, v). These findings show that the use of IR for data management has not been undertaken in the universities. This result corroborate the findings by Pinfield, Cox and Smith (2014:11) in the study on the role of libraries in RDM in UK institutions which established that libraries have adopted repositories for RDM, though it was uncertain the extent to which this had been undertaken.

6.7.2.4 Libraries' Support in Publishing and Sharing

In the fourth phase of the research lifecycle, the study established that copyright issues relating to publishing were not known to all the researchers (See Table 5.30) despite all the Reference Librarians (12, 100%) indicating that their libraries make their researchers aware of this aspect (See Table 5.31). Some of the university libraries (A, C, and F respectively) do provide online alerts of call for papers to their researchers (See Table 5.31), as affirmed by 376 (60.8%), (See Table 5.30). Only three libraries (A, C, and F respectively) provide guides on online publishing. The results showed that 19.9% of the respondents were not aware and 18.6% disagreed that their libraries supported them with guides.

The library has a critical role to play in advising researchers on publishing especially in the wake of predatory journals (Koltay, 2016:100; Frances, Fletcher & Harmer, 2011:5). In this study, more than half of the respondents (56.0%) affirmed that their libraries advised them on which e-journals they could publish their work (See Table 5.30). The results from the Reference Librarians further suggest that this advisory is provided in only three university libraries (A, C, and F respectively) (See Table 5.31). In terms of awareness on OA publishing, the findings revealed that 54.7% of the respondents were aware. The librarians indicated, however, that advocacy about OA was done in four of the universities (A, B, C, and F respectively) (See Table 5.31). The lack of support in universities D and E could explain why some of the respondents disagreed or were not aware of OA publishing (See Table 5.30).

6.7.3 eResearch Support

In the eResearch Capability Model, support has been presented to include eResearch training, services, assistance with the research process and the general support provided across the university and externally to enhance eResearch. An assessment of the support provided at the VUW by the working group using their devised ranking scale, ranked it on a scale of two, which meant that the support services at the VUW were not particularly targeted at research. The support was found to be dispersed and majorly reactive, while training on eResearch was found to be ad-hoc. Furthermore, there was a low organisational commitment to eResearch awareness (Whakamuri, Whakaaro & Me Aro, 2014:26).

The current study investigated the support provided to researchers within an eResearch context in relation to establishing procedures for promoting eResearch. The findings indicate that all the university libraries surveyed offered some level of training on varied aspects related to eResearch. More than 50% of the PhD students and Faculty affirmed that training had been provided on proper referencing, reference management tools, and searching strategies (See Table 5.32). Similarly, 12 (100%) of the Reference Librarians confirmed that they trained researchers on proper referencing, while 11 (91.5%) train them on reference management tools and search strategies (See Table 5.33). The Universities' libraries integrate these trainings in their information literacy (IL) skills training programmes. The CUE guidelines states that "*the library shall facilitate academic success and encourage lifelong learning through information literacy and competency initiatives*" (CUE, 2012:12). University libraries in Kenya conduct IL trainings where issues of referencing and searching strategies are clarified. The study revealed that despite this effort, close to a half of the PhD students and Faculty did not indicate they have been trained by their libraries in these aspects suggesting a gap in terms of outreach to researchers (See Table 5.32). There is a need to train all the researchers in IL in order to enhance discoverability and ethical use of resources.

Other training opportunities were provided in legal and compliance issues as revealed by close to 50% of the respondents (researchers) who had training on this aspect. The study did not establish the exact aspect of ethics on which training was provided. Nevertheless, 53.9% of the respondents indicated not to having been trained on legal and compliance issues (See Table 5.32).

Only 278 (44.9%) of the respondents had been trained on statistical data analysis tools by their libraries (See Table 5.32) in Universities A, C and F, respectively where only 4 (33.3%) Reference Librarians indicated to have trained researchers in this aspect (See Table 5.33). It is evident from this result that data analysis training was ad hoc. Moreover, 271 (43.7%) of the respondents indicated they have been trained on RDM by their libraries (See Table 5.32). The findings from the Reference Librarians indicated that only 3 (25.0%) of the respondents from universities A, B and F respectively had provided RDM training to researchers. This finding suggests that training on RDM is not established in the libraries. Finally, the least training was provided in research metrics and impact with only 231 (37.2%) of the researchers having been trained in this aspect (See Table 5.32). Researchers often lack the know-how to perform metrics and analyses (Ball & Tunger, 2006:565), consequently, it is compelling for librarians to provide support to researchers' on impact metrics (Roemer & Borchadt, 2012). The findings in this study show that not all librarians have stepped up to support researchers with metrics and impact factors (See Table 5.33).

Interviews with University Librarians revealed that all their libraries worked closely with research offices, ICT departments, Deans, HoDs and various departments to offer research support (See section 5.7.3.2). However, the extent of eResearch support remained unclear. It was evident from the findings presented in Table 5.34 that most of them strongly provide eResearch support during the first phase of the research life cycle in Universities A, B, D, E and F respectively. Grant support by the libraries included endorsements and providing references (A), validation of grant seeking proposals (B), informing researchers on funding opportunities (C) and handling research grants consultations (D). The results on grants did not bring out need for the libraries to provide support in preparing DMPs required by funding agencies during grant application as articulated by Morgan, Duffield & Hall (2017:299); Tenopir *et al*. (2015:1); and Heidorn (2011:663).

The findings further showed that IR was used to support information management (B) and the research office supported data management in universities A and D respectively. Finally, there was a general indication that support was provided in the last phase of research life cycle with regard to training (A), publishing and dissemination (C), and OA (D) respectively (See Table

5.34). Generally, the findings reveal unstructured eResearch support across the research lifecycle.

The findings generally showed some level of partnerships between the libraries and researchers. However, the study did not detect any evidence with regard to the librarians working closely with researchers consistently in all the research phases. To enhance eResearch, librarians need to develop a close working relationship with researchers from the early stages to dissemination of findings. This is supported by studies by Koltay (2016:98); Heidorn (2011:667), Kesselman and Watstein (2009:392), and Luce (2008:48), among others. Koltay (2016:98), for instance, suggested that libraries should "liaise and partner with researchers...to foster an interoperable infrastructure for data access, discovery, and data sharing".

The responses from the University Librarians with regard to the level of support that their universities provided to researchers indicated that there is a general goodwill to support libraries by their universities, but the eResearch framework is yet to be established by the libraries. Currently, the support is mainly geared towards e-resources acquisitions, training and technologies (See section 5.7.3.2).

Studies by Cox *et al*. (2017:4); Foley (2016:34-35); Macquarie University (2016:5); Kahn *et al*. (2014:304); Richardson *et al*. (2012:259-260); Wolski, Richardson & Rebollo (2011:5-6) and Lewis (2010:10) have revealed the relevance of national and international participation in advancing eResearch in academic contexts with more emphasis placed on data management infrastructures. Within the African context there is increasing efforts to operationalise National Research and Education Networks to advance eResearch such as KENET, which is the NREN in Kenya (See section 3.6.3). This study therefore sought to establish from the University Librarians their awareness of existing bodies in support of eResearch. The findings showed that while bodies such as CUE, INASP, KENET, and KLISC have worked to encourage integration of technologies through supporting training and some infrastructure in university libraries, there was no evidence these organisations were engendering eResearch (See section 5.7.3.2). Overall, appropriate organisational commitment to eResearch support in terms of services and policies seemed elusive in the universities surveyed.

6.7.4 eResearch Tools

This study sought to establish online tools that support eResearch collaborations, data and the research lifecycle.

Enhancing collaborations among researchers across the globe through use of technologies has become crucial for eResearch since they are enabled to work together on a project or share data and findings. On the question of tools available to support researchers in finding collaborators, this study found that two of the universities (A and C respectively) had encouraged the use of Mendeley, Zotero, Academia.edu, Research Gate, Google Scholar, Real Time, Google Docs and ORCID. Some of the Reference Librarians in universities D, E, and F respectively did not indicate the tools they used suggesting that their libraries did not provide this support. One of the librarians from university B stated that this is a role provided by their research department.

Furthermore, in a related query, the University Librarians indicate that they are aware of some researchers using social media platforms such as Zotero, SCOPUS and Research Gate to collaborate but the libraries had not taken an active role to support this as a library service. Nevertheless, UL1 indicated that their library has made considerable efforts in this regard as expressed in this comments:

> *We have implemented a virtual conferencing facility we call it a walk-in studio whereby our patrons can exchange ideas with others who are in remote locations... a teleconferencing facility whereby discussions can take place across distances* (See section 5.7.4.1).

This result suggests the need for libraries to integrate both physical and virtual facilities to enable researchers engage with each other from any geographical location. In contrast, 67.6% of the PhD students and Faculty affirmed that their libraries provided tools for them to find collaborators, while 50.0% indicated that their libraries have online tools that enhance collaborations (See Table 5.35).

In relation to data analysis tools, 61.3% of the PhD students and Faculty agreed that their libraries provided them with these tools (See Table 5.35). The researcher further queried the Reference Librarians to establish if data analysis tools were provided by the university libraries. Findings in Table 5.36 showed that these tools are provided in University A only. The other libraries did not indicate that they provided data analysis tools because in a follow up question,

two of the respondents indicated that other offices which handled data analysis to include ICT office (university B), research centre, and in a training room (University C). Thus, the findings reveal that libraries in these universities do not support data analysis directly. Furthermore, University Librarians were asked if the library has RDM tools, results showed that no specific tools were available in libraries which were geared towards supporting RDM (See section 5.7.4.2). These findings suggest a gap in data management at the universities.

Increasingly, libraries are playing a critical role in providing alerting tools for updating researchers on new research. According to Kumara, Rajalaxmi and Devendrappa (2013:1-2), alerting tools enhance awareness on new resources, articles, and call for papers (See section 3.6.4). The findings of this study regarding whether the PhD students and Faculty are provided with alerting tools by their libraries revealed that only a small number of the respondents (less than 33%) had been supported with online alerting tools on new research (See Table 5.37). Similarly, not all Reference Librarians had been involved in providing alerting tools to researchers (See Table 5.38). These findings may imply that the majority of researchers are not quite aware of new researches through their libraries because of lack of the necessary tools and enabling policies.

Because of OA and increasing demands from funders that researchers provide evidence for the impact of their research output, academic libraries have been faced with new roles to support researchers in utilising new tools for this purpose (See section 3.6.4). This study, therefore, sought to establish if researchers are supported with tools to enhance and to measure their research impact. The findings in Table 5.39 showed that Google Scholar is the most popular tool among the researchers while SSRN was the least popular. Furthermore, the results showed that across all the listed tools, more than 50% of the respondents did not select the tools indicating that they may not have created online tools to help maximise the impact of their research output. Further investigation into the tools being used to measure impact revealed that not more than 40% of the respondents had used metrics tools (See Table 5.41).These results suggest that libraries have not provided sufficient support to researchers to utilise online tools to maximise and measure the impact of their research. This was confirmed by responses of Reference Librarians that not all of them had recommended tools to researchers (See Table 5.40).

With regard to storage tools, the majority of the PhD students and Faculty stored their own digital files in personal computers (63%) rather than using their library servers which were used by only 2 (0.3%) respondents. This is despite five of the universities (A, B, C, D, and F respectively) having created digital repositories (See Figure 5.7). When University Librarians were asked about tools to they used to support eResearch, the findings outlined in section 5.9.4.6 showed fairly good support for IR publishing and provision of basic infrastructures such as computers and networks. Furthermore, a question on awareness of high-performance computing technologies revealed minimal knowledge of existing external computing facilities that can be used by the university libraries to support research.

In general, the findings showed that the ICT environment at the universities was not strategically positioned and set to support eResearch. These findings echo the situation at the VUW where it was found that tools to support eResearch were informal and inconsistent.

6.7.5 eResearch Collaborations

Collaborations entail collaborative work among researchers both within the universities and externally. Within the eResearch context, technologies can be provided to enhance cooperative work among researchers regardless of time and geographical boundaries. The role of libraries in this has been highlighted by authors such as: Henderson (2016); Frances, Fletcher and Harmer (2011:6); Kesselman and Watstein (2009:393-394); and Luce (2008:44). These studies have addressed the role of libraries in enhancing collaborations within an eResearch context by addressing issues such as building strong partnerships; recognising the 'busy' life of a researcher, thus, intervening in enabling collaborations; recognising the new ways of scholarly communications that compel partnerships not only between researchers but also between librarians and researchers; recognising the need for online tools to facilitate collaborations; provision of virtual guides to collaborative platforms; and enhancement of interdisciplinary research among others (See section 3.6.5).

This study sought to establish from PhD students and Faculty how their university libraries enabled internal and external collaborations. Very few respondents provided feedback on this questions with 29 (4.7%) indicating to have been facilitated internally, while 19 (3.1%) indicating external facilitation. The low response could be an indication of very minimal support provided to researchers by university libraries to enhance collaborations. The study further

revealed limited facilitation through online platforms as the majority of respondents highlighted conventional ways of collaborations that were in place (See Tables 5.43 and 5.44). These results suggest very little support towards eResearch collaborations by university libraries. The implication of this is that the majority of the researchers could be working independently and, therefore, research partnerships and sharing of research data could be hindered. Furthermore, the possibility of research duplication is enhanced, as well as a lack of collaboration. The findings in this study were similar to the findings at the VUW which suggested minimal support in collaborations that affected capabilities such as data transfer, access to shared data, real-time communication, and remote access to resources (Whakamuri, Whakaaro & Me Aro, 2014:23).

6.8 Perceptions and Attitudes

The sixth and final research question sought to establish the inclination of library and academic staff towards eResearch (See section 1.4). Literature on perceptions and attitudes towards eResearch was reviewed (See section 3.7). Questions in relation to perceptions and attitudes of the researchers and librarians towards eResearch were posed.

The findings showed that the majority of the PhD students and Faculty (83%) were willing to share their research output (See Figure 5.8). The researchers were further asked about their willingness to share research output through their universities' IRs. The findings showed a slight reduction of the willingness with 74% expressing inclination towards this, while only 6% indicating unwillingness. The rest (20%) needed more information about sharing research through the repositories (See Figure 5.9). Through these findings, it can be surmised that the majority of the researchers are inclined towards sharing research but the libraries require doing more in creating awareness about IRs as not all the researchers are well versed with this resource.

An investigation into the perception of the PhD students and Faculty about eResearch (adopting of technologies throughout the research process) showed a general positive attitude as only 7.4% of the respondents indicated not to like the idea of eResearch (See Table 5.45). The responses from the Reference Librarians on the same issue showed optimism as almost all (92%) from five of the universities (A, B, C, D and F respectively) supported the idea of eResearch and provided comments such as "*[eResearch] is the best way to go*" (RL5), "*for any research institute, this is very crucial if it shall promote the university's efforts to keep abreast of all matters that are*

research related" (RL10); "*I encourage the use of technologies in our research*" (RL12) among others (See Table 5.46). These findings corroborate Dutton and Meyer (2008) who surveyed 526 researchers in the UK and globally to establish eResearch awareness and found that regardless of disciplines and methodologies, researchers were receptive towards eResearch (See section 3.7).

Furthermore, some of the Reference Librarians suggested that to enhance eResearch, their libraries ought to create awareness and enabling strategies, and conduct trainings (universities A, B and C respectively), while the others in universities C, D and F respectively stated the need to champion the use of technologies in research and to provide infrastructure. Working closely with researchers was also established as critical in eResearch with the majority of the Reference Librarians saying it was crucial to partner and support researchers throughout the research process as expressed in comments such as "*during the entire process of identification of topic, resources, writing and publishing*" (RL3, university A); "*they should partner throughout the process*" (RL7, University C); "*from the onset of the project*" (RL8, University C); "*the librarian should be informed and involved in all the stages of the research*" (RL12, university F) (See section 5.8).

Opinions on the relevance of RDM were also sought. A minority of the PhD students and Faculty (20, 3.2%) responded to this query and noted data should be managed in order to enhance access and re-use (See Table 5.47). A possible explanation to the low response in this question can be attributed to the fact that RDM is yet to be established in the university libraries (See section 6.7.2.3). The lack of organisational support towards RDM hinders its application as established in a study by Tenopir *et al.* (2015) which examined the perceptions of 1329 scientists towards RDS (See section 3.7). Reference Librarians' opinions on RDM were varied, but commonly, there was a positive attitude towards RDM and willingness to apply it in their libraries (See section 5.8).

University Librarians were asked to comment on the attitude of PhD students and Faculty towards eResearch. With comments such as,

> "*…the doctorate students' attitude is very positive… I do not say that it is negative but I said compared, the students are more [receptive]"* (UL2).

"If you actually look at the older faculty, professors, there is a lot of phobias. Students I think are on board, it is much easier for students, but there is also a category of older students who struggle with this e-thing" (UL4).

"I think I see a lot of excitement from the student part but I think from the faculty part there is a lot of reservation" (UL6).

The findings, generally suggest that students are more receptive to embracing eResearch compared to the Faculty members, but in essence, there is room for all researchers to adopt eResearch practices (See section 5.8).

Further engagement with the University Librarians with regard to resources usage revealed that both print and electronic resources remain relevant to researchers, but there is more inclination towards e-resources among the PhD students compared to the Faculty members. However, hindrances to adoption of e-resources were highlighted such as lack of awareness (UL1) and lack of IT literacy (UL2) (See section 5.8). The findings corroborate with Tenopir (2003) who in an investigation that examined more than 200 studies on user behaviour towards e-resources, and found that younger users were more enthusiastic and early adopters of e-resources compared to the older users, and particularly the Faculty (See section 3.7).

6.9 Summary

The discussed findings presented in this chapter revealed eResearch was a new concept in the libraries hence there was limited understanding about what it entails. Library organisational structures were found to be conventional and, therefore, not appropriate for eResearch support. The findings suggested limited skills and competencies among the librarians which pose a challenge to their ability to work closely with researchers in order to enhance eResearch. It was discovered that the majority of the PhD students and Faculty had not been provided with adequate eResearch support; hence, RDM was compromised. Responses from the Reference librarians and the University Librarians confirmed a lack of formalised RDM support to researchers from their libraries. A range of RDM challenges was unearthed from the researchers and librarians alike and this could pose a big challenge in data management efforts. Appropriate policies and infrastructures were established as vital to enabling eResearch and RDM. Finally, despite the lack of competencies and appropriate infrastructures to support eResearch, there was a general indication of willingness among the librarians and researchers to adopt eResearch practices.

CHAPTER SEVEN

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This chapter presents the summary of the findings, conclusions, and recommendations. Kalusopa (2011:263) posits that a conclusions aims at re-stating the findings of the study, while drawing implications of the findings for the research questions in the study.

The general aim of the study was to investigate eResearch support at private university libraries in Nairobi County, Kenya. The study sought to address the following research questions: How do the organisation structures of the university libraries support eResearch? What positions in the organisation structure and competencies are available for coordinating eResearch? How is curation, analysis, and provenance (Metadata) of both basic data and information produced by research achieved? What problems of data management, organisation, dissemination, and preservation exist and how can they be addressed? What procedures, tools, and policies are used to promote eResearch? What is the inclination of library and academic staff towards eResearch?

The study was guided by the Purdue University Libraries model and the eResearch Capability Model (See section 2.3). The pragmatism paradigm was used to underpin the research problem. The study applied a multiple-case design to enhance generalisability of the results. This study focused on six private chartered universities in Nairobi County which included the Africa International University; Africa Nazarene University; the Catholic University of Eastern Africa, Daystar University; Pan African University, and the United States International University. The unit of analysis consisted of University Librarians, Reference Librarians, IR Managers, PhD students and, Faculty members. A mix of open and close-ended questionnaires were designed to obtain data from the PhD students, Faculty members, Reference Librarians, and IR Managers (See Appendices 1-3). A semi-structured interview guide was used to conduct in-depth interviews with the University Librarians (See Appendix 4). A high response rate ranging between 71-92% was achieved (See section 5.2).

The overall structure of the study takes the form of seven chapters. Chapter one presents the introduction and background to the study providing meaning to eResearch and discussing it within the international and African contexts. Chapter two lays out the theoretical dimensions of

the research. Chapter three focuses on the review of extant theoretical and empirical literature in relation to library organisational structure; competencies and eResearch coordination; research data management; institutional repositories; RDM challenges; policy, processes, support, tools and collaborations; and perceptions and attitudes. Chapter four presents the methodologies employed in this study. Chapter five analyses the findings of the study drawn from interviews and questionnaire surveys used to collect data from PhD students, Faculty members, University Librarians, Reference Librarians, and IR Managers. Interpretation and discussions of findings is presented in the sixth chapter. The final chapter draws upon the entire thesis and presents the summary, conclusions, as well as the recommendations.

7.2 Summary of the Findings

This section presents a summary of the findings based on the research questions formulated for this study.

7.2.1 Demographic Characteristics of the Respondents

The respondents were required to provide biographical information of their university and department affiliation, gender, current position, duration worked, year of study for PhD students, job responsibilities, academic qualifications, and age. The participating universities as confirmed through the data collection instruments are highlighted in section 7.1 of this study. The study revealed that the majority, about a third (158, 27.7%) of the PhD students and Faculty members were affiliated to the Business and Theology departments in the universities.

Male (408, 66%) researchers outnumbered the female (210, 34%) confirming the gender disparity in Kenyan universities as described in the report by Mukhwana *et al*. (2016). A majority of the researchers and librarians in the study indicated to have worked for less than five years at their current jobs. The majority of the PhD students and Faculty members (413, 66.8%) indicated a Master's degree as their highest qualification, which falls short of the requirements for lecturers to have a PhD in Kenyan universities. The study also established that the majority of the Reference Librarians had a Bachelor's degree, while a half of the University Librarians had PhDs. These findings demonstrate that most university libraries do not meet CUE requirements for University Librarians to be holders of a PhD qualification. In terms of age, the findings show that the majority of the PhD students and Faculty members were in the age ranges of 31-40 and

41-50 respectively with each category having 214 (34.6%) respondents. These results suggests a youthful population in the universities surveyed.

7.2.2 Library Organisational Structures and eResearch Support

The study sought to establish how libraries' organisation structures of the university libraries surveyed supported eResearch. From the University Librarians' perspectives, the findings revealed a lack of structures to support eResearch. Roles available in their oganisational structures included: a Research Librarian, Reference Librarians, E-resources Librarian, User Services Librarians, and IR Managers with whom the University Librarians indicated that they have engagements. They further highlighted that these librarians worked in sections such as reference and multimedia which were perceived to be geared towards supporting eResearch.

7.2.3 Positions and Competencies for Coordinating eResearch

The second question in this research was 'What positions in the organisation structure and competencies are available for coordinating eResearch?' In view of the results presented in section 5.4.1 and the discussions in section 6.4, the findings revealed that the university libraries surveyed had some positions that partially reflected support to some aspects of eResearch such as IR Managers, Reference and Research Librarians (See Table 5.8). Limitations in their roles, in view of supporting eResearch came out clearly when they had to indicate their responsibilities at their libraries (See Table 5.7), which indicated strong support towards repository management and e-resources access and usage; thus, indicating gaps in supporting the entire research lifecycle. Studies have illustrated that university libraries have re-positioned their personnel with more new roles that are more reflective of eResearch support. eScholarship and RDM Specialist, for instance, were cited at Australian University libraries by Keller (2015). This was also reflected in the PUL model, whereby the Purdue Library had to assign new roles to subject librarians (See section 2.3.2) to cover eResearch functions.

In terms of competencies, this study established that there were gaps in Reference Librarians knowledge and skills, as well as a need for training and development. Furthermore, the study established that librarians need to have a wide range of skills including IT skills, project management, soft and hard skills (See section 6.4). This study noted over reliance on Reference and Liaison librarians to coordinate eResearch which Richardson, *et al*. (2012:271) established

as ineffective given that researchers require to be supported from the stage of idea formulation to dissemination of their results.

Given the wide range of skills needed by librarians to provide eResearch support, several propositions of acquiring knowledge and skills through formal and informal approaches have been presented in literature (See section 3.3.2). These include:

i. Learning through experience,
ii. Reading on eResearch,
iii. Formal tertiary education including enrolling in programs that have eResearch,
iv. Attending to webinars,
v. Attending to events such as OA events,
vi. Peer mentorship,
vii. Self-training, for instance, RDMRose data management online course,
viii. Getting involved in joint appointments to roles/research projects,
ix. Training courses (in-house or externally provided),
x. Short courses, for instance, RDM short course at the University of Cape Town,
xi. Supervisor/peer-assisted,

Integration of these methods into librarians' staff development would help enhance knowledge and skills critical to eResearch support.

7.2.4 Research Data Management in Universities

The third research question was designed to determine how curation, analysis, and provenance (Metadata) of both basic data and information produced by research are achieved. To address this question, the variable of Research Data Management was obtained from the eResearch Capability Model. In particular, this study examined the support using the various stages of the UK data archive lifecycle as described by Ball (2012:9-10). The stages included: data creation, processing, analysing, preserving, access, and re-use.

The study established that more than 55% of the PhD students and Faculty members are not supported at the data creation stage (See section 6.5). The implication of this is that planning for data management is compromised, as this is crucial in this stage. Libraries are required to support researchers in creating DMPs at the earliest stage of the data lifecycle (See Table 3.1).

The relevance of DMPs has been highlighted in section 3.4.2a, essentially as a requirement by funding agencies (Yu, 2017:791; Strasser, 2015:2; Burnett, 2013; Molloy & Snow, 2012; Wolski, Richardson & Rebollo, 2011:3) and also, to enable researchers plan for data so that appropriate formats, descriptions and metadata can be established in advance (Heidorn, 2011:668).

With reference to the second stage of the data lifecycle, that is, processing of data, the findings revealed limited support by the libraries for researchers especially in the processes of data entry, translation, validation, cleaning, anonymising and describing. More than 61% of the PhD students and Faculty members indicated they have neither engaged nor been supported by their libraries in this stage. This finding was confirmed by the Reference Librarians (See section 6.5).

The result of the investigation into the support provided by libraries on data analysis suggested that the majority (more than 60%) of the PhD students and Faculty members had not been supported (See section 6.5). Additionally, only 4 (33.3%) of the Reference Librarians appeared to have offered some support in data analysis. Therefore, largely, the university libraries are yet to offer data analysis support to their researchers.

Data preservation, the fourth stage in the data cycle has been cited as crucial in enhancing long term preservation of data and data re-use. The results of this study showed that an average of 68% of the PhD students and Faculty members had not been supported to preserve their data and this included metadata creation and storage. Consequently, much of the research data generated could not be traced for preservation and re-use. Findings from the IR Managers appeared to agree with these findings, as they seemed to suggest that the library has not been at the fore front in training researchers on metadata descriptions, but instead have helped the researchers on demand (See section 6.5).

The final phase of the data lifecycle, data access and data re-use produced the same results with more than 53% of the PhD students and Faculty members indicating they had not been supported to access research data, while more than 60% claimed their libraries did not help them to re-use research data (See section 6.5). Access to data and re-use is dependent on appropriate creation and preservation of the data.

Some PhD students and Faculty members; however, affirmed to have been assisted by their libraries in RDM but the study did not extend to find out the extent to which such support was provided across the various stages of the data life cycle. However, with an average of more than 60% of the respondents from the six universities stating not to have been supported by their libraries across all the stages of the data lifecycle, it appears that the university libraries are yet to institutionalise RDM support as part of their core services.

Some Reference Librarians indicated they have supported researchers in some aspects of data management such as data entries and analysis; however, the overall findings suggested a lack of formal strategies to support the processes in the research data lifecycle. Most of the support provided from the libraries appeared to be ad-hoc and reactive. The findings from the University Librarians interviewed about libraries' role in RDM indicated that their libraries have not formally positioned themselves to support RDM, even though some minimal aspects may be found (See section 6.5).

7.2.5 Challenges in Data Management, Organisation, Dissemination, and Preservation

The fourth question set to find out the problems of data management, organisation, dissemination, and preservation as well as how they can be addressed. Some of the PhD students and Faculty established privacy and confidentiality issues, creating metadata, locating datasets and storage as challenges to RDM. The majority, however, were not able to identify RDM challenges possibly due to the lack of involvement in well thought-out RDM practices. The various categories of librarians also cited some challenges, and in some cases potential RDM challenges.

Collectively, the following RDM challenges were revealed from the PhD students, Faculty members, and Librarians as discussed in section 6.6:

i. Ethical issues associated with data management
ii. Creation of metadata
iii. Locating datasets
iv. Data storage
v. Lack of RDM strategies and policies
vi. Insufficient access to data

vii. Poor technological infrastructure
viii. Lack of funding and institutional support
ix. Inadequate skill set among librarians
x. Unwillingness to share data by researchers
xi. Lack of awareness and knowledge of RDM
xii. Lack of curriculum on RDM
xiii. Lack of trust
xiv. Lack of interest from researchers
xv. Inaccessibility of data
xvi. Attitude
xvii. Inappropriate technological infrastructure

The findings of this study revealed that the majority of the challenges that had been experienced by the researchers were similar to those discussed in literature (See section 3.5). Other challenges as discussed in literature and not mentioned by the respondents included culture (Morgan, Duffield & Hall, 2017:302), lack of motivation (Koltay, 2016:95), lack of time and data security (Deninson, Kethers & McPhee, 2007:9), lack of training for both library staff and researchers (Yu, 2017:793), and, technological obsolescence (Cox & Pinfield, 2013:299).

7.2.6 Procedures, Tools and Policies for Promoting eResearch

The fifth research question sought to identify the procedures, tools, and policies in place to promote eResearch. Respondents were queried on eResearch policies in place; the support the library offered to researchers across the research lifecycle; eResearch support provided to researchers in terms of training, staffing, internal, and external support; tools to enhance eResearch, and how online collaborations are facilitated.

The results on policies indicated that some policies on ICT, referencing styles, research, OA and preservation were in existence in at least four of the universities surveyed but the particular policies in place varied from one university to the other. Other policies such as e-strategies and RDM seemed to be scarce as they were only confirmed to be in two and one of the universities respectively (See Table 5.21). In all, these policies were designed to serve the specific services existing in the libraries, but were not generally designed with eResearch in mind. This was confirmed by the University Librarians who generally indicated that their policies and strategies

did not explicitly target eResearch (See section 6.7.1). These findings were consistent with VUW's findings from the eResearch Capability Model that established a lack of realignment of policies towards supporting eResearch methodologies (See section 2.3.1, i).

This study further sought to establish what support was offered to researchers in the first phase of the research process within an eResearch context. Both the PhD students and Faculty members confirmed that the libraries had made significant effort in terms of providing up-to-date citation databases and e-resources in a bid to support provision of literature to aid in formulation of ideas and research questions. It was, however, revealed that not all the researchers were aware of the existence of these resources; and furthermore, online research consultancy services were only available in three libraries (See section 6.7.2.1). These findings point to a gap in terms of awareness and advocacy of available resources if libraries were to ensure support for all researchers.

Support for the second phase of the research process revealed that very few (3, 25%) of the Reference Librarians had been involved with supporting researchers with grant seeking and application by helping them to analyse metrics and citations, as well as finding funding opportunities. This was done casually as there appeared to be no strategies requiring this service to be provided in the university libraries (See section 6.7.2.2). With the increasing mandates from funding agencies, university libraries have a greater responsibility to support researchers in the grant seeking process and more increasingly in creation of DMPs.

In terms of information and data management, the study established that the libraries have institutional repositories for information management and not as data repositories. These repositories were used by the libraries largely for long term preservation of information resources. Furthermore, four of the six university libraries (B, C, D, and F respectively) had their repositories publicly available, thus enhancing OA. Despite this effort, it was found that the majority of the researchers were reluctant to deposit their work in the IRs due to the lack of awareness of its relevance. In addition, when it came to archiving, the study revealed that the majority of the libraries did not have self-archiving policies and, therefore, archived the resources on behalf of the researchers. This is despite the fact that self-archiving empowers researchers to deposit their work and leaves librarians to conduct quality checks of the deposited

works. Copyright issues were established as a challenge to researchers requiring to use IRs (See section 6.7.2.3).

In terms of publishing, the study established that copyright issues related to publishing were a hindrance to online publishing. Evidence showed that some of the libraries made effort in providing alerts for call for papers and online guides for publishing. Additionally, slightly more than a half (54%) of the researchers indicated to have been advised on appropriate e-journals to publish their work and use of OA as a publishing option. These services were, however, only evident in some of the libraries surveyed indicating that not all of the libraries had made good effort in this regard (See section 6.7.2.4).

Overall, on the four phases of the research lifecycle above, the results suggest that some of the processes in the research lifecycle were supported in the different universities but were not specifically designed towards meeting eResearch needs. This finding is consistent with the situation at the VUW using the eResearch Capability Model; the working group assessed processes in the different stages of the research, process and established that library support towards this was dispersed and disconnected (See section 2.3.2, ii).

The result of the investigation further showed that all of the university libraries had some form of training that support aspects of eResearch, for instance, all are involved in training researchers on reference management and searching strategies. However, it was established that not all of the researchers had been trained. The findings also suggest that the training offered is insufficient, as it is not structured to cover all the phases of the research lifecycle. Responses from the University Librarians on eResearch support indicated that stakeholders such as university research offices, ICT, and government play a critical role in supporting eResearch, but the extent of their support could not be established in this research. They further highlighted that the libraries failed to provide support in all the phases of the research lifecycle with much of the emphasis having been placed on the first phase of e-resources access, and the last phase of establishing IR to support OA publishing. The phases of research grant and data management received minimal support. In addition, meaningful collaborative partnerships between librarians and researchers had also not been established. University Librarians also highlighted some existing bodies such as the CUE and KENET, which were useful in supporting eResearch but much has not been done by the libraries to engage them (See section 6.7.3).

The study sought to establish tools in use to support eResearch. The findings showed that there were no established policies with regard to training on eResearch tools. However, some of the Reference Librarians had trained some researchers to use some tools such as Mendeley, Research Gate, and Google Scholar in an ad-hoc manner. The study further established that the libraries had not established tools to support RDM apart from university A, which had data analysis tools for researchers, though these were not sufficient to support the entire data lifecycle. In addition, the findings showed that there was minimal library support to researchers towards applying alerting tools, online tools to maximise and measure the impact of their research, efficient data and information tools, as well as access to high-performance computing tools (See section 6.7.4).

In relation to eResearch collaborations, the study found that there was limited support to facilitate internal and external collaborations among researchers, as the results indicated that the majority of the PhD students and Faculty members had not been facilitated by their libraries (See section 6.7.4).

7.2.7 Perceptions and Attitudes

The sixth research question investigated attitudes and perceptions of librarians and researchers towards eResearch. The study established that the majority of the PhD students and Faculty members expressed willingness to share their research output through their institutions repositories and their general attitude towards adopting eResearch was high. The findings showed that there was very limited awareness about RDM as only 3.2% of the respondents were able to provide their opinions about it. On the side of the librarians, the study found that 92% of the Reference Librarians were receptive to providing eResearch support to the researchers. However, they expressed the need for training on creating awareness and establishing close working relations with the researchers.

7.3 Conclusions

This section presents the general conclusions of the major findings of the study thereof discussed in the section above. The research limitations are also presented.

7.3.1 Demographic Characteristics of the Respondents

Based on the findings, the study concludes that gender disparity is still apparent in private universities in Kenya as there were more male than female PhD students and Faculty members.

A majority of the Faculty members were found to hold a Master's degree demonstrating a shortfall of the CUE requirements that lecturers and University Librarians should hold PhD degrees. A significant number of the researchers in the universities were found to be youthful with their ages ranging between 31 and 40.

7.3.2 Library Organisational Structures and eResearch Support

It can be concluded from the findings that private university libraries in Kenya surveyed in this study have made efforts to accommodate technology-oriented services to a greater extent, but are still structured and focused on conventional service delivery that hinder eResearch support. Evidence from the interviewees (See section 6.3) also demonstrate the existence of some resources such as technologies and human resources but limited organisational structures to promote eResearch perhaps due to a lack of understanding of the eResearch concept as was expressed by the University Librarians (See section 5.4).

7.3.3 Positions and Competencies for Coordinating eResearch

The results of the study showed inadequate roles and competencies for eResearch support. The researcher concludes that private university libraries in Kenya have not purposed to re-assign roles and to enhance librarians' competencies in view of supporting eResearch. As a consequence, eResearch cannot be effectively supported by the libraries.

7.3.4 Research Data Management in Universities

From the findings on the issue of RDM support in the universities, the study established that the libraries were not yet positioned to support research services across the data lifecycle. It can, therefore, be generally concluded that support for RDM is minimal across all the six private universities due to a lack of structures and formal policies. As a result, the issues of curation, analysis, and provenance are not appropriately achieved within the eResearch context. These findings resonate with the findings at the VUW which revealed that a lack of policy and appropriate technologies hindered curation, analysis, and provenance of research data (See section 2.3.1, vi).

7.3.5 Challenges in Data Management, Organisation, Dissemination, and Preservation

Despite RDM not having been institutionalised in the universities, the respondents revealed a wide range of anticipated challenges in relation to the management, organisation, dissemination

and preservation of data (see section 7.2.5). In view of these findings, it can be concluded that the management of RDM at the six private universities will remain an obstacle to eResearch if they are not addressed.

7.3.6 Procedures, Tools and Policies for Promoting eResearch

Based on the findings in this study, the researcher concludes that the universities lack appropriate and integrated policies to guide eResearch support. Effort has been made to offer support towards the first phase of the research phase but there is a general lack of awareness on the services such as availability of online databases, thus, researchers are not making effective use of the services. Grant seeking and application appeared to be novel in the libraries, hence, minimal support was offered to researchers in this aspect. As a result, the university libraries are not appropriately supporting the research grant phase of the research lifecycle. Great effort has been made to establish IRs but a lack of awareness and appropriate policies has hindered the management of data and information through use of the repositories, thus, the majority of researchers were yet to embrace this support. The study concludes that adequate policies, training, advocacy of researchers, and creation of data repositories are required in order to enhance information and data management. The study also indicated minimal policies, training and tools towards eResearch support, thus, concludes that the university libraries have limited ICT infrastructure and ICT policies to support eResearch.

7.3.7 Perceptions and Attitudes

Despite the minimal structures, tools and uncoordinated policies, this study established that the majority of the respondents were open to the idea of eResearch, hence, the study concludes that the university libraries have to take a proactive role in institutionalising and supporting eResearch services given the open-mindedness among the researchers to embrace it.

7.3.8 Study Limitations

A number of limitations for this study follow:

i. The study was limited by the lack of empirical literature on holistic approach to eResearch. The researcher, therefore, had to sift through a wide range of literature through the use of themes and sub themes. This made it slightly difficult to integrate empirical studies in the

discussions, as most of the literature was descriptive. However, for an exploratory study this was considered adequate.

ii. Both the model and the actual study appeared limited in specifying what an organisation structure meant in the context of the study, while pursuing the first research question. While the researcher had 'organograms' in mind, the concept of organisation structure appeared to have been pursued in an ambiguous way. The responses from the UL painted the image of structures in relation to technologies, spaces, service delivery, and titles. This, however, gave the study a wider perspective of the eResearch support in the libraries with regard to structures, but also pointed out the need for future studies to be keen on the clarity of concepts being pursued.

iii. The theories namely: Purdue University Libraries and eResearch Capability Model that were used to underpin this study were both very valuable in providing key variables for this study (See section 2.3). However, there was a challenge in that both of their sources (Carlson & Garritano, 2010:36; Whakamuri, Whakaaro & Me Aro, 2014:5) were not quite explicit in how the models were applied. For instance, the PUL model indicated 'processes' as a critical enabler when assessing eResearch in an organisation and went ahead to provide results of the process (See section 2.3.1), but the report failed to indicate the actual aspects of the process that were originally investigated. As a result, the researcher had to adopt a research lifecycle to investigate 'processes' in the current study.

iv. The generalisability of the results may be limited to universities with significant ICT infrastructure as that was one of the core criteria used to select the case settings for the current investigation to be explored. This is because eResearch is dependent on using technologies in the research process.

v. The study employed majorly a quantitative approach especially when collecting data from the PhD students and Faculty members. This was necessitated firstly, by the newness of the concept eResearch which required the researcher to be more descriptive of the aspects used in the survey questionnaire in order to enhance understanding; and secondly, the huge target population. The challenge with the approach was that questions could not be further clarified from the researchers, as was the case when the researcher personally interviewed the University Librarians.

7.4 Recommendations

Based on the research findings, the following recommendations are adduced.

7.4.1 Recommendation 1: Libraries' Organisational Structures

This study recommends a review of the university libraries' organisational structures to accommodate not only the traditional library services, but also new services such as data management to better suit the researchers' changing needs. The structure should be versatile to reflect new service deliveries and to accommodate new research needs. This study also found that the librarian's role were not reflective of eResearch support and thus, it is recommended that a review of their tasks should be done so that new roles that would enhance collaborative research engagements with researchers to support the research process should be determined.

7.4.2 Recommendation 2: Positions and Competencies for Coordinating eResearch

University libraries should ensure that they have appropriate, qualified, and adequate staff to support library services and continuous training of these staff should be ensured (Commission for Higher Education, 2012:7). The findings showed limitations in the roles of Reference Librarians that were insufficient to support eResearch. The study recommends that new roles be assigned to not only the Reference Librarians, but also other library staff as eResearch support is extensive and will require the involvement of all library staff. The study further found insufficient skills and competencies among librarians to support eResearch. This study suggests that libraries should identify relevant skills needed to support eResearch and to invest on staff development programs. Library staff should also be encouraged to take up on free online training and webinars and to attend workshops and conferences that address eResearch in order to keep them abreast of the constant changes in the research environment. There is need to expand the librarians' capabilities into blended librarianship in order to enhance their ability to support both conventional and modern library services. This should include both soft and hard skills.

7.4.3 Recommendation 3: Research Data Management

The study found that researchers had not been supported across the stages of the data lifecycle and that the university libraries did not have strategies to support RDM. RDM is complex and hence, researchers cannot be able to manage it solely (Strasser, 2015:6). Consequently, the study recommends that the libraries should assist researchers to create DMPs in order to determine

metadata and data formats earlier in the data lifecycle. Libraries should also train library staff on data management skills in order to empower them to support data processing and analysis as well as also engage the research office to support these stages. While the study established that the libraries had set up repositories, data was not being preserved; and, therefore, this study recommends that the libraries should set up OA data repositories to enhance preservation, access, and re-use of research data. Pinfield, Cox and Smith (2014:17) suggested that libraries should approach the various research data elements as a single RDM agenda to enable coherent management. Therefore, there is a need to institutionalise RDM as a core library service to aid in centralising its activities and enable more researchers to get RDM support.

This study has established several challenges of managing research data not only by researchers, but also by the libraries involved (See section 7.2.5). According to Pinfield, Cox and Smith (2014:2), RDM calls for the generation of appropriate systems, structures, policies, infrastructures and services for the management of data geared towards aiding researchers in the creation, collection, manipulation, analysis, transportation, storage and preservation of datasets. Accordingly, this study proposes that university libraries spearhead the establishment of an extensive strategy that accommodates all these facets.

7.4.4 Recommendation 4: Procedures

This study established a lack of strategies to coordinate support to the entire research process in order to meet eResearch needs (See section 7.2.6). The study proposes for a framework that would explicitly show the various procedures of the research lifecycle within an eResearch context and how libraries can support each of the phases. The study further established minimal internal and external support towards eResearch, thus, recommends an identification of all stakeholders, as well as connecting them to the eResearch support framework.

7.4.5 Recommendation 5: Tools

The study found that there were no policies on tools to be used to facilitate eResearch. The findings echoed Procter, Voss and Asgari-Targhi (2013:1676) that there is a general lack of capacity within higher education institutions to provide ICT and more advanced services in support of eResearch. Considering that eResearch is dependent on a wide range of tools from social media, and tools to advanced systems such as high computing facilities, there is a need for an elaborate eResearch ICT policy to offer support in provision of appropriate tools. For

instance, the libraries will need to work with the Kenyan NREN to support high capacity data storage while internally; the ICT department will be critically assist in helping the libraries to set up infrastructure (See Figure 7.1).

7.4.6 Recommendation 6: Policies

The lack of policies can negatively influence RDM and eResearch effectiveness. Most of the inadequacies towards library support for eResearch in this study have been attributed to a lack of policies. The university libraries should consider putting in place policies to support the procedures in the entire research process. Policies such as RDM policy, research policies, ICT policy, policy for staff development, and preservation policies are among the many policies that need to be promulgated by the libraries. In addition, this study suggests that university libraries harmonises and integrates all policies ideally with the research process in mind. This will be in a bid to avoid having scattered policies addressing different aspects of eResearch.

7.4.7 Recommendation 7: Perceptions and Attitudes

This study sought to investigate the researchers' and librarians perceptions towards eResearch. Findings revealed that the majority had no misgivings with regard to sharing their research product, particularly the finished product through the university's repositories. However, there was a major uncertainty when it came to the aspect of data as it was revealed that the majority of respondents could not indicate if they were willing to share. For effective eResearch, all stakeholders need to understand the eResearch concept properly and more importantly, the increasing relevance for data management. The researcher recommends that deliberate marketing and advocacy should be spearheaded by the university libraries. There is a need to ensure that the relevance of eResearch is known to all the librarians.

7.4.8 Recommendation 8: Training

This study revealed a general lack of understanding about eResearch despite some of its aspects such as supporting e-resources access and developing IRs having been fairly established in the libraries. There should be capacity building programs to create awareness and skills on eResearch and data management among librarians including University Librarians and researchers. The lack of awareness and skills made it difficult for respondents to indicate the extent of eResearch support that was available at the universities. The study also established

minimal awareness among the Reference Librarians; this could affect eResearch support, as they are required to aid researchers. The study recommends a focused training program for librarians that should involve soft and hard skills relevant to eResearch that can be conducted through both formal and informal approaches (See section 7.2.3). Furthermore, researchers will also require training. Frank and Pharo (2016) suggested data information literacy. This can involve integrating data literacy in the information literacy programs available at the universities.

7.4.9 Recommendation 9: Top Management Support

Top management support will be crucial in the effective implementation of an eResearch environment. To enhance continuity and sustainability of eResearch in the universities, the support from the top management will be vital in areas such as infrastructure development, skills enhancement, effective implementation of eResearch policies, change management, for instance in organisational culture, provision of adequate funding, linkages with external partners such as KENET among others.

7.4.10 Recommendation 10: eResearch Framework

Based on the above recommendations, this study proposes an eResearch framework. The proposed framework (See Figure 7.1) illustrates the need for University Librarians and other library staff to be made aware of the eResearch concept and practices to enable UL to coordinate eResearch endeavours, and library staff to collaboratively work with researchers. The University Librarians have been proposed to act as intermediaries to connect the library to external stakeholders such as the CUE to support national frameworks; KENET to support high level e-infrastructures, KLISC to facilitate training of academic librarians; and information schools to propose curriculum changes that will enhance librarians to be trained of eResearch. Furthermore, University Librarians have a responsibility to re-organise library organisational structures, which had been found to be too stringent for eResearch support. In this case, there will be a need to organise the staff members into teams so as to support every phase of the research process. This will also require a change in their job roles as well as continuous training to enhance their knowledge and skills for eResearch support. As a result, the librarians will be able to work closely with researchers across the research phases to better enhance technology use in research. Furthermore, there will be a need for the librarians to continuously advocate and train researchers on eResearch practices.

University Librarians will also need to coordinate with other internal stakeholders such as the university top management as there will be a need for approval of an integrated eResearch policy and funding where necessary; ICT to ensure sufficient technological infrastructures to support internal stakeholders (researchers, librarians, research department and the university management); and research departments to support the processes in the data lifecycle during data management phase.

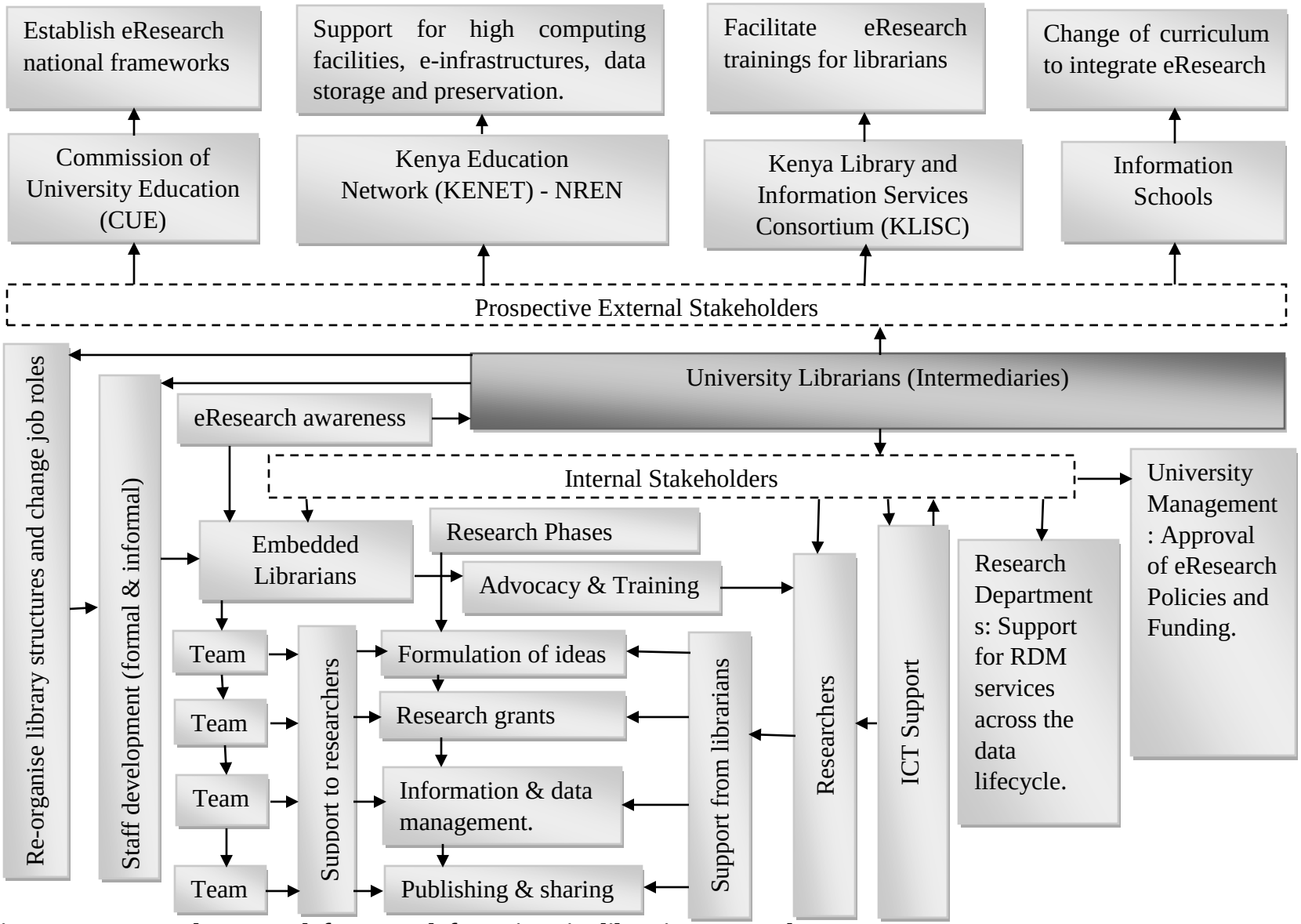

Figure 7.1 Proposed eResearch framework for university libraries surveyed

7.5 Contributions and Originality of the Study

This study investigated eResearch support in private universities in Kenya. The study has contributed to literature by addressing eResearch practices in Kenyan universities and contributing evidence of the eResearch status in the areas of policy framework, human resourcing, and infrastructure development. In addition, the study established that research into the role of university libraries in research data management was still in the early stages of development within the African context. This study has, therefore, contributed literature into this area.

This study also contributes to the body of knowledge by demonstrating that the success of eResearch will require a collaborative approach involving varied stakeholders such as researchers, ICT and research department working closely with the librarians. Thus, a team approach has been found to be more pertinent; and neither University libraries nor researchers can work independently.

The study contributes to practice by revealing the actual state of eResearch in Kenyan private universities. The study found that eResearch was a freshly novel idea within these contexts, thus, familiarity with some eResearch and data management practices could not be well understood. Through the reviewed literature, this research has contributed to highlighting the core aspects to be considered such as competencies, policies, processes, and tools among others in order to have eResearch in universities effectively. This knowledge may be relevant to libraries looking at supporting eResearch in universities. Furthermore, the study found that eResearch is barely institutionalised in the universities; hence recommendations for formulation of policies, strategies and training, as well as advocacy about eResearch.

The CUE requires that university libraries in Kenya should establish infrastructures for data, information, and knowledge management (See section 1.1.4). Through this study which approached the support of eResearch through the lenses of the research process and data lifecycle, a framework has been suggested (See Figure 7.1) that if put in practice by university libraries, the CUE requirements will be accommodated within the eResearch umbrella.

For policies, the findings in this study have the potential to influence the formulation of eResearch policies in private university libraries in Kenya. The current study found that policies

addressing eResearch were scarce and as a result, libraries were not effectively supporting it. The findings may also be useful in establishing national policies and frameworks for supporting eResearch.

In terms of methodology, the study employed a mixed method approach to explore the extent of eResearch in the universities surveyed. Both the qualitative approach employing semi-structured interviews and the quantitative approach employing survey questionnaires were used. The use of both approaches contributed to an in-depth research as it enabled the researcher to detect the weakness of either approach and to use findings from the qualitative approach to compliment the quantitative approach.

Theoretical model: This study builds on the theoretical models used by proposing an eResearch framework that encompasses a holistic approach towards eResearch support to the research life cycle based on the variables from the two selected models: PUL and eRCM.

Originality: Several studies in eResearch have addressed its aspects such as role of libraries in IR management, e-resource usage, and scholarly communications among others, but there was generally limited literature specific to eResearch, especially in the African context. This study is unique because it has attempted to take a holistic approach to studying eResearch by investigating the support provided to the entire research lifecycle from idea formulation to publishing and sharing of the results. This study is, therefore, built on the existing research from a developing country perspective by looking at other roles the library can play in eResearch besides supporting RDM, which appeared distinct in preliminary studies (See section 1.7). The study establishes, therefore, that eResearch needs to be approached holistically compared to the ad hoc approaches that came out in the findings. Furthermore, the eResearch framework that has been established (See Figure 7.1) could guide university libraries in the holistic approach to providing eResearch support.

7.6 Suggestions for Future Research

This section recommends some potentially useful future research that can address some of the limitations of this study.

The present study investigated the role of university libraries in eResearch support, but was limited to six private universities in Nairobi County, Kenya out of the 18 private universities in

Kenya (See Table 1.1). Furthermore, a possible 70 universities are in the country (CUE, 2017a). A similar study could be conducted to establish the role of public universities in eResearch support in Kenya as well as universities in other Counties in Kenya to determine the levels of eResearch support.

A survey of university library organograms to establish considerations made for eResearch support could be conducted to establish their readiness to implement and manage RDM.

Future research could be conducted on structures and competencies for eResearch in Universities that have successfully implemented eResearch. This will further reveal the actual competencies that advance eResearch support by librarians.

The scope of the current study was general. Additional studies can be conducted to explore any possible associations between gender, age, qualifications, and eResearch adoption within university settings. Furthermore, it may be valuable for further studies to investigate if some single disciplines are more receptive to eResearch than others particularly with regard to data sharing and re-use, as the current study was general with regard to the respondents' disciplines.

Given that eResearch is complex and would require active participation of internal and external support, the role of the top management becomes indispensable. Whilst this study recognized that university management will be involved in the implementation as highlighted in figure 7.1, the coverage of their role was minimal. Consequently, it is suggested that further studies be carried out to establish the attitude and perceptions of the senior university management towards the role of libraries with regards to eResearch. This is given that university libraries will be reliant upon the decision of the top management to establish and implement eResearch services.

7.7 Summary

The aim of this study was to explore eResearch support in private university libraries in Nairobi County, Kenya. Using the variables library organisational structures, staffing competencies and eResearch coordination from the Purdue University Libraries model, as well as RDM, policy, processes, support, tools and collaborations from the eResearch Capability Model, the study investigated researchers and librarians from six private universities. The study established that generally, there were some significant ICT infrastructures at the universities, but there was an overall lack of knowledge about eResearch. As a result, there were no specific strategies and

policies geared towards eResearch; thus, minimal support was provided by the libraries towards this endeavour. The final chapter has highlighted the limitations of the study and has provided recommendations, including an eResearch framework to enhance creation of appropriate policies and strategies for eResearch. Despite its exploratory nature, this study offers some insight into eResearch and the status of the eResearch environment at the universities studied, and the aspects that libraries can work with in order to provide eResearch support.

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APPENDICES

Appendix 1: Survey questionnaire for Liaison, Reference and/or Research Librarians

I kindly request you to participate in this survey whose aim is to establish the role of private university libraries in Kenya in support of eResearch. eResearch refers to the use of information and computational technologies to enhance all phases of research process. This survey is part of PhD study being undertaken by the researcher at the University of KwaZulu-Natal, South Africa. The survey will take approximately 20 minutes to complete. Your input will help to inform the development of eResearch support services in academic libraries in Kenya.

Your responses will be kept strictly confidential and data from this research will be anonymously reported in the PhD thesis.

Thank you very much for your time and support.

Ms. Everlyn M. Anduvare,
PhD student, University of KwaZulu-Natal
Email: 217076206@stu.ukzn.ac.za

Section One: Biographical Information

1 a) Name of your university.....

b) Department.....

2. Gender: Male [ ] Female [ ]

3. a) Please indicate your current position at the university library: .....

b) Please indicate the duration worked in the current post..... Years..... Months

c) What does your job entail? .....

.....

4. What is your highest academic qualifications?

Diploma [ ] Bachelor's [ ] Master's [ ] PhD [ ] other (specify).....

5. Age category: 20-30 [ ] 31-40 [ ] 41-50 [ ] Above 50 [ ]

Section Two: Research Data Management

Definition: *Research data management concerns the creation, organisation, storage and publication of* ***research data*** *to enhance its sharing, accessibility and re-use.*

6. The library staff works closely with researchers in the following areas of the research data cycle (select those that apply)

Creation of their data	[ ]	Processing their data	[ ]
Analysing their data	[ ]	Preserving their data	[ ]
Giving access to their data	[ ]	Promotion of their data to be re-used	[ ]

7. Which of the following research data services are provided by your library? (select those that apply)

a. Creation and management of institutional data repositories [ ]
b. Providing tools for data mining and visualization [ ]
c. Training researchers on data management activities [ ]
d. Guidance on institutional policies [ ]
e. Helping with creating data management plans [ ]
f. Helping with creation of metadata for data sets [ ]
g. Assistance with intellectual property and privacy issues surrounding research data [ ]
h. Digital archiving [ ]
Others (please specify).....

Section Three: Skills and Competencies

8. I have knowledge and skills in the following areas related to eResearch: (select those that apply)

Data curation	[ ]	Technical skills in data management	[ ]
Research methodologies	[ ]	Research lifecycle	[ ]
Data description and documentation	[ ]	Institutional repositories management	[ ]
Open access initiatives	[ ]	Legal and copyright frameworks	[ ]

Others (please specify).....

Section Four: Policies

9. Which of the following policies do you have in place to support eResearch? (select those that apply)

Research policy	[ ]	RDM policy	[ ]
ICT policy	[ ]	Staff development policy	[ ]
Open access policy	[ ]	E-strategy	[ ]
Referencing styles policies	[ ]	Preservation policies	[ ]

Others (please specify).....

Section Five: Research Process

The following are ways through which the library can apply technology to support researchers in the research process. Please tick those that apply in your university library:

10. Formulation of ideas and research questions:

a. The library provides up-to-date citation databases [ ]

b. The library provides access to a wide range of e-resources [ ]

c. The library provides easy access to the institutional repositories [ ]

d. The library has online research consultancy services for researchers [ ]

11. Research grant:

a. The library assists researchers with publication citation analysis and other metrics to support grant proposals [ ]

b. The library provides advisory on research funding opportunities [ ]

12. Managing information and data

a. The library has guides for citation styles [ ]

b. The library has guides on research data management [ ]

c. The library has online modules on research data management [ ]

13. Publishing and sharing

a. The library has provided advocacy and awareness on open access publishing [ ]

b. The library does provide guides on online publishing options [ ]

c. The library provides advisory on appropriate e-journals to publish with [ ]

d. The library provides to researchers online alerts for call for papers [ ]

e. Researchers are made aware of copyright issues related to publishing [ ]

Section Six: Support

14. The library offers appropriate training on: (select those that apply)

a. Search strategies to enhance online resource discovery [ ]

b. Research metrics and impact [ ]

c. Selection of reference management tools [ ]

d. Research data management [ ]

e. Statistical data analysis tools [ ]

f. Proper referencing [ ]

g. Open access and institutional repositories [ ]

Section Seven: Tools

15. Please indicate online tools that the library has provided to enable researchers to find collaborators?

.....

.....

16. Which of the following tools have you recommended to the researchers to keep them up-to-date with new research?

Alerts [ ] Table of Content alerts [ ] RSS feeds [ ] Conference alerts [ ]

Others (specify).....

17. Does the library provide statistical tools for data analysis?

No [ ] Yes [ ]

If yes, Please list the tools.....

18. The library assists researchers to create profiles using the following tools (select those that apply)

Google scholar	[ ]	ResearcherID	[ ]	Scopus Author Identity	[ ]
ORCID	[ ]	Research Gate	[ ]	Academia.edu	[ ]
Mendeley	[ ]	SSRN	[ ]	other (specify).....	

Section Eight: Perceptions

19. What are your views about researchers adopting technologies in every phase of their research process? .....

.....

20. What is your view about managing research data? .....

.....

21. What in your opinion should your library should do in order to support researchers in the integration of technologies in their research process?.....

.....

22. To what extent should librarians need to work closely with researchers from the time they select their topics to the publishing stage? .....

.....

Section Nine: Research Data Management Challenges

23. What challenges do you face when providing research data management services? .....

.....

Appendix 2: Survey Questionnaire for Institutional Repository Managers and/or Systems Librarians

I kindly request you to participate in this survey whose aim is to establish the role of private university libraries in Kenya in support of eResearch. eResearch refers to the use of information and computational technologies to enhance all phases of research process. This survey is part of PhD study being undertaken by the researcher at the University of KwaZulu-Natal, South Africa. This survey will take approximately 20 minutes to complete. Your input will help to inform the development of eResearch support services in academic libraries in Kenya.

Your responses will be kept strictly confidential and data from this research will be anonymously reported in the PhD thesis.

Thank you very much for your time and support.

Ms. Everlyn M. Anduvare,
PhD student, University of KwaZulu-Natal
Email: 217076206@stu.ukzn.ac.za

Section One: Biographical Information

1. a) Name of your university……
   b) Department ……..**.....**
2. Gender: Male [ ] Female [ ]
3. a) Please indicate your current position at the university library:
   Institutional Repository Manager [ ] Systems Librarian [ ]
   b) What does your job entail? ……...
   ……...
4. Highest academic qualifications

Bachelor's [ ] Master's [ ] PhD [ ] other (please specify)**.....**

5. Age category: 20-30 [ ] 31-40 [ ] 41-50 [ ] Above 50 [ ]

Section Two: Research Data Management

Definition: *Research data management (RDM) concerns the creation, organisation, storage and publication of* ***data*** *to enhance its sharing, accessibility and re-use.*

6. What measures have you put up to enable researchers to self-archive their research in the repositories?

……

……

7. How is research data currently stored, shared and managed?

……

8. In what ways does the library ensure long term preservation of data and information?

……

……

9. How does the library assist researchers to create metadata for datasets to enhance re-use?

……

Section Three: Institutional Repository

10. How does the library ensure a centralised, persistent, and reliable storage for scholarly output?.....

……..

11. What measures does the library have in place to ensure data security for the repositories?.....

……..

12. Please list the type of digital materials that are published in the IR?

……

13. What category of institutional repository does the university have in place?

a. Open access (publicly available) [ ]

b. Institution access (Available to users within the university) [ ]

c. No open access (archived but not available at all) [ ]

14. To what extent does the library use the institutional repositories to store and preserve research data?.....

15. Which of the following persistent identifiers do you use in the research repositories?

DOI [ ] Handles [ ]

Others (please specify)……...

Section Four: Policies

16. What policies does your university have to support eResearch?

……

17. What strategy does the university have to ensure long term preservation of data and information in the repositories?**.....**

……

Section Five: Tools

18. What data storage tools does the library have for the researchers?

……..

19. Which software is the library using to manage digital works?

……..

Section Six: RDM challenges

20. What challenges does the library experience while managing data?

……

……

Appendix 3: Survey Questionnaire for PhD Students and Faculty

I kindly request you to participate in this survey whose aim is to establish the role of private university libraries in Kenya in support of eResearch. eResearch refers to the use of information and computational technologies to enhance all phases of the research process. This survey is part of a PhD study being undertaken by the researcher at the University of KwaZulu-Natal, South Africa. The survey will take approximately 20 minutes to complete. Your input will help to inform the development of eResearch support services in academic libraries in Kenya.

Your responses will be kept strictly confidential and data from this research will be anonymously reported in the PhD thesis.

Thank you very much for your time and support.

Ms. Everlyn M. Anduvare,
PhD student, University of KwaZulu-Natal
Email: 217076206@stu.ukzn.ac.za

Section One: Biographical Information

1. a) Name of your university.....
   b) Department.....
   c) If Faculty, please indicate the duration worked in the current post ..... Years ..... Months
   d) If doctorate student, include your year of study .....
2. Gender: Male [ ] Female [ ]
3. a) Please indicate your current academic rank at the university:

Doctorate student	[ ]	Tutorial Fellow	[ ]	Assistant lecturer	[ ]
Lecturer	[ ]	Senior lecturer	[ ]	Associate Professor	[ ]
Professor	[ ]				

   b) If Faculty, what does your job entail? .....
4. Highest academic qualifications

Bachelor's [ ] Master's [ ] PhD [ ] Other (specify).....

5. Age category: 20-30 [ ] 31-40 [ ] 41-50 [ ] Above 50 [ ]

Section Two: Research Data Management

Definitions: *Research Data is data that is collected, observed, or created, for purposes of analysis to produce original research results while Research Data Management concerns the creation, organisation, storage and publication of* ***research data*** *to enhance its sharing, accessibility and re-use.*

6. The following indicates procedures in the research data cycle. Please select only the areas within which the library has assisted you, or has provided you with advisory services (select those that apply using a tick - √)

a. The library has assisted me in data creation in the following ways:

Planning data formats [ ] Planning consent for data sharing [ ] Locating existing data [ ]
Collecting data [ ] Data capturing [ ]

b. The library has assisted me in data processing in these aspects:

Data entry [ ] Data translation [ ] Data transcription [ ]
Data validation [ ] Data cleaning [ ] Data anonymity [ ]
Data description [ ]

c. The library has assisted me in data analysis in these aspects:

Data interpretation [ ] Production of research output [ ]
Author publications [ ] Preparation of data for preservation [ ]

d. The library has assisted me in preservation of data in:

Migrating data to appropriate formats [ ] Migrating data to suitable medium [ ]
Data back-up and storage [ ] Meta-data creation [ ] Data archiving [ ]

e. The library has assisted me in enhancing access to data through:

Data sharing [ ] Data control [ ] Copyright establishment [ ]
Data promotion [ ]

f. The library has aided the re-use of my data through:

Follow-up research [ ] New research [ ]
Undertaking research reviews [ ]

7. Have you ever created a data management plan (a document that provides details on how your data will be stored, accessed, secured, shared, re-used) for your research?

Yes [ ] No [ ]

8. Have you ever created any meta-data (descriptors such as author, subject etc) in your research process?

Yes [ ] No [ ]

9. Where do you normally store your research data? (Select those that apply)

Library server [ ] PC hard drive [ ] USB stick [ ] Portable hard drive [ ]

My laptop [ ] Cloud storage [ ] External servers [ ]

Other (specify)……...

Section Three: Institutional repository (IR)

10. I am able to self-archive my research output in the IR

Agree [ ] Disagree [ ] Need more information [ ]

11. Do you find it helpful to publish your work in the university institutional repository?

Yes [ ] No [ ] Never deposited [ ]

12. I would be interested in depositing my materials in a university repository if I was: (select those that apply)

a. Given more information about the benefits of a repository [ ]

b. Given more information about copyright and plagiarism [ ]

c. Provided with training in the submission procedures [ ]

d. Given more information about how a repository could assist me with my scholarly communication endeavours [ ]

e. Provided with assistance with submitting my material into the repository [ ]

f. Given assistance in clearing up copyright issues with my work [ ]

g. Assured of prompt upload of my work in the repository by the library [ ]

Section Four: Research Process

13. The following statements indicate ways through which the library can offer support to researchers in the adoption of technologies throughout the research process. Please select the most appropriate answer between 'Agree, 'Disagree' and 'Not aware' by ticking (√)

	Statements	Agree	Disagree	Not aware
	Formulation of research ideas and questions:			
a	The library provides up-to-date citation databases			
b	The library subscribes to a wide range of e-resources			
c	The library provides easy access to the institutional repositories			
d	The library provides assistance in finding research collaborators			
e	The library has online research consultancy services			
	Research grant:			
f	The library assists in analysing the impact of my research			
g	The library assists with publication citation analysis and other metrics to support grant proposals			
h	The library provides advisory on research funding opportunities			
	Managing information and data			
i	The library has guides for citation styles			
j	The library has guides on research data management			
k	The library has online modules on research data management			
	Publishing and sharing			
l	I am aware of open access as a publishing option			
m	The library does provide guides on online publishing options			
n	The library provides advisory on appropriate e-journals to publish with			
o	I do get online alerts on call for papers from the library			
p	The library provides advise on copyright issues related to publishing			

Section Five: Support

14. The library provides training on the following: (select those that apply using a tick - √)

a. Search strategies to enhance online resource discovery [ ]

b. Research metrics and impact [ ]

c. Selection of reference management tools [ ]

d. Research data management [ ]

e. Statistical data analysis tools [ ]

f. Proper referencing [ ]

g. Legal and compliance obligations [ ]

Section Six: Tools

15. Please select 'Agree' Disagree' or 'I don't know' for each of the statement below related to eResearch tools (use a tick - √)

No.	Statement	Agree	Disagree	I don't know
a	The library has online tools that enable researchers to find collaborators			
b	The library provides tools for online collaborations among researchers			
c	The library provides statistical tools for data analysis			
d	I have access to ready to use Data Management Plans			

16. I have access to the following tools that keep me updated on new research (select those that apply)

Alerts [ ] Table of Content alerts [ ] RSS feeds [ ] Conference alerts [ ]

17. I have created online profiles using the following tools that can help maximise my research impact (select those that apply)

Google scholar [ ] ResearcherID [ ] Scopus Author Identity [ ]

ORCID [ ] Research Gate [ ] Academia.edu [ ]

Mendeley [ ] SSRN [ ] other (specify).....

18. I have used the following tools to measure my research impact (select those that apply)

Citation counts [ ] Journal impact factors [ ] H-index [ ]

Altmetrics [ ] Author identity [ ] Social networks [ ]

Other (specify) …….

19. Where are you currently storing your digital files?

Personal computer [ ] University server [ ] Library [ ]

External servers [ ] other (specify).....

Section Seven: Collaborations

20. In what ways does the library facilitate collaborations amongst:

a. Internal researchers at your institution

.....

.....

b. Internal researchers at your institution with external researchers

.....

.....

Section Eight: Perceptions

21. I am willing to freely share my research output? Yes [ ] No [ ]

Explain your answer.....

22. Would you use a centralised university repository managed by your university library to deposit your digital materials? Yes [ ] No [ ] Need more information [ ]

23. Do you support the use of technology in every phase of a research process?

.....

.....

24. What in your opinion is the importance of managing research data?

.....

.....

Section Nine: Research data management challenges

25. I face the following challenges while managing data (select those that apply)

a. Privacy and confidentiality issues associated with research data [ ]

b. Creating metadata [ ]

c. Locating datasets [ ]

d. Storage of data [ ]

Others (please specify).....

……

Appendix 4: Interview Schedule for University Librarians

Introduction: I kindly request you to participate in this survey whose aim is to establish the role of private university libraries in Kenya in supporting eResearch. eResearch refers to the use of information and computational technologies to enhance all phases of the research process. This survey is part of a PhD study being undertaken by the researcher at the University of KwaZulu-Natal, South Africa. The interview will take approximately 30 minutes to complete. Your input will help to inform the development of eResearch support services in academic libraries in Kenya.

Section One: Biographical Information

1. a) Name of university.....
   b) Designation & what the job entails.....
   c) Duration worked in the current post.....
2. Gender: Male [ ] Female[ ]
3. Highest academic qualifications

Bachelor's [ ] Master's [ ] PhD [ ] Other (specify).....

4. Age category: 20-30 [ ] 31-40 [ ] 41-50 [ ] Above 50 [ ]

Section Two: Organisation Structure

5. How does the current library organisation structure support eResearch?
6. Who is responsible for eResearch management in the library or university?

Section Three: Research Data Management

7. To what extent is the library involved in research data management (curation, analysis, and provenance)?
8. How does the library provide services to support researchers in the management of data throughout its life cycle?
9. How does the library handle copyright issues related to electronic data and information management?
10. How does the library ensure long-term preservation of digital scholarly work?
11. Please comment on the status of your institutional repository and how it supports eResearch?

Section Four: Staffing Competencies

12. Which specific positions do you have in the organisational structure that aims at supporting eResearch?

13. What skills and competencies do the library staffs have to support RDM services?

14. What internal capacity building programmes and strategies are available to develop skills for providing eResearch services?

15. What external opportunities for developing staff to manage eResearch have been availed?

Section Five: Policies

16. Does your library vision and mission encompass support for eResearch?

17. What policy framework is available to support eResearch?

18. How does the library's strategic plan address eResearch support?

Section Six: Support

19. What model of research support does the library provide (centralised or decentralised?)

20. What is the scope of support that the library provides for eResearch?

21. To what extent do library staffs collaborate with researchers to enhance eResearch?

22. What support do researchers get on issues relating to responsible conduct of research and research ethics?

23. What in your view is the level of support that the university provides for eResearch?

Does the library have a budget allocation to support eResearch?

24. What national or international frameworks are available to your university to support eResearch?

Section Seven: Tools

25. What tools if any has the library created for use in data management?

26. What technological infrastructure is available to the library to enhance eResearch?

27. What external high performance computing technologies are available to your library for data management?

28. Which platforms if any are in place to enhance online collaborations among researchers both within and outside the university?

Section Eight: Perceptions

29. What in your view is the attitude of Faculty and doctorate students towards eResearch?

30. What do you think the Faculty and doctorate student prefer to use between print and electronic resources?

Section Nine: RDM challenges

31. Please outline any research data management challenges and barriers that the library faces?

Thank you very much for your time and support.

Appendix 5: Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

22 January 2018

Ms Everlyn M'mbone Anduvare 217076206
School of Social Sciences
Pietermaritzburg Campus

Dear Ms Anduvare

Protocol reference number: HSS/2168/017D
Project Title: E- research support: an exploratory study of private university libraries in Nairobi Country, Kenya

Full Approval – Expedited Application

In response to your application received 8 November 2017, the Humanities & Social Sciences Research Ethics Committee has considered the above mentioned application and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

Professor Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

cc Supervisor: Professor S Matula
cc. Academic Leader Research: Professor Maneshvari Naidu
cc. School Administrator: Ms Nancy Mudau

Humanities & Social Sciences Research Ethics Committee
Professor Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 Facsimile: +27 (0) 31 260 4609 Email: [illegible] / [illegible] / [illegible]
Website: [illegible]

Appendix 6: Informed Consent Letter

DECLARATION OF CONSENT

PROJECT TITLE:

eResearch support: an exploratory study of private university libraries in Nairobi County, Kenya.

RESEARCHER

Full Name: Everlyn M'mbone Anduvare

School: Social Sciences

College: Humanities

Campus: Pietermaritzburg

Proposed Qualification: PhD Information Studies

Contact: + (254) 709-691111

Email: 217076206@stu.ukzn.ac.za

SUPERVISOR

Full Name of Supervisor: Prof. Stephen Mutula

School: Social Sciences

College: Humanities

Campus: Pietermaritzburg

Contact details: 033 2605571

Email: mutulas@ukzn.ac.za

HSSREC RESEARCH OFFICE

Full Name: Prem Mohun

HSS Research Office

Govan Bheki Building

Westville Campus

Contact: 0312604557

Email: mohunp@ukzn.ac.za

I, Everlyn M'mbone Anduvare, Student no. 217076206, is a PhD student, at the School of Social Sciences, at the University of KwaZulu-Natal. You are invited to participate in a research project entitled: eResearch support: an exploratory study of private university libraries in Nairobi County, Kenya. Through your participation, I hope to understand your perceptions on the extent of eResearch support provided to researchers by your university library. I guarantee that your responses will not be identified with you personally. Your participation is voluntary and there is no penalty if you do not participate in the study. Please sign on the dotted line to show that you have read and understood the contents of this letter. The questionnaire will take approximate 20 minutes to complete.

Declaration of Consent

I…… (Full Name) hereby confirm that I have read and understand the contents of this letter and the nature of the research project has been clearly defined prior to participating in this research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

Participants
Signature……..

Date……..

Appendix 7: Informed Consent Letter for Audio Video Recording

Social Sciences, College of Humanities,

University of KwaZulu-Natal,

Pietermaritzburg Campus.

Dear Participant,

INFORMED CONSENT LETTER

My name is Ms Everlyn M'mbone Anduvare, I am a PhD candidate studying at the University of KwaZulu-Natal, Pietermaritzburg campus, South Africa.

I am interested in conducting an exploratory study on eResearch support in private university libraries in Nairobi County. Your university library is one of my case studies. To gather the information, I am interested in asking you some questions.

Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.
- The interview may last for about 30 minutes and may be split depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalised for taking such an action.
- The research aims at establishing the role of private university libraries in Kenya in supporting eResearch.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	willing	Not willing
Audio equipment		
Photographic equipment		
Video equipment		

I can be contacted at:

Email: 217076206@stu.ukzn.ac.za

Tel: + (254) 709-691111

My supervisor is Professor S Mutula who is located at the School of Social Sciences, Pietermaritzburg campus of the University of KwaZulu-Natal.

Contact details: email: mutulas@ukzn.ac.za Phone number: 033 2605571

You may also contact the Research Office through:

P. Mohun

HSSREC Research Office,

Tel: 031 260 4557 E-mail: mohunp@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I…… (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT DATE

…… ……

Appendix 8: Authority to Carry Out Research from NACOSTI and Nairobi County Commissioner

NATIONAL COMMISSION FORSCIENCE, TECHNOLOGY ANDINNOVATION

Telephone +254-20-2213471,
2241349,3310571,2219420
Fax +254-20-318245,318249
Email: dg@nacosti.go.ke
Website www.nacosti.go.ke
When replying pleasequote

9th Floor, Utalii House
Uhuru Highway
P.O.Box 30623-00100
NAIROBI-KENYA

Ref No. **NACOSTI/P/17/88088/18426** Date **3rd August, 2017**

Everlyn Mmbone Anduvare
University of Kwazulu Natal
SOUTH AFRICA.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"E-Research support: an exploratory study of private university libraries in Nairobi County, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for the period ending **3rd August, 2018.**

You are advised to report to **the Vice Chancellors of selected Universities, the County Commissioner and the County Director of Education, Nairobi County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The Vice Chancellors
Selected Universities.

The County Commissioner
Nairobi County.

COUNTY COMMISSIONER
NAIROBI COUNTY
P. O. Box 30124-00100, NBI
TEL: 341666

Appendix 9: NACOSTI Permit

THIS IS TO CERTIFY THAT:
MS. EVERLYN MMBONE ANDUVARE
of UNIVERSITY OF KWAZULU-NATAL,
13019-400 Nairobi,has been permitted
to conduct research in *Nairobi County*

on the topic: *E-RESEARCH SUPPORT: AN EXPLORATORY STUDY OF PRIVATE UNIVERSITY LIBRARIES IN NAIROBI COUNTY, KENYA.*

for the period ending:
3rd August,2018

Permit No : NACOSTI/P/17/91750/18342
Date Of Issue : 3rd August,2017
Fee Recieved :Ksh 2000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Appendix 10: Authority from the County Director of Education, Nairobi County

Republic of Kenya
MINISTRY OF EDUCATION
STATE DEPARTMENT OF BASIC EDUCATION

Telegrams: "SCHOOLING", Nairobi
Telephone: Nairobi 020 2453699
Email: rcenairobi@gmail.com
cdenairobi4@gmail.com

When replying please quote

REGIONAL COORDINATOR OF EDUCATION
NAIROBI REGION
NYAYO HOUSE
P.O. Box 74629 – 00200
NAIROBI

Ref: RCE/NRB/GEN/1 VOL. I

DATE: 25th January 2018

Everlyn Mmbone Anduvare
University of Kwazulu Natal
SOUTH AFRICA

RE: RESEARCH AUTHORIZATION

We are in receipt of a letter from the National Commission for Science, Technology and Innovation regarding research authorization in Nairobi County on "**E-Research support: an exploratory study of private university libraries in Nairobi Kenya**".

This office has no objection and authority is hereby granted for a period ending **3rd August, 2018** as indicated in the request letter.

Kindly inform the Sub County Director of Education of the Sub County you intend to visit.

COUNTY DIRECTOR OF EDUCATION NAIROBI 25 JAN 2018 MINISTRY OF EDUCATION P.O. Box 74629 NAIROBI

JAMES KIMOTHO
FOR: REGIONAL COORDINATOR OF EDUCATION
NAIROBI

C.C

Director General/CEO
Nation Commission for Science, Technology and Innovation
NAIROBI

Appendix 11: Permission to Undertake a Pilot Study at Tangaza University College

TANGAZA UNIVERSITY COLLEGE

The Catholic University of Eastern Africa

DIRECTORATE OF POSTGRADUATE STUDIES & RESEARCH

E-mail: dir.pgsr@tangaza.ac.ke **Website:** www.tangaza.ac.ke

OUR Ref: DPGSR/ERC/No.001/01/2018 **Date:** 25th January 2018

Everlyn M'mbone Anduvare
University of Kwazulu Natal
SOUTH AFRICA

Dear Anduvare,

RE: Research Ethics Approval

Reference is made to your request dated *8th January 2018* for ethical approval to conduct a pilot study towards your PhD thesis title: *E-research support: an exploratory study of private university libraries in Nairobi County, Kenya*.

We are pleased to inform you that the Tangaza University College Ethics Review Committee has gone through the proposed tools and the research proposal and has approved your request as per the stated letter of application. In line with Tangaza University College Research policy, you will be required to submit a copy of the final research findings to the Committee for records.

This approval is valid up to **3rd August 2018** as also stated in the NACOSTI and Nairobi County Education Office authorization letters.

Kindly inform the Chief Librarian, Tangaza University College when you intend to commence this pilot study for appropriate guidance.

Yours sincerely,

TANGAZA COLLEGE
The Catholic University of Eastern Africa
P.O. Box 15055 - 00509 NAIROBI KENYA
Tel: 020 6067007 Fax: 6690016
E-mail: inquiries@tangaza.org

Dr. Daniel M. Kitonga (Ph.D)
Director, Postgraduate Studies & Research

CC:
Chief Librarian Tangaza University College

Appendix 12: Request and Permission to Undertake Research at the Catholic University of Eastern Africa

Everlyn M'mbone Andavare.
P.O. Box 13019 Nairobi,
00400.
Aug 10, 2017

The Director, Research,
Catholic University of Eastern Africa.
P.O. Box 62157-00200,
Nairobi, Kenya.

Dear Sir,

Re: Request for permission to conduct research at the Catholic University of Eastern Africa (CUEA)

I am a PhD student currently enrolled at the School of Social Sciences, University of KwaZulu-Natal in South Africa. I am currently affiliated to the Catholic University of Eastern Africa, Nairobi. I am conducting a PhD study on: *E-research support: an exploratory study of private university libraries in Nairobi County, Kenya.* This is a multi-case study and the CUEA is one of the selected cases. The aim of this study is to investigate e-research support in private university libraries in Kenya. Recommendations will be provided on how e-research can be enhanced in private universities in Kenya to promote quality and timely research output.

Data will be collected using interviews and questionnaires from respondents that will include: the faculty, doctorate students, university librarians, reference and research librarians and institutional repository managers.

Please find attached copies of the research permit issued by the National Commission for Science, Technology and Innovation; the research proposal; and data collection instruments.

I am kindly seeking authorisation to conduct research in your institution. The results will be made available to your University once the PhD is completed.

Yours Sincerely,

Everlyn M'mbone Andavare
+254733758162
217076206@stu.ukzn.ac.za

Allowed to collect Data within the University between August 2017 and August 2018

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA
DIRECTORATE OF RESEARCH, INNOVATION & GRADUATE TRAINING (DRIGT)
01 SEP 2017
P.O. Box 62157 - 00200, NAIROBI

Appendix 13: Request and Permission to Undertake Research at the Daystar University

DVC – AA

I have reviewed the proposal and the attached data collection tools. In my opinion there is no very classified information. I propose that we approve the request.

Michael Bowen

Director, Research

21/2/18

Everlyn M'mbone Anduvare,
P.O. Box 13019 Nairobi,
00400.

Jan 10, 2018.

The Vice Chancellor,
Daystar University,
P.O. Box 44400-00100,
Nairobi, Kenya.

Approved 28/2/18

Through The Deputy Vice Chancellor, Academics Affairs,

Dear Sir,

Re: Request for permission to conduct research at the Daystar University

I am a PhD student currently enrolled at the School of Social Sciences, University of KwaZulu-Natal in South Africa and currently affiliated to the Catholic University of Eastern Africa, Nairobi. I am conducting a PhD study on: *E research support: an exploratory study of private university libraries in Nairobi County, Kenya.* This is a multi-case study and the Daystar University is chosen as one of the cases. The aim of this study is to investigate e-research support in private university libraries in Kenya. Recommendations will be provided on how e-research can be enhanced in private universities in Kenya to promote quality and timely research output.

Data will be collected using interviews and questionnaires from respondents that will include: the faculty, doctorate students, university librarians, reference and research librarians and institutional repository managers.

Please find attached copies of the research permit issued by the National Commission for Science, Technology and Innovation; the research proposal; and data collection instruments.

I am kindly seeking authorisation to conduct research in your institution. The results will be made available to your University once the PhD is completed.

Yours Sincerely,

Everlyn M'mbone Anduvare

+254733758162

217076206@stu.ukzn.ac.za

Appendix 14: Permission to Undertake Research at the United States International University

United States International University-Africa

Everlyn M'mbone Anduvare,
P.O. Box 13019 Nairobi,
00400.
varelynn@yahoo.com

13th October 2017

Dear Ms. Anduvare

Following your request to conduct a research study in USIU-Africa dated 10th August, 2017, on the topic "**E-research support: an exploratory study of private university libraries in Nairobi County, Kenya.**" the University's Research Office has authorized you to pursue your research.

However the university imposes the following conditions on the researcher:

1. No personal information will be asked of the participants.
2. Will share the preliminary report findings with us prior to completion.
3. Will provide a copy of the completed research to us.
4. Under no circumstances will the information obtained from USIU-Africa be re-used or disclosed for other purposes.

This Research Approval will be for a period of 3 months commencing from 5th January, 2018. Please contact research@usiu.ac.ke for more information.

Sincerely,

Prof. Amos Njuguna
Dean, School of Graduate studies Research & Extension
United States International University - Africa
Email: amnjuguna@usiu.ac.ke
Phone: + 254 730 116 442

Appendix 15: Permission to Undertake Research at the Pan Africa University

PAN AFRICA CHRISTIAN UNIVERSITY

P.O. Box 56875 - 00200
Nairobi, Kenya
Lumumba Drive, Roysambu
off Kamiti Rd, off Thika Rd
Tel: 0734 400694/0721 932050
Email: enquiries@pacuniversity.ac.ke
website: www.pacuniversity.ac.ke

19th February, 2018

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: DATA COLLECTION AUTHORIZATION - EVERLYNE ANDUVARE

Greetings. This is to inform you that the Centre for Research, Innovations and Publications at PAC University has authorized Everlyne Anduvare, a PhD student registered at Kwa Zulu Natal University, to collect data on the use e-resources from PhD students and faculty members at PAC University.

This permission was granted upon receipt of her request dated 12th February, 2018 and subsequent to approval from the National Commission for Science, Technology and Innovation (NACOSTI).

Kindly contact Dr. Dionysious Kihika Kiambi, Director of Research, via email on director.research@pacuniversity.ac.ke for further clarification where necessary.

Yours sincerely,

PAN AFRIEA EHRISTIAN UNIVERSITY
P. O. Box 56875, NAIROBI - 00200.
TEL: 8561820/8561945/2013146

Dr. Dionysious Kiambi
Director of Research

Where Leaders are Made

Appendix 16: Permission to Undertake Research at the Africa Nazarene University

AFRICA NAZARENE
UNIVERSITY

5th March, 2018

Ms. Everlyn M'mbone Anduvare
University of Kwazulu-Natal
South Africa

Re: Permission to Collect Data for Research Work

We acknowledge with thanks receipt of your letter requesting us to grant you permission to collect data for your Thesis **"E-research support: an exploratory study of Private University Libraries in Nairobi County, Kenya."** in our institution.

We are pleased to inform you that your request has been granted with effect from today the 5th March, 2018. However, you are requested to submit a copy of your report to the office of the DVC Academic Affairs after you are through with data collection.

With best wishes.

AFRICA NAZARENE UNIVERSITY
05 MAR 2018
DEPUTY VICE CHANCELLOR
ACADEMIC AFFAIRS

Prof. Zablon Nthamburi
REGISTRAR.

Appendix 17: Permission to Undertake Research at the Africa International University

AFRICA INTERNATIONAL UNIVERSITY

Committed to His mission
Connected to His world

8th February, 2017

Ms. Everlyn M'mbone Anduvare
P.O. Box 13019 - 00400
Nairobi

Dear Ms. Anduvare,

RE: PERMISSION TO COLLECT DATA

Following your application for permission to collect data from Africa International University (AIU), I am pleased to inform you that your request has been granted.

On completion of your research, you are expected to submit a copy of the research report/thesis to AIU.

Wishing you success in your studies.

Sincerely,

Prof. Samuel Katia

DVCAA & R

Appendix 18: Departments under Study

	Frequency	Percent
Missing	47	7.6
Communication	25	4.0
Education	69	11.2
Economics	11	1.8
Counselling psychology	16	2.6
Science	14	2.3
Commerce	28	4.5
Theology and biblical studies	3	.5
Developmental studies	14	2.3
Research, publication and consultancy	2	.3
Child development	3	.5
Nursing	1	.2
Media and film	5	.8
Language and performing arts	2	.3
Biblical studies	17	2.8
Law	15	2.4
Computer science	9	1.5
Peace and conflict	1	.2
Social sciences	32	5.2
Clinical psychology	1	.2
Music	1	.2
Intercultural studies	2	.3
Mission	3	.5
ICT	2	.3
Business	53	8.6
Theology	43	7.0
Registry	1	.2
ODeL	2	.3
Psychology	20	3.2
Fundraising, partnership and development	1	.2
Inter-religious studies	1	.2
Student affairs	1	.2
Marketing	2	.3

Philosophy	21	3.4
Social work	2	.3
Post graduate studies	1	.2
School of business	30	4.9
Registry	1	.2
Marketing and management	3	.5
Natural science	2	.3
Finance and accounting	3	.5
English	1	.2
Moral theology	7	1.1
Sacred theology	2	.3
Dogmatic theology	2	.3
Biblical theology	2	.3
Health science	4	.6
Centre for social justice and ethics	2	.3
Journalism	2	.3
Human resource	1	.2
Mathematics	3	.5
Academic affairs- business	3	.5
Academic affairs- science	1	.2
Actuarial science	4	.6
Pharmacy	7	1.1
School of humanities	8	1.3
Criminal justice	1	.2
International relation	10	1.6
School of humanities and social sciences	12	1.9
Research and development	1	.2
Extra project management	1	.2
Chemistry	1	.2
Leadership	14	2.3
Religion	19	3.1
Total	**618**	**100.0**