

**THE ROLE ACADEMIC LIBRARIES COULD PLAY IN DEVELOPING RESEARCH DATA  
MANAGEMENT SERVICES: A CASE OF MAKERERE UNIVERSITY LIBRARY**

Mini-dissertation by

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Submitted in partial fulfilment of the requirements for the degree

**MASTER OF INFORMATION TECHNOLOGY**

In the

**SCHOOL OF INFORMATION TECHNOLOGY**

of the

**FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY**

**UNIVERSITY OF PRETORIA**

October 2017

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**DECLARATION**

I, Joseph Ssebulime, declare that this mini-dissertation is my own work and I explicitly state that it has not been submitted to any other university. Where works of other scholars was used, the researcher acknowledged it in the text and included in the references the reference list.



.....

**Joseph Ssebulime**

06 – November - 2017

.....

**Date**

## **DEDICATION**

To the entire family of Charles Kyeyune and friends.

## **ACKNOWLEDGEMENTS**

In the first place, I thank God for blessing me with the opportunity of participating in the MIT programme.

My sincere appreciation goes to the Department of Information Science, University of Pretoria as well as the Carnegie Corporation of New York for providing me with the opportunity to study under the Carnegie MIT Stream B programme. I also thank all my lecturers and the administrative team for the support and encouragement.

I wish to express my gratitude to all my family members, friends and classmates for being patient and supportive throughout the entire MIT study period.

I want to thank my study leaders; Dr Martie van Deventer and Dr Heila Pienaar for your patience and support.

I wish to thank Makerere University Library management and the Sir Albert Cook Medical Library in particular for the time off duty you accorded me to attend online lectures and travel for the face-to-face lectures.

I especially thank Patrick Sekikome for his support, advice and encouragement.

I want to thank the top researchers at Makerere University who agreed to participate in this study.

## **ABSTRACT**

Research data management (RDM) focuses on the organization and description of data, from its entry to the research cycle through to the dissemination and archiving of valuable results. RDM entails storage, security, preservation, compliance, quality, sharing and jurisdiction. In the academic world, RDM can support the research process by searching for relevant data, storing data, describing data and advising researchers on good RDM practice.

This study focused on developing RDM services. The aim of the study was to establish the role Makerere University Library could play in developing RDM Services. A number of questions were formulated to guide the researcher in finding answers to the research questions.

A literature review, based on the research sub-questions, was carried out. The review covered the concept of RDM, academic libraries and their RDM practices, various RDM services in academic libraries, RDM services that require sustainability and how current researchers, in general, manage their data.

The research undertaken took a qualitative approach with a case study design. This was due to the need to gather in-depth and comprehensive views and experiences regarding RDM at Makerere University. A purposive sampling technique was used to identify researchers who are actively involved in managing research data at Makerere University. Data were collected using semi structured interviews, from eight participants; one from each college. The participants were selected because of their knowledge about RDM and semi-structured interviews were preferred due to their flexibility. An interview schedule was used as the data collection instrument. Data was transcribed into Microsoft Word for easy analysis.

Findings that addressed the research question and sub-questions were presented and interpreted in chapter four and conclusions as well as recommendations were discussed in detail in chapter five of this research report. In summary it is possible to say that although researchers, from across the entire university, generate big volumes of research data it appears that researchers themselves manage, control and store their data making use of different removable devices. This is risky. So there is a need to develop RDM skills for all stakeholders. It does appear though that the researchers at Makerere University would be willing the support of RDM services if these are developed by the library.

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## LIST OF (ACRONYMS)

AHRC	Arts and Humanities Research Council
AIDA	Artificial Intelligence and Data Analytics
CARDIO	Collaborative Assessment of Research Data Infrastructure and Objectives
CEDAT	College of Engineering Design Art and Technology
CHS	College of Health Sciences
COCIS	College of Computing and Information Sciences
COVAB	College of Veterinary Animal and Bio security
DCC	Digital Curation Centre
DMP	Data Management Plan
EPSRC	Engineering and Physical Sciences Research Council
JISC	Joint Information Systems Committee
MRC	Medical Research Council
NFS	National Scientific Foundation
NORAD	Norwegian Agency for Development Cooperation
PhD	Doctor of Philosophy
RDM	Research Data Management
RDS	Research Data Services
RLUK	Research Libraries UK
RUFOUM	The  Regional Universities Forum for Capacity Building in Agriculture
SERAC	Department for Research Cooperation
SIDA	Swedish International Development Cooperation Agency
UK	United Kingdom
UNICEF	United Nations Children's Fund

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## CHAPTER ONE: INTRODUCTION

### 1.1 Overview

Advances in digital technologies have both strengthened the power of and access to data and created new challenges for communities involved in research. Research oriented institutions face several challenges in the process of research data management (RDM). Preservation of vast amounts of data for long term use, consistently describing data, keeping up with evolving data standards, sharing data consistently and effectively while also observing restrictions are some of the challenges that emerge when the organisation is confronted with the huge increase in the amount of data being created (Lawal, 2010:366). Despite these identified pressures, academic libraries are considering ways that they can get involved in solving research data-related challenges facing their institutions (Catherine, Catherine, Jennifer, 2010:37).

This new data-intensive research environment of scientific study has been referred to as the “fourth paradigm” of scientific inquiry (Nielsen, 2009:722). It is prevalent in all fields of study, not only natural sciences. It is vital for researchers in contemporary research environments to have the ability to collect, analyse, share, and effectively manage and preserve data.

Unfortunately, there is a scarcity of services that support researchers in managing their research data for both the short and long term. Tenopir et al. (2011:3) found that one major difficulty in data sharing is the lack of institutional support and guidance to researchers. The absence of formal data management processes, inadequate RDM tools and training, and insufficient funding contribute to the loss and misuse of research data. Heidorn, (2011:663) academic libraries, in union with campus research offices, are instrumental in supporting academic researchers through developing RDM services; similar to what is done for other artefacts, academic libraries can play a role in supporting academic researchers to locate, describe, and preserve data, and to aid the implementation of data management needs. It is believed that academic libraries have the capacity to curate research data to serve the innovation of science and the entire society

Tenopir, Birch, Allard (2012:3) found that research data services are more evident in ‘four-year’ and research universities than in ‘two year’ institutions. Traditional approaches of offering informational and consultative services have been adopted by academic libraries because such services are aligned with existing liaison and reference roles. These include; consulting with faculty, staff, or students on DMP offering reference support for locating and citing data sets.

However, very few offer technical services which involve offering technical support for data repositories, preparing data sets for repositories, deselecting data set from a repository and creating metadata for data sets. Based on responses to a survey conducted by Fearon et al. (2013:26), libraries offering RDM were expected to increase in 2014. In contrast Tenopir, Hughes, Allard (2015:18) noted that their survey of United States and Canadian college and research libraries indicated that the number of libraries providing research data services did not increase. Academic libraries usually face several challenges relating to the development of research data services. Libraries have to plan the kind of research data services to be offered, with whom they will collaborate with to offer the services, and how librarians will acquire the relevant skills to provide a range of services (Kim, 2013:502; JISC, 2016; Flores et al., 2015:88). The ACRL Research Planning and Review Committee identified Research Data Services as number one, followed by Data Policies and Data Management Plans, as well as Professional Development for Librarians providing research data services as the 2016 top trend issues affecting academic libraries in higher education (ACRL, 2017).

The National Science Foundation (NSF) is one of the funding agencies that has new requirements for RDM (National Science Foundation, 2014). A case in point includes the detailed data management plans that are required when applying for research funding. On the other hand some agencies require data deposition (Office of Science and Technology Policy, 2011). Academic libraries could provide infrastructure tools and services as a way of supporting their respective academic researchers. There are therefore genuine reasons for library professionals to explore how academic libraries can perform better in the new data-intensive research atmosphere, as a way to satisfy the needs of researchers. A good number of library organizations, funding institutions and other stakeholders in the library environment have appreciated the importance of providing research data services to academic researchers.

For example DataONE has a mission to ensure that multi-scale, multi-discipline, and multi-national science data are preserved and made accessible. To support this mission, tools, education and training in the area of data management have been provided. Efforts to understand the perceptions, attitudes, and requirements of data intensive science have been established (Data Observation Network for Earth, 2017). In this case, a diverse community of users is supported throughout the entire data life cycle, from data gathering, to management, to analysis and publication.

The need for promoting RDM is broadly spread, and the resource requirements to finish up these tasks are widely discussed (Tenopir et al., 2011:73). This implies that Makerere University Library can ably start up an RDM initiative. The next section provides more on the background to the study.

## **1.2 Background to the study**

Makerere University is the oldest and research leading University in East Africa and has nine colleges and one school which are semi-autonomous. These colleges include; Agriculture and environmental sciences, Business management sciences, Computing and information sciences, Education and external studies, Engineering, Health sciences, Humanities and social sciences, Natural sciences, Veterinary medicine, and a School of law. The University comprises of the main library and college libraries that aim at meeting the study, teaching, and research and outreach information needs for sustainable development. Researchers and students are responsible for generating research data every year (Makerere University, 2017).

Makerere University receives financial support from various funders to conduct different research projects in a variety of the colleges on campus. The source of funding is mainly from SIDA /SAREC of Sweden, Carnegie Corporation of New York, NORAD from Norway, Walter Reed and Irish Aid. These funds allow researchers to address issues such as capacity building for research, institutional development, PhD scholarships and finding a safe and effective HIV vaccine (Makerere University, 2017). Substantial attention in the form of RDM planning and data deposition of research data are yet to be fully actualized at Makerere University.

Research funders and government agencies across the world are increasingly requiring data management planning and data deposition of research data (National Science Foundation, 2014; Office of Science and Technology Policy, 2014; Shearer, 2015; Wellcome Trust, 2010). RDM is becoming an integral part of research activities, and university libraries can play a major leadership role in offering research data services to researchers.

Unfortunately, as science becomes more collaborative, data-intensive, and computational, academic researchers at Makerere University will be faced with a range of data management needs. The combination of these needs with funding directives that require data management planning will influence research activities in the entire university.

Makerere University has a huge collection of research data generated over several years by researchers on behalf of the University. Unfortunately, users have not yet enjoyed the benefits



provided by effective RDM due to the absence of services to plan and sustainably manage research data. Developing RDM services at Makerere University library has always been complicated due to the fact that new technologies are emerging and influencing the way research data are collected, processed, analysed, preserved, accessed and re-used.

Makerere University library is an academic library and suitable for playing a major leadership role in the development of research data services to academic staff and students.

This study therefore sought to create awareness regarding RDM, establish how research data are currently managed and identify those RDM services Makerere University library could sustainably implement to help manage research data at the University. Additionally, it is assumed that other universities may have the same predicament; this research aims to serve as a pilot study for other university libraries in Uganda so that they too could learn to effectively manage the research data generated within their institutions.

To ensure this study is effectively focussed, there was a need to identify and find a central research question. "To find the right question, requires that we understand what we are asking about, and know to keep the question simple enough to be answerable, but challenging enough to be interesting." (Howie, 1991 quoted in Khoo, 2005:25). This implies that, as with any other research project, it is extremely important to be clear on the specification of the research questions (**what** is to be studied) and the research strategy (**how** to conduct the study). The research questions are provided in the next section.

### **1.3 Research questions**

Isaac and Michael (1971) cited in Khoo (2005:25) noted that a question well stated is a question half-answered. This implies that question formulation is more vital than its solution. According to Howie, (1991); Isaac and Michael (1971) a good research question should to be; Important and relevant; interesting to the researcher and others; simple; feasible; clear and succinct; original and set to discover new information.

Khoo (2005:25-26) further explains that when formulating research objectives, it necessary to think ahead and plan the possible and achievable methodology that is required by each research objective to ensure that research is accomplished within the stipulated period. The section below discusses both the main research question and sub questions.

### **1.3.1 Main question**

The main research question that guided the study is:

What Research Data Management (RDM) services could Makerere University Library be developing?

### **1.3.2 Sub questions**

- 1 What is meant by RDM?
- 2 What role could an academic library play in a university's effort to manage its research data?
- 3 What are the different RDM services that could be offered by an academic library such as Makerere University Library?
- 4 Which of these services would require sustainability planning if introduced at Makerere University?
- 5 What are the top researchers currently doing with their data and how would the suggested library services be of use to them and their students?

### **1.4 Value of the study**

This research sought to also create awareness regarding RDM and to identify those services which Makerere University Library could sustainably implement to help manage research data at the University.

The study may:

- Contribute to the body of literature about research data services;
- Reveal areas of development required in terms of RDM Services;
- Contribute to an understanding the role of academic libraries in developing research data services;
- Provide the Makerere University Library with direction when promoting RDM to their researchers;
- Provide direction for other libraries that may have similar concerns as the Makerere University Library as it relates to improving RDM Services.

## **1.5 Scope of the study**

This study focused on identifying the Research Data Services (RDS) that could be developed at Makerere University Library. Ten (10) Makerere University researchers, who have published in the last five years, were purposively sampled.

Development of RDS in academic libraries requires both a top-down and bottom-up approach. Librarians and staff to spearhead and promote this service are indispensable, though top management is also essential in the provision of leadership and resources (Tenopir, 2015:18). This was done only in the context of Makerere University.

## **1.6 Justification of the study**

Out of the thirteen top trends and issues affecting academic libraries in higher education in United States and Canada, the first three position were dominated by

1. Research data services
2. Data policies and data management plans
3. Professional development for librarians providing RDS (ACRL, 2017).

Makerere University is a research oriented institution. Therefore, it is important to create awareness regarding RDM and to identify those services which Makerere University Library could sustainably implement to help manage research data at the University. Additionally, because it is assumed that other universities may have the same predicament, this research aims to serve as a pilot study for other university libraries in Uganda so that they too could effectively manage the research data generated on the behalf of their institutions.

Proper RDM is indispensable for researchers and students because it enables researchers to manage the project outputs as early as is possible. RDM includes activities such as creating data management plans, developing data models, identifying suitable standards, collecting appropriate data and metadata, documenting the data analysis process, sharing data, archiving data and discovering data for re-use.

## **1.7 Overview of literature**

It was established that there was adequate relevant literature to use. This literature overview provides a brief synthesis of what various authors have discussed regarding research data services. This literature overview was structured according to sub questions. Themes and sub

themes were further developed into chapter two of the research. Below is an outline of what is discussed in chapter two of this research.

### **1.7.1 Importance of academic libraries to academic institutions**

To understand the need for RDM and, therefore, its effective development, it is important to first establish the value of academic libraries. Carey, Justh and Williams (2003:4-5) define an academic library as a library entity in a tertiary institution that provides:

- an organized collection of a combination of both printed or other reading materials;
- trained staff to provide and interpret informational materials as required to meet the needs of institutional users.
- an established programme to deliver library services to patrons; and
- the physical facilities necessary to support the noted collection, staff, and programmes

The importance of libraries is discussed in more detail in section 2.1.1 of this report.

### **1.7.2 Concept of RDM**

According to University of BRISTOL (2012) and Whyte & Tedds (2011:1) RDM refers to the various practices that range from the creation of a Data Management Plan (DMP) through the storage, the sorting and cataloguing and finally the dissemination of research data. These activities indicate how research data will be managed during and after the project, which authorized users will have access through sharing as well as making research data openly available for a specified period.

### **1.7.3 Role players required to together develop RDM**

The development of RDM cannot be delegated to an individual or a single unit. According to Whyte & Tedds (2011:5); Jones (2011:2); University of Bath (2012);Erway (2012:7); Whyte and Allard (2014:7) academic institutions are complex and federated environments ,therefore it is necessary to share the roles and responsibilities with various stakeholders such as;

- University management;
- Researchers;
- Funders;
- The research office and
- The academic library,

as a role players when developing research data services.

### **1.7.3 Academic libraries and their role in RDM**

The development of data intensive science, together with funding requirements for data management plans and open data has paved the way for paying more attention to RDM across all academic disciplines. At the same time, the role of academic libraries has changed dramatically within the last ten years. Academic libraries are now often integral partners in aspects related to research process right from collecting data to publicizing and preserving research output (Tenopir et al. 2015:2). This therefore, calls for a suitable strategy to be used in setting up a feasible, desirable and sustainable collaborative RDM initiative. The strategy would involve formulating an RDM policy, assessing the RDM needs, building suitable partnerships and developing RDM capacity.

### **1.7.4 RDM services in academic libraries**

Management of research data can be attributed to various forms, and there are a variety of possible research data services that libraries provide, ranging from helping researchers find resources about data management planning or metadata standards in their disciplines to the creation and maintenance of full digital repositories. To Jones, Pryor and Whyte (2013:10) customized support and extra hands on training are required by researchers to ascertain whether the skills they already have can appropriately manage research data. This topic is discussed in more detail in section 2.3 of Chapter 2.

### **1.7.5 RDM services that would require sustainability planning**

Advancement in technology has created avenues for collection, storage, analysis, and communication of increasing amounts of scientific data on an international scale (Open Data Charter, 2015; The Royal Society, 2012). In such an environment, there is need to sustainably plan for services that will ensure transparency of scientific research, data preservation, reuse and reanalysis of research data. Having a clear understanding of what is required by whom and ensuring that everyone engaged in resourcing and supporting the infrastructure bears in mind the significance of implementing and sustaining it (University of Oxford, 2014:5) is good strategy for sustainability planning.

### **1.7.6 The role of the library in keeping track of the legal requirements**

Research data under legal jurisdictions is associated with benefits such as; making subject access requests, avoiding causing damage when processing, and addressing compensation and destroying inaccurate data. MONASH University (2017); JISC (2016); JISC (2014) note that since 1998, researchers were expected to comply with the Data Protection Act. The Act enables researchers to maintain privacy over their personal details. Supervisors and their candidates must observe research data planning thus documenting copyright ownership, ethical requirements, retention periods, secure storage, restricted access and detailed metadata. Personal creative works are protected from manipulation. Liabilities arising from copyright infringement between researchers and employers are easily addressed.

### **1.8 Overview of research methodology**

The researcher mainly utilized the qualitative research method because of the nature of the research which required to collect in-depth and detailed opinions and experiences as described by Tenopir et al. (2017:28) regarding research data services in academic libraries. A purposive sampling technique was used to identify eight colleges which are actively engaged in generation of data in Makerere University. Responses were collected from eight participants; one from each college using semi structured interviews. These participants were selected due to their knowledge about research data. Semi-structured interviews were preferred due to their flexibility as stated by Kombo and Tromp (2006). An interview schedule was used as the data collection instrument. Data was transcribed into Microsoft Word and later entered into Microsoft excel for easy analysis.

All ethical issues were addressed. The researcher obtained clearance from the University of Pretoria and sought the consent of the participants before data was collected.

Research data are observed as an essential part of the scholarly record to be managed by academic libraries which have a traditional role of providing access to scholarly records in various forms (Tenopir et al., 2017:25). Research data are highly required for reproducibility purposes. Unfortunately much of the data are not properly managed due to the absence of RDM initiative. The findings of the study and the subsequent recommendations identified the concept of RDM, role of academic libraries, services academic libraries could provide, services that require sustainability planning for RDM to take place as further discussed in chapter four. These

could be used as a basis for other academic institutions and other research oriented government organs to manage their research data.

The findings of the study resulted into recommendations that could act as a basis for scholars to conduct further studies and to the available body of knowledge in the field of RDM.

The values of research can easily be understood when operational terms are defined. There were mainly three operational terms as used in the study that were clarified for the readers to have a proper understanding of their meaning. These three terms were clarified below.

### **1.9 Clarification of key terms**

By defining the three key terms, the researcher aimed at avoiding the misunderstandings that may come up in the process of developing this study as well as from the reading audience. These clarifications will specifically help to identify appropriate methods of gathering data and interpreting data.

#### **Research Data**

Research data are defined as recorded factual material usually retained by and accepted in the scientific community as necessary to validate research findings (University of Leicester, 2012, 2017). Although much of the research data are generated in a digital format, all research data need to be treated with utmost care.

#### **Research Data Services**

Research data services can be defined as a network of support and enabling services provided by the library to assist one in the course of all phases of the research data lifecycle (University of Michigan, 2017). Such services are usually provided by a subject librarian.

#### **Research Data Management (RDM)**

Research data management also known as RDM, concerns the organization of data, from its entry to the research cycle through the dissemination and archiving of valuable results (University of Leicester, 2017). It is part of the research process and aims at meeting the expectation and requirements of the University, legislators and research funders.

The mini-dissertation is composed of five chapters. The elements contained in each chapter are highlighted in the section below.

## **1.10 Division of chapters**

Chapter one is considered as an introductory chapter and it consists of the Overview; background information about the research; the research question and the sub-questions; value of the study, scope of the study, justification of the study, overview of literature, overview of research methodology, clarification of key terms, division of chapters for this study.

Chapter two focuses on the available literature on the subject. The researcher reviewed the RDM concept; the role academic libraries should play when developing research data services. Literature related to the research data services academic libraries could provide, research data services that require sustainability planning, will be investigated and results reported.

Chapter three addressed the methodology that the researcher used to conduct the study. This chapter discussed the research paradigm with emphasis on qualitative paradigm; research design, data collection methods used and the relevant instruments; population of the study and sampling process and highlighted the steps in data analysis.

Chapter four covered on the analysis and interpretation of the study findings and it is upon the findings that the researcher was guided to develop the research data services for sustainably manage research data generated across Makerere University.

Chapter five consisted of the summary of the findings, conclusions and recommendations meant to ensure effective management of research data of Makerere University.

## **1.11 In summary**

It was anticipated that Makerere University would own large volumes of research data that need to be managed. It was not clear to what extent the concept and practice of RDM were embraced by faculty and research staff. It was anticipated that the library would need to develop research data services.

This chapter introduced the research question, sub-questions and background to the study upon which the recommendations would be based. Other areas addressed in this chapter include; the value of the study, an overview of the literature and the methodology followed, clarification of relevant terms, the scope, justification and limitations of the study. The next chapter focuses on the literature review that is in line with the research under study



## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction.**

This chapter reviews some of the available and relevant literature related to RDM with an emphasis on the concept of RDM, RDM and the role academic libraries could play', RDM services in academic libraries, current RDM practices among researchers and the conclusion. The chapter is categorized into five sections with relevant subsections addressing specific themes as discussed below.

Research data are invaluable products that for a long time have not been effectively managed. This has made the smooth flow of future research projects difficult (Strasser, Cook, Michener, Budden, 2012:2). The role played by research data has become significantly important - to the extent that institutions of higher learning believe that managing research data is a critical success factor for future RDM (Whyte and Tedds, 2011:5). Establishing how to collect, document, organize, manage and preserve research data benefits the principle researcher and collaborators during research and in the future respectively (Strasser, Cook, Michener, Budden, 2012:1).

Research data are observed as a form of infrastructure that supports the creation of quality research output across all disciplines worldwide (Whyte and Tedds, 2011:2).

Effective RDM offers the intended users greater accessibility and discoverability of research data. This supports the answering of research questions which relate to the entire research project (Jones, Pryor, Whyte, 2013:2). Comprehending the needs of researchers, and continuously engaging them in the RDM initiatives, is fundamental for the development and implementation of RDM in academic institutions (Wilson, Martinez-Uribe, Fraser, Jefreys, and 2011:285).

#### **2.1.1 Importance of academic libraries to academic institutions**

To understand the need for RDM services and its effective development, it is important to first establish the value of academic libraries. Carey, Justh and Williams (2003:4-5) defined an academic library as a library entity in a tertiary institution that provides:

an organised collection of a combination of both printed or other reading materials;

trained staff to provide and interpret informational materials as required to meet the needs of institutional users.

an established programme to deliver library services to patrons; and  
the physical facilities necessary to support the noted collection, staff, and programmes.

The magnitude and quantity of the requirements mentioned in the above definition are not standard. This implies it may vary from one library to another.

Academic libraries can therefore be taken to be exceptional centres in which patrons find information resources vital to their academic work and research. According to Metz (2010:1), academic libraries provide services to multiple communities. These communities are classified into categories such as faculty staff, students and the general community. This is very applicable to Makerere University Library.

Based on the previous literature, there is adequate literature about the role of libraries in academic institutions which exhibits that such libraries play a critical role in ensuring the success of academic institutions and the achievement of institutional strategies. To stress this role, Lewis (2007:16) notes that the kind of duties the library performs today deviate from what was done in the past as well as what they will do in the future. All these efforts are aimed at remaining relevant so that their role can be still realized in the institution and in the wider ever changing environment.

### **2.1.2 The academic library and academic research**

The section below reflects some of the contributions academic libraries extend to their various communities:

In the first place, academic libraries are key units in facilitating access to established research for the entire institution. Ka (2005:45) observes that academic libraries play a fundamental role in supporting research. This is manifested through the acquisition of relevant information resources for their patrons. These may include physical books, electronic resources, and digitized information. Academic libraries are even capable of accessing materials not within their collections that are invaluable to their patrons. Rasul and Singh (2010:77) agree with this view by emphasizing that “the effective academic libraries are gateways to academic knowledge through their own collection and by facilitating access to material.” This may be actualized through subscription to online resources and enabling inter-library loans to support research

activities (Patterson, 2009:2:5). The above noted avenues ensure access to useful information for academic work.

Besides providing information resources, academic libraries provide a conducive environment for research work and private reading. Rasul and Singh (2010:77) note that academic libraries tend to focus so much on the students' and researchers' needs at the university and as a result adequate space is provided to perform both group and private study sessions. Oakleaf (2010:24) highlights the fact that libraries are increasingly moving from supporting silent private study to facilitating both private and group study.

Additionally, academic libraries are useful in making better the university's rank in comparison with other academically oriented institutions. According to Rasul and Singh (2010:76) research is greatly contributing towards universities and colleges rankings across the world. Academic libraries are responsible for gathering research output of their mother institutions and make it accessible to the ranking authorities. Oakleaf (2010:75) however, contends that simply gathering research output for ranking may not be ideal for the quality assurance of research output. Although there are challenges associated with evaluating research output, the fact is that ranking authorities still regard research output in academic libraries invaluable thus making academic libraries vital units for the parent institutions.

Academic libraries provide valuable user education to their users as a way of ensuring that all collections and services are fully utilized. Simmonds and Syed (2001:630) observe that the worth of academic libraries is mostly determined by how users are competent with the library and its resources. As a result, users who are familiar with the library services and resources usually benefit from the academic library (Simmonds and Syed, 2001:630). To ensure great access and usability of library resources both within the library building parameters and online resources, library sensitization is conducted through user education sessions.

In summary, academic libraries provide a foundation for the certification of universities and other tertiary institutions. According to the National Council for Higher Education (2005:40), to have an effective and well-designed library in Uganda, is one of the requirements for the accreditation of universities and other tertiary institutions. Therefore, any university or tertiary institution in Uganda may be granted a charter to operate on grounds of the quality of the library it possesses. This implies that academic institutions whose libraries don't meet the set terms and conditions are subject to be deprived of permission to operate.

From the above discussion, it can be confirmed that academic libraries play a great role in relation to the survival and continuity of the institution. Oakleaf (2010:30) notes that each academic library must establish unique ways in which they contribute to the mission of their parent institution. It therefore makes sense to extend the current library services to also include research data management (RDM). As a first step the RDM services offered by other academic libraries ought to be evaluated to determine whether such services can be recommended to institutions of higher learning in Uganda. Fully understanding the RDM concept is critical before embarking on the development of any of the related services.

## **2.2 Research Data Management**

### **2.2.1 Research Data**

According to Rice (2009:16), research data are referred to as ‘data collected, observed or created for the purposes of analysing to produce original research results’. However, Kennan and Markauskaite (2015:71) further observed that data are not only useful in achieving research findings, but also for tracing behaviour applicable in learning analytics as well as tracing personal lives through social media platforms. This is so because data includes administrative records, log files of learning management systems and web portals.

The UK Data Archive (University of Essex 2017) acknowledges the availability of various formats of research data such as textual, numerical, databases, geospatial, images, audio-visual recordings and machine generated data. Therefore it is important to ensure that data files are clearly named and properly organized. Controlling the structure, quality and version of research data throughout the research cycle is worth mentioning in the process of RDM.

### **2.2.2 Importance of RDM**

University of BRISTOL (2012) noted that proper RDM is important because it:

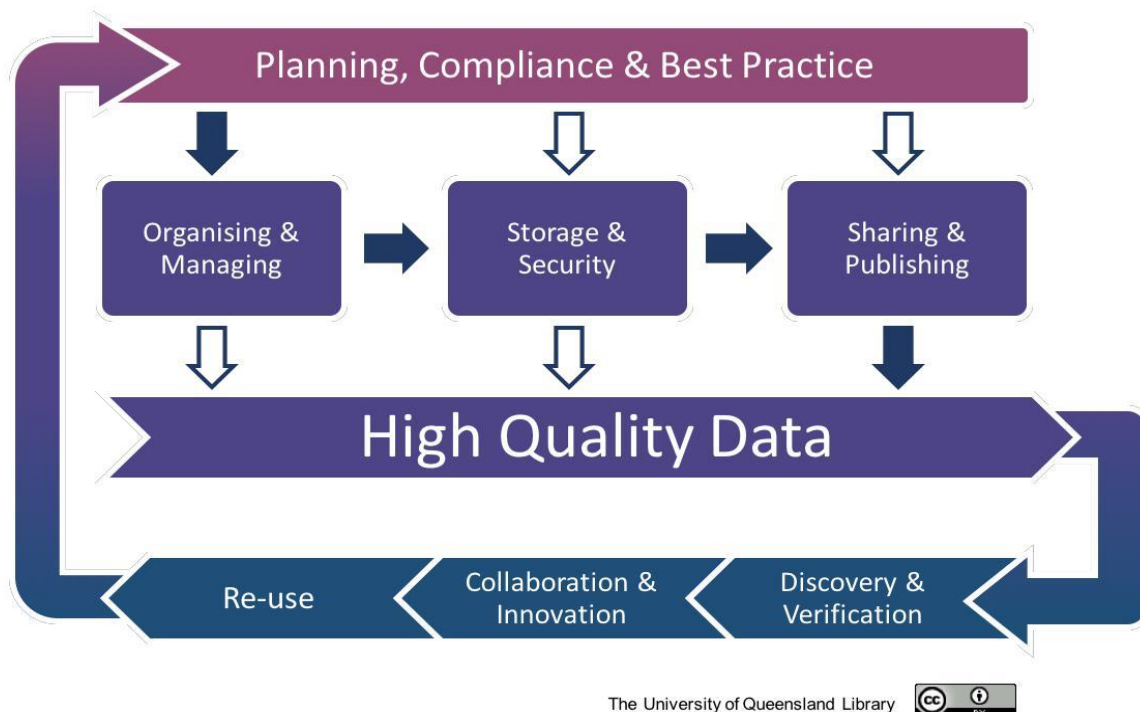
- is associated with benefits such as; compliance with funder and regulatory requirements,
- ensures integrity of research and result validation, increasing research efficiency whereby data can be accessed and analysed easily,
- improves data security and reduces risks related to data loss,
- broadly disseminates research thus increasing research impact,
- achieves accountability through making data available to the entire public, and

- supports future research using secondary data.

To ensure an organized, clearly understood and transparent data collection process, RDM must be integral part research activities of research oriented institutions. (Surkis and Read 2015:154-155; Mercury Project Solution 2013:1; Jones 2011:2) observe that academic institutions that practice RDM are in position to generate understandable research data that supports researchers in the validation of the original results. Research data collected can be valuable but without access by the intended users, it becomes worthless. RDM ensures that quality and useful data are discoverable by other researchers with the help of data catalogues. In addition to the application of standardized RDM procedures, RDM ensures that future research is supported effectively. This is observed in the need to share data as well as the process applied during data collection so that more research funds can be provided and research articles published. Furthermore, easy data retrieval is assured, continuation of the project is assured, duplication of data is minimized, collaboration among researchers is increased, and research visibility is realized leading to citing and credit earning.

The University of Queensland (2017) graphically illustrated the importance of RDM as shown in the figure below:

Figure 1: Importance of research data management



The University of Queensland Library 

(The University of Queensland, 2017)

In figure 1 above research data are managed to meet the legal, statutory, ethical and funding requirements of the University. RDM is responsible for the planning, collecting, organizing, managing, storage, security, backing up, preserving and sharing research data.

Effective management of research data:

- Increases research efficiency;
- guarantees the quality and authenticity of data;
- enables the exposure of research findings through collaboration and dissemination;
- ensures the reproducibility of experimental and computational results;
- facilitates the validation and verification research findings

Having highlighted the importance of effective and efficient management of research data, it is necessary to know the various stakeholders responsible for the development of RDM services in research institution.

RDM has got activities that cut across the entire organizational structure. It is therefore wise to convince (through providing RDM awareness) all units such as the research office, the office of sponsored programs, the IT department, academic departments and the library to collaborate towards the RDM initiative. This strategy is ideal when advocating for RDM development in an institution (Humphrey, 2014; Wilson, Martinez-Urbe, Fraser, Jefreys, 2011:281).

Steering of the RDM project should be performed by senior management - to ensure the feasibility, desirability and sustainability of the project.

The language and vocabularies applied when advocating for RDM should be given some consideration. Different researchers originate from various academic disciplines and environments. For that reason, it is always important to first understand the way the researchers think about and address their data (Surkis and Read, 2015:156).

HRK German Rectors' Conference (2015:3-4) advises that a research data policy should be publicized to ensure that RDM is among the priorities of the University. It is further recommended that a framework should be provided to support the awareness of proper handling of research data. The university management and the high education authorities should be convinced about the relevance of the institutional RDM. All stakeholders should be involved in developing RDM strategy. Current structures and activities should be reorganized to ensure proper RDM implementation. Supportive subject related infrastructures should be

established and devolved. RDM Capacity building should be rolled out to all stakeholders in the institution.

Whyte and Allard (2014:7) believe advocating for RDM calls for the identification of primary and secondary stakeholders as well as for a good understanding of their RDM requirements. A case in point includes the development of DataONE infrastructure for biological and environmental research where scientists and librarians were identified as primary and secondary stakeholders respectively.

As a research support and administrative services such as research administration function, records management and computing are actualized through the identified stakeholders who collaborate to explore and negotiate new roles.

The concerned stakeholders can be convinced through giving an assurance about the creation of a dependable RDM infrastructure, sharing the relevance of RDM to the institution as well as the benefits that can be accrued by the respective researchers (HRK German Rectors' Conference, 2015:10) and the institution at large.

Promoting RDM to various stakeholders such as data producers, researcher funders, participants and users is important- it creates a fertile ground that enables academic libraries to play their role in the strategic development of RDM services that ensures proper management of research data during and after research projects. Therefore, it is necessary to discuss in detail the different stakeholders as observed in the next section.

### **2.2.3 Data Management plans**

According to University of BRISTOL (2012) and Whyte & Tedds (2011:1), RDM was referred to as the various practices that range from the creation of a Data Management Plan (DMP) through the storage, the sorting and cataloguing and finally the dissemination of research data. These activities indicate how research data will be managed during and after the project, which authorized users will have access through sharing and making research data openly available for a specified period. RDM aims at verifying the existing research results and creates avenues for developing new research findings basing on the available information. However in the process of all these activities many challenges are encountered

## 2.2.4 RDM role players

Technical and policy advancements in the management of research data has caused pressure to the stakeholders as well as the flow of information involved. Specifically:

- Researchers have to adapt to reproducibility requirements;
- Data repositories are required to deliver effective ways of managing volumes of data;
- Libraries are at a risk of being disinter mediated in an open space environment;
- Offices of Research Administration are anticipating the need to track all the data created within the institution (De Waard, Rotman, Lauruhn, 2014).

As various approaches to RDM are developing in universities and other research institutions, different stakeholders have become involved, including support services staff and faculties. University libraries have moved into space and are observed as the main contributors to RDM activity in general as well as in the designing of research data services in particular. The development of the RDM cannot be delegated to an individual or a single unit. In a complex and federated environment of universities, the roles and responsibilities are shared among various stakeholders such as University leadership, researchers, research support units, governments and funders.

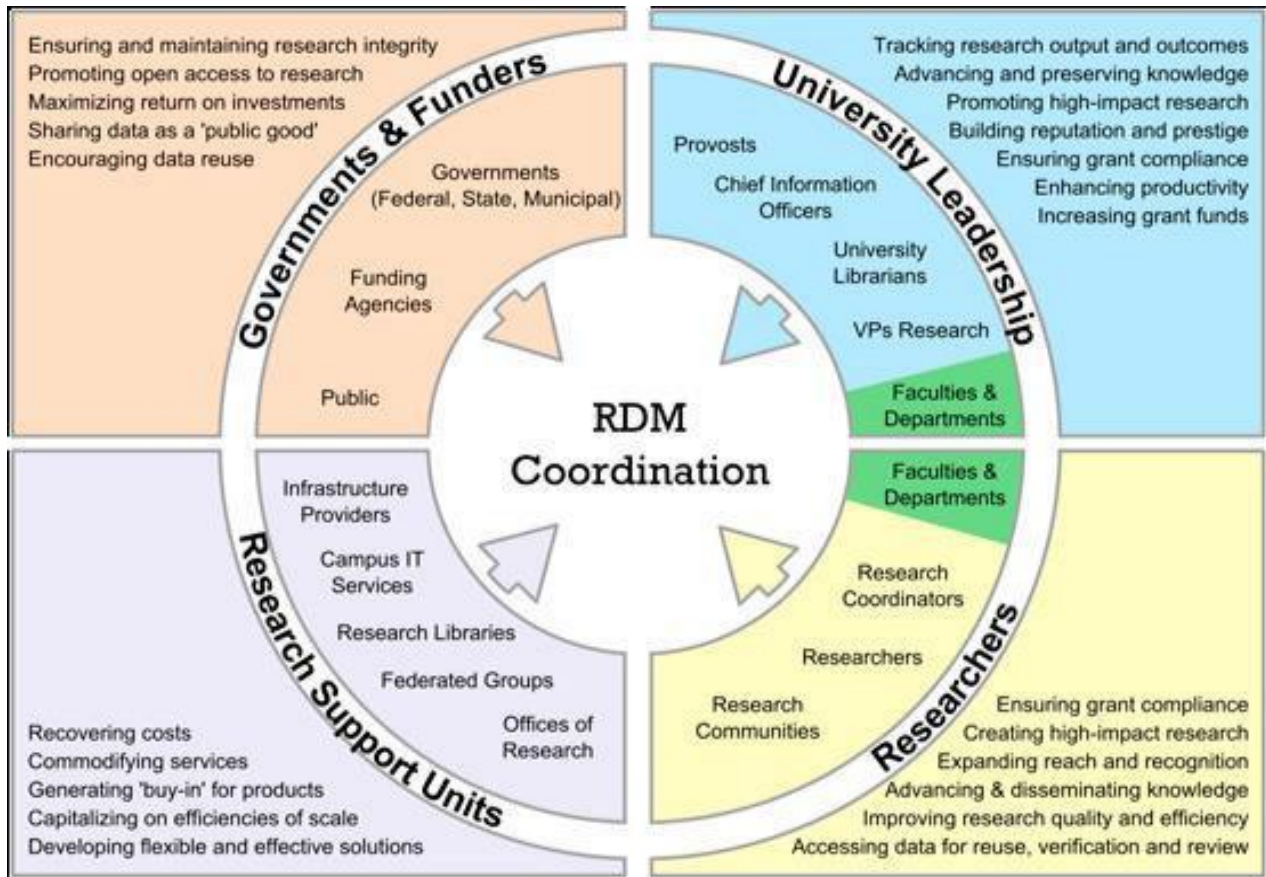
Development of RDM at institutional, national, or international level depends upon the collaboration and coordination of the engaged partners. Considering the role of academic libraries in activities at any of these levels, requires a general consideration of the current RDM landscape. Establishing the various stakeholders involved in RDM activities and characterizing their interests, roles, and responsibilities makes it possible to identify activities where the library is well placed to support and coordinate RDM development (Flores et al. 2015:83).

RDM stakeholders can be assembled into four main categories, although the spectrum of RDM stakeholders has been differently categorized in various literature such as (Pinfield et al. 2014:4; Jones, Pryor, Whyte, 2013:3).

Flores et al. (2015:83) graphically illustrated the four categories of RDM stakeholders as shown in the figure below.



Figure 2: Four categories of RDM stakeholders



(Source: Flores et al. 2015:84)

In figure 2 above, stakeholders in RDM development are grouped into four general stakeholder units. Individual stakeholder groups are identified in the central ring, with general group interests listed in the adjacent boxes. The figure further indicates the similar interests, roles, and responsibilities of stakeholders in RDM.

Governments and funding agencies are primary funders who support research with an interest of maximizing their investments. Properly managed and shared data has potential to support research reproducibility across all disciplines. Emphasis is usually put on submission of the proposal together with DMP and at the same time sharing data products appropriately and where applicable.

The University leadership is interested in compliance, advancing the creation and preservation of knowledge, tracking research output and building institution’s reputation and prestige.

Researchers are responsible for production of data and dissemination of knowledge. Together with their associated communities, departments and faculties, regard RDM as a mean of adhering to funder requirements.

Research support units have interest in developing effective RDM solutions and services that are highly used, scalable and sustainable. They further ensure long term support for services.

There is need to discuss some of the stakeholders in details as observed in the next section.

#### **2.2.4.1 Funders**

Expectations from funders include: data exchange via diverse platforms, the creation of effective system that store, access and share data securely (Jones, Pryor & Whyte, 2013:2). The EPSRC Policy Framework on Research Data has been instrumental in the development of RDM services across institutions of higher learning. Policies are also fundamental in the development of the effective RDM services. There are various funder requirements, approaches and considerations taken to ensure effective development of RDM policy (JISC, 2015).

Adequate financial resources are required in the RDM development. In relation to the use of project funds, several funders have indicated that at least ten percent of the research grant can be used for developing RDM (Jones, 2011:1- 4). Majority of the institutions have resorted to having an overarching strategy to ensure that a coherent RDM service is developed. The strategy is defined by understanding the current position; future destination; and as well as the mapped program of activity of RDM. However these three objectives are influenced by factors such as funder polices, where funders need to closely work with researchers in RDM development (Jones, Pryor & Whyte (2013:5).

#### **2.2.4.2 Researchers**

Researchers are more loyal to their research communities than to their institutions (Jones, Pryor & Whyte, 2013:14). Therefore to effectively create RDM systems, close engagement of researchers in their respective communities is necessary. Involving researchers in the development of RDM is very important because they fully participate in the creation and usage of research data. Collaborating with working groups enables researchers to present their opinions, test solutions, share challenges and champion the approved services in their respective communities. Engaging researchers in gathering research requirements contributes

towards RDM development, and at the same time addresses research data related issues (Jones, Pryor & Whyte, 2013:3).

Through the Research Liaison Manager, effective relationships are easily built among researchers as well as identifying, defining and prototyping RDM services required at respective institutions (Whyte & Tedds, 2011:5). Several institutions are resorting to involving researchers in the description of their own data. This approach is very effective in the development of RDM because researchers understand the process involved in deriving the data, the context applied in assembling the data and limitation that may be encountered by future users (Wilson, Martinez-Uribe, Fraser, Jeffreys, 2011:277).

RDM service can be achieved basing on the skills and experiences of the researchers. These skills include; how data are collected, analysed, managed and most importantly making relevant data available. The involvement of researchers ensures the provision of a well-established service as well as ensuring requirements gathering. This explanation is in line with the discussions of various authors in 2.2.4.2. However researchers need to closely operate with other role players such as the research office in the development of an effective RDM services.

#### **2.2.4.3 The research office**

The office of research is alternatively referred to as the division of sponsored programs, and is responsible for administering funded research and related policies and services. Advocating for matters concerning legislation and regulation of research funding is managed by the senior research officer. Responsibilities such as patent and intellectual property administration, research integrity, grants management and administration are managed by the research office. The same unit further supports investigators with funder requirements, as well as data management and sharing (Erway, 2013:7).

This same unit is one of the stake holders that ensure proper tracking of proposals, awards, reports and project completion (Jones, Pryor, Whyte, 2013:3). The research office is the focal point in terms of research related issues. This makes its staff immediate contacts and responsible for providing appropriate services for data management both internally and externally. Research office staffs also have a voice in the discussion concerning RDM local services, infrastructure and practice required to manage data throughout all stages. Due to technological advancements, it is necessary to closely work with other stakeholders such as the IT department in the development of an effective RDM service. The above discussion is more

supported by (Erway, 2013:8). The University Management is also an integral part of RDM development as shown below.

#### **2.2.4.4 University Management**

The major role of the University management is to ensure that the proposed RDM services can be desired, achieved and sustained. Convincing the Vice chancellor-Research to be a champion, providing a suitable representative for the stakeholders, offering professional advice, approving a policy, proposal and endorsing budgets, are great roles meant for the management (Jones, Pryor & Whyte, 2013:3). Institutions ought to provide either templates or guidance in relation to the components of the data management plan (University of Bath, 2017).

These act as checklists and they include; “data description, roles and responsibilities, standards and quality assurance, access, usage and credit, benefits and cost effectiveness, the research process, preservation and sustainability” (Herfordshire, 2011:3). Other universities have resorted to developing templates for their specific audiences, through the research360 project a widely acceptable template has been developed to cater for the needs of postgraduates (University of Bath, 2017).

Several universities usually face extra charges from IT service storage providers for managing extra data; all efforts rendered by the University management are significant and aim at treating the RDM service as a priority through; investing seriously in the infrastructure to ensure sustainable data access and usage. Creating Identifiers such as DIO to data. Digital preservation and version strategy can be developed and implemented to ensure that the published data remains static to be easily located. This explanation shares similar views with Jone, Pryor & Whyte (2013). University management cannot as a single unit develop RDM service, therefore other role players such as the library is necessary to together develop an effective RDM service.

#### **2.2.4.5 The academic library as a role player**

The library is strategically positioned to be a key player in data management, curation, and preservation based due to its broad experience with selection, metadata, collections, institutional repositories, preservation, curation and access (Erway, 2013:10). The library is believed to be the most suitable place in the university to ensure safety, sustainability, and trusted stewardship of research data. Based on the skilful and experienced personnel, the library is in position to greatly support RDM through orientating researchers about the

significance of managing and sharing research data, and more is explored in the next section. The role of the academic library is considerably expanded in section 2.3 of this document.

RDM practices in the developed world completely differ from RDM practices in developing countries. Therefore it is necessary to also discuss how research data are managed in research institutions in developing countries.

### **2.2.5 RDM practices in research institution in developing countries**

Chigwada, Chiparausha and Kasiroori (2017:5) reported that in developing countries researchers are responsible for managing their research data within their respective academic institutions. Research ethics committee and record managers are taken to be in charge of RDM. Most of the institutions lack institutional policy on research data. Data repositories are also rare among academic institutions. The researchers, development partners, librarians, and information technology personnel are involved in the development of repositories.

Chigwada and colleagues further observed that researchers in most academic institutions are not mandated to keep the data while a few are required to keep the data by the publishers. The kept data are in forms such as; text documents, spreadsheets, graphics, audio, databases, video, software applications and structured text. Research data are not archived implying that data are destroyed soon after the data are analysed while others try to keep the data for one year or less.

Having comprehended the meaning of research data, RDM, the challenges faced as well as the management of research data currently in academic institutions, there is need to discuss why RDM is important as observed in the section below.

### **2.2.6 The challenges associated with RDM services provision**

Van den Eynden, Corti, Bishop and Woollard (2011) noted that RDM is complex task and not every kind of data can be accepted in the repositories because some institutional repositories – because some require specialized software or the dataset may simply be too large. Some may not be in position to maintain data for a long-term due to the complexity in the storage and management of some research data.

In addition, Harvey 2010 cited in Kennan and Markauskaite, (2015:72) indicated that RDM is also associated with challenges such as:

- Technology obsolescence;
- Technology fragility;
- Lack of guidelines on good practice;
- Inadequate financial and human resources to manage data well; and,
- Lack of evidence about best infrastructure

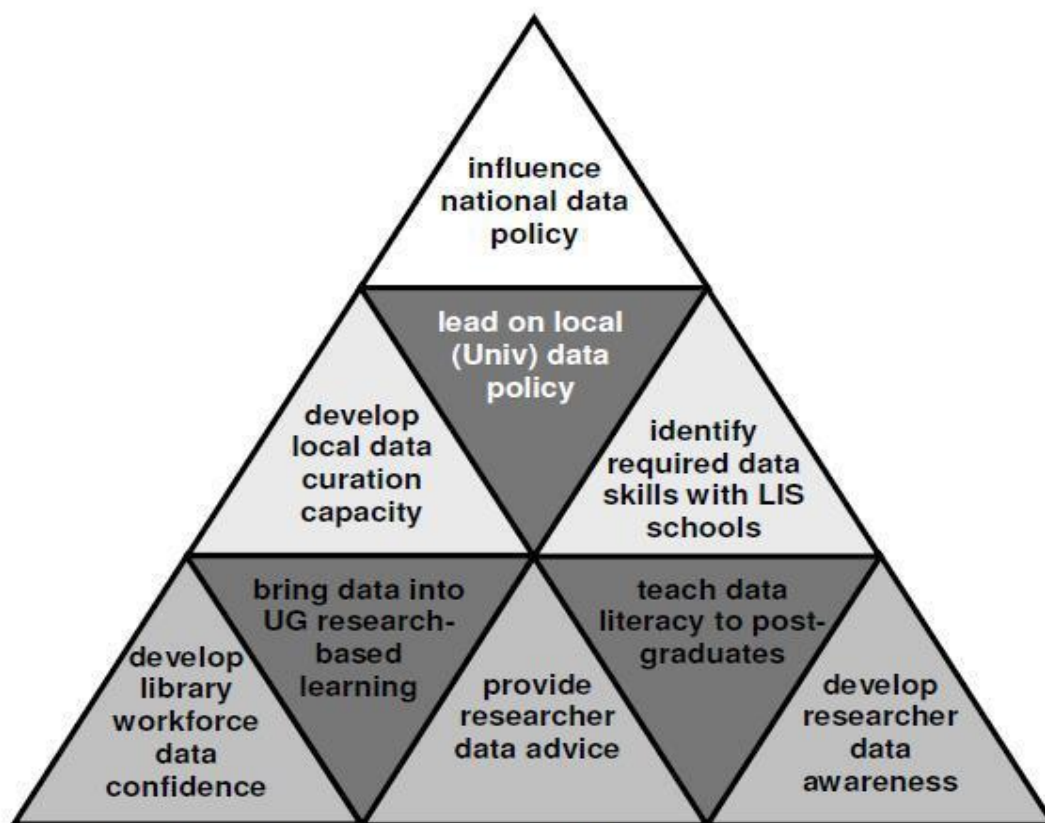
### **2.3 Academic libraries and their role in RDM**

As was documented in section 2.2.4 above there are various RDM stakeholders. Because of the varied requirements, mandates, techniques and tools that make up a fully functioning RDM service, it becomes difficult for stakeholders to figure out their specific role and responsibilities in relation to the wider RDM function.

As was indicated, one of the stakeholders is the university academic library. Academic libraries have always offered a variety of research services (see section 2.1.2), and as digital data keep on increasing, RDM services were incorporated in more and more of the library services (Tenopir et al. 2015; Corral et al, 2013; Cox and Pinfield, 2013; Jones, Pryor, Whyte, 2013; Lewis, 2010).

The RDM pyramid proposed by Lewis (2010) advocates a broad role for libraries and librarians:

Figure 3: A broader RDM role for libraries and librarians



(Source: Lewis, 2010:16)

These nine aspects include : (1) influencing national data policy, (2) lead on local (university level) data policy, (3) developing local data curation capacity, (4) identify required data skills with LIS schools, (5) developing library workforce data confidence, (6) bring data into UG research research-based learning (7) provide researcher data advice (8) teach data literacy to post graduates and develop researcher data awareness later formed the base of possible services for other authors.

In the figure above the integration of RDM into teaching at the post-graduate level and in schools of library and information science, as well as influence and participation in national policy development are illustrated.

Focusing on the library's role in RDM development, other common themes identified include;(a) activities associated with conducting RDM needs assessment in user communities, (b) help

desk services, (c) data management plans (Corrall et al. 2013:646), (d) policy development, (e) advocacy and awareness (f) training, (g) advisory services, and (h) data repository development (Cox and Pinfield 2013; Jones, Pryor, Whyte, 2013).

Tenopir et al. (2012:3; 2014:1, and 2015:2), Surkis and Read (2015) reported that American and European libraries have taken RDM as a key component of their duties and responsibilities. This has been observed through planning for additional RDM services to be offered by libraries and at the same time libraries are looking for opportunities to develop RDM-related skills.

Wilson, Muartinez-Urbe, Fraser, Jeffreys, (2011:275) documented that academic institutions usually have a federated structure consisting of faculties, academic departments, and support services each with a high degree of independence. This poses a challenge in RDM service development. It, therefore, calls for a suitable strategy to be used in setting up a feasible, desirable and sustainable collaborative RDM initiative. The strategy would involve formulating an RDM policy, assessing the RDM needs, building suitable partnerships and developing RDM capacity. Each of these is discussed in more detail below.

### **2.3.1 Formulating RDM policy**

Effective communication and coordination among various working groups is significant in the formulation of RDM policy. This ultimately enables the top university board to approve the policy. Pinfield et al. (2014:9) note that the Deputy-Vice-Chancellor for research sponsors RDM policy development and its management is ensured by the research committee. To ensure a successful RDM policy initiative, a task force needs to be formulated and it consists of senior representatives from academic community and support services such as research support services, IT services and the library.

Policy development is a process that cuts across the entire institution. However, academic libraries have a significant role to play in relation to RDM policy development. Erway (2013:10) notes that academic libraries have a voice in conversations concerning the formulation of RDM policy because of their potentiality in data management, curation, and preservation- and its extensive experience in institutional repositories, metadata preservation and access.

Librarians are the target audience in relation to RDM policy formulation, not because they alone can make this occur, but are observed as the suitable stakeholders to initiate the conversation. They are taken to be ideal because they are responsible for receiving data for curation, providing guidance and most importantly librarians are equipped with vital skills and



experiences to contribute to the RDM discussion. This discussion shares similar opinions with Pinfield et al. (2014).

Flores, et. al.(2012:95) state that management and representation of all stakeholders is necessary in policy formulation. However, to ensure policy acceptance, RDM policy formulation should comprise both the element of top-down involvement and bottom-up engagement (Pinfield et al., 2014:8).Process facilitation could be performed by libraries since they are connected throughout the entire institution. A perfect example where this was the case is the University of Alberta library which was tasked to support “Research Records Management and Preservation Guidelines”(University of Alberta 2013).

Libraries with their cross-institutional connections are in a good position to manage and represent the interests of stakeholders to the concerned team of policy developers. Pinfield and associates (2014:9) note that various stakeholders such as librarians have to be repetitively consulted across the institution, and it is a common practice to adapt elements from other institutions when developing RDM policy. These findings are in line with the recommendations made by authors such as (Erway 2013:10; Jones, Pryor, Whyte, 2013:12; Lewis 2010: 11) that libraries should play a leadership role in the development of RDM policy and this includes RDM needs assessment among others.

Academic institutions need to manage the ever-increasing research outputs. To ensure effective management, research data policies have been established. Research integrity is fundamental for policy –makers. Employers are expected to ensure the integrity of research generated. Different funders have data policies which indicate the policy coverage, policy stipulation and support provided by the policy (University of Cambridge, 2017). Policies cover issues relating to published articles, conference papers as well as the access and maintenance of data. Some policies also address guidance on best practice guides and supporting staff (DCC,2017; Whyte and Tedds,2011:1). Policies and procedures support institutions in terms of giving measurable improvements in research capacity as well as in the institutions’ ability to respond to policy-makers and regulators. This arrangement further ensures that research organizations preserve data securely and curate data effectively throughout the entire data lifecycle.

To foster effective RDM practice, (Research Councils UK., 2015) organized a statement of Common Principles on data policy and emphasis was put on;

- Making publicly funded research data openly available to the entire public with minimal restrictions.
- RDM policies and plans supported by preservation plans, need to ensure valuable data remains utilized.
- Metadata should be easily discovered and at the same time results published need to indicate how supporting data can be accessed.
- Research institutions policies and practices need to observe confidentiality by ensuring research process is not affected by inappropriate release.
- Period for using data exclusively should be provided to ensure research groups can publish results with ease.
- Researchers need to recognize data sources as well as access terms and conditions
- Publicly invest in research requires to be appropriate, efficient and effective.

These principles aim at making the data openly available, long preservation and accessibility of data, easy data discoverability and to ensure ethical considerations are observed throughout all stages of data management.

AHRC (2015) note that such data policies and procedures ensure that data are appropriately managed throughout its life cycle; staffs are trained on how to handle and be responsible for data protection. RDM requirements need to be assessed as seen in the next section.

### **2.3.2 Assessing RDM Needs**

RDM needs could be established through surveys and interviews. RDM librarians can assess how various campus constitutes are managing research data and assess its impact. RDM assessment would reveal how researchers are informed about DMPs (Flores et. al.(2015:94).Results obtained portray the kind of experience universities have in terms of making datasets available to support validation of results, reproducibility of research and preparation of DMPs. This helps to assess if collaborations, new areas of research can be established as well as DMPs prepared are in line with expectations of the funding agencies.

Based on the ever increasing importance of data management in the academic environments, it has been observed that several institutions of higher learning have resorted to developing their own RDM strategies. This has been evidenced through undertaking requirements-gathering exercises with the help of tools such as DAF, CARDIO and AIDA (Rans and Jones, 2013:1).

These tools support organizations to survey researchers' RDM practices and available infrastructure in place to assess RDM needs.

The Data Asset Framework (DAF) is one of the many tools that provide institutions with avenues to preserve, identify, locate, describe and assess the management of their research data (Data Asset,2017). Based on the findings of a series of this tool several institutions have developed RDM policies. Ekmekcioglu and Rice (2009:12-13) gives a perfect example of a first RDM policy that was released by the University of Edinburgh in May 2011 basing on the DAF findings.

Collaborative Assessment of Research Data Infrastructure and Objectives (CARDIO) is a benchmarking tool that is applied at either departmental or research group level to develop a data management strategy (DCC.2017). This tool creates an agreement between data creators, information managers and services providers, identifies practical RDM goals for improvement, identifies inefficiencies in operation, and most importantly it supports the collaborative assessment of RDM needs (CARDIO, 2017). Every institution that engages in RDM must have enough skilled staff, infrastructure, resources and top management support to ensure effective data management for purposes of evidence, reuse and validation.

Assessing Institutional Digital Assets (AIDA) is an auditing tool that aims at assessing the institution with major focus on technology and resources. Emphasis is also put on reflecting the strengths and weaknesses as well as encouraging collaboration between various disciplines This tool enables the ability to measure the effective management of digital content, portrays the status of best sustainability of continued access, direct management of repositories, and establishment of the current position of an institution and what steps may be taken next (Miller, Blake, Sorsby, 2010:13).

Case studies of research groups' data practices are very significant in understanding their RDM needs. This involves observing the work produced by researchers, interviews, workshops or focus groups with researchers RDM policy and support requirements (Whyte and Allard, 2014:11-12) and workshops can be referred to as a complex approaches and light weight approaches respectively. Although too much time is required while dealing with case studies, this approach is feasible when collaborating with researchers. Light weight is usually preferred in the development context. This discussion shares similar opinions with Whyte and Allard (2014). RDM needs assessment cannot solely contribute to the development of RDM services; therefore it is necessary to create RDM partnerships.

### **2.3.3 Building RDM partnership**

Managing research data is a relatively new challenge for support teams such as library, research administration, and records management to mention a few. Teams traditionally involved in managing information and computer services, will be in charge of identifying solutions, standards and requirements. Research administration gets involved in various activities and in most cases bridges the gap between funders, management and researchers (Pinfield, Cox and Smith, 2014:23). Office of sponsored programs is a suitable partners as they support preparation of grant proposal and submission (Jones, Pryor, Whyte, 2013:3; Flores, et al, 2012:93; Rans and Jones, 2013:2). Originally each team operated independently. Creating RDM partnership will provide efforts to:

- build up an RDM team to execute the actions defined by the steering team;
- analyses national, funder and institutional policy needs;
- discover the nature of the institution's data assets and RDM practices;
- support training opportunities for managers, researchers and support staff

Akers et al. (2014:184) note that RDM initiatives have been developed through reaching out to numerous groups on campus “with university research offices, advanced research computing facilities, and campus information technology departments being prominent library partners”. This implies within a university community, several stakeholders play significant roles in planning RDM services. However equipping personnel is a necessity for outstanding RDM services in academic libraries.

### **2.3.4 RDM Capacity building**

Several authors have cited the importance of library staff training in the area of data curation and management services (Kuusniemi, Heino, Larmo, 2012:6). For instance, identifying and collecting data and data set to include in the repositories has become increasingly vital, leading to the need to train staff members whose collection experience may be restricted to majorly traditional materials (University of Glasgow, 2017).

According to Newton, Miller, and Bracke (2011:54) report that although research libraries- through their connections with faculties and their expertise in developing traditional collections- are chief candidates for developing scientific data collections for academic institutions, additional skills are necessary to populate an institutional repository with relevant data. In

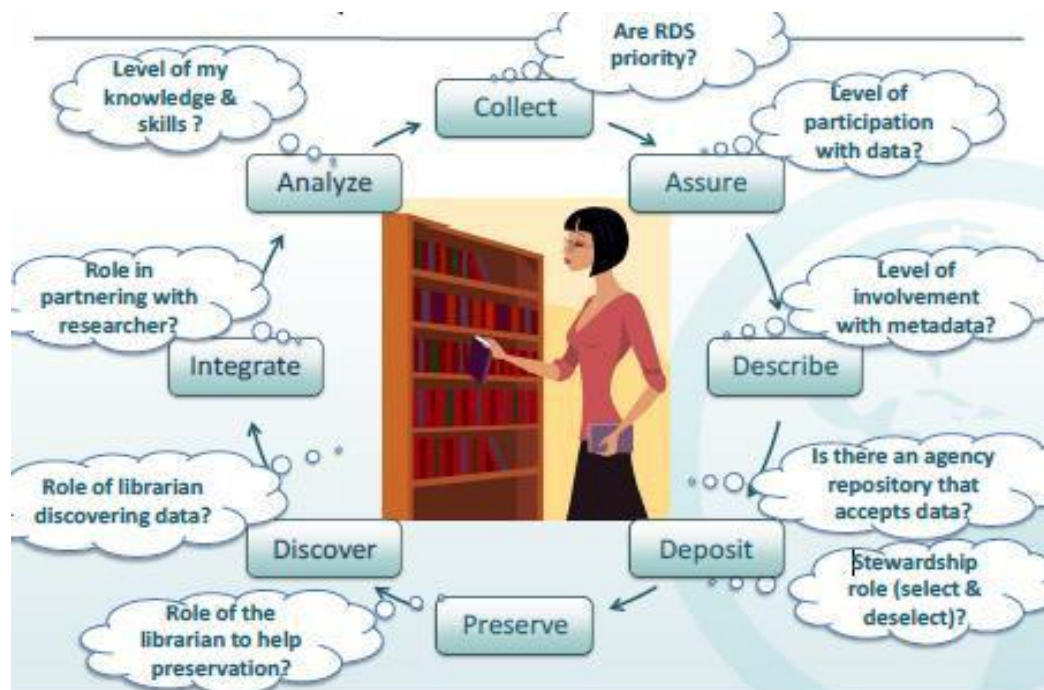
particular, academic libraries need to make use of professional relationships and collaborations with faculty across fields and between academic institutions to find materials.

According to Creamer et al. (2012: 18) report that of the twenty needed data competency areas, the greatest need for librarians was technical hands-on training in the digital description and curation of data sets.

Perhaps one of the most important aspects of providing research data services is the ability for the librarian to communicate effectively with researchers about concepts related to data. The DataONE Usability & Assessment Working Group adapted the data life cycle to put questions that libraries and librarians may have in relation to research data services. This is reflected in the figure below.

Figure 4: Background, skills, and education to provide RDS

### The librarian ponders whether she has the background, skills, and education to provide RDS



(Tenopir, Birch, Allard, 2012:12)

There are specific data skills that need to be developed to ensure RDM practices are handled professionally. Through comprehending the repository system and other technologies used to curate data librarians' skills are upgraded (Carlson, 2013:17-18). Advancement in RDM skills

can be attained through joining professional development opportunities offered by library schools and organizations. HRK German Rectors' Conference (2015:13) note that to achieve a dependable and reliable RDM institutional system, competence upgrading for all stakeholders is one of the viable approach. Suitable RDM modules should be integrated into the curriculum to underpin the RDM related competencies of students. This implies that information services offered by both the libraries and computer centres should be more geared towards RDM issues. Additionally, both Masters' and PhD students as well as the professors need to be exposed to RDM knowledge and skill to ensure proper data management.

There is a broad range of RDM advisory roles meant for librarians to upgrade and these include; long term preservation of research findings, complying with funding policies, and practical training on the development of metadata. In-houses training is necessary for purposes of keeping RDM negotiation, communication and advocacy up-to date; formal education, in-house training and informal learning are observed as the three training avenues through which librarians can acquire and stay relevant with RDM skills (Simons and Searle, 2014:10; Brown et al., 2015:229; Auckland, 2012:3). To ensure a sustainable RDM services, librarians need to continuously upgrade their skills and knowledge and be able to apply them appropriately. When drafting RDM capacity building programs, there is need to observe both the background of librarians as well as the expended role their meant to play. Different strategies are required in the development of RDM service. However, it is important to discuss about the benefits that are associated with alignment of RDM with research strategy.

When developing RDM services, libraries have an enormous role to play in terms of training and providing advisory services (Erway,2013:11). The University of Nottingham (2013) provides seven training areas of managing and sharing data. These include;

- "Why and how to share data;
  - data management planning;
  - documenting data;
  - formatting data;
  - storing data, including data security, data transfer, encryption, and file sharing;
  - ethics and consent and
  - data copyright".

The entire research community is still challenged by RDM related issues. Institutions need to address these challenges through RDM best practices such capacity building. JISC (2017)

takes this opportunity by promoting and developing necessary skills and expertise through capacity building.

It is always important to refer to recent and emerging RDM professionals, roles and responsibilities in an effort to build capacity and improve the sustainability. Some of them include; data curators, data scientist, data managers and data librarians. However the library has a role to play in building capacity to ensure sustainability of RDM services.

#### **2.3.4.1 Training researchers (staff and post-graduates)**

Bruce (2016) explains how impossible it was to easily associate with valuable research outputs leading to extreme inefficiency in RDM and difficulty in locating new research. JISC (2017) asserts that through negotiation various agreements have supported universities to benefit from ORCID membership at a reduced cost. JISC (2015) notes that staff and post-graduates need to be exposed to ORCID which supports the reuse of data via the automaton of processes and data exchange and acts as a hub that connects with funders and publishers and researchers need to be trained about the recent funder policies.

Researchers are central stakeholders and their career advancement is greatly dependent upon their research outputs. Basing on the mix of research data requirements, it is necessary to train researchers on how to negotiate publishing agreements that determine data ownership and at some time requires open access. The library can also focus on training librarians in its efforts to build capacity.

#### **2.3.4.2 Training librarians**

Librarians are well positioned for skills relating to open access and metadata. At the same time library professionals easily link up with other service departments and researchers. However, in spite of that, researchers are still reluctant to seek for help from librarians (Guy, 2013:1).

As the information needs of researchers keep on changing, so must the role of library information profession in relation to research support services (RLUK, 2012:1). Academic libraries have put more emphasis on continuous professional development courses as a way of extending RDM service training to librarians. These training may focus on copyright issues, privacy issues, creating DMPs and long-term preservation.

Creamer et. al.(2012:18) note that basing on a survey, it was evident that the greatest need for librarians is technical hands-on training in line with digital description and curation of large data

sets. This means that, all librarians with interest in data curation development and data management to support eScience should train more in Data Curation Management competences.

#### **2.3.4.3 Training ICT staff**

A conversation among several research professional bodies highlighted the need for a research data specialist. Universities develop RDM policies and at the same time identify skilled staff like IT specialist to implement such policies. However, staffs need to keep up-to-date to remain relevant (Kennan, 2016:6; Learn Project, n. d.)

Institutions provide a variety of IT services, equipment but in most cases ICT staffs are not up to date in terms of practical skills. Such detailed support enables post-graduate students to access RDM online courses and appropriate RDM advice. Researchers are always troubled with storage space for data. Drop box greatly support researchers with extra space although the space race promotion has expired (Bruce, 2015;TheUniversity of Nottingham, 2017; Kaye, 2015). ICT staff therefore needs to be equipped with such the latest development in terms of storage space options.

Enabling researchers to collaborate is one area IT professional need to get trained. Oldfield, et. al. (2012:2) and JISC (2016) note digital technologies support researcher to collaborate, to stay relevant in this competitive era. Tenopir et. al. (2015:18) collaboration enables the creation of “research data network”. This initiative creates platforms thorough which researchers with varied expertise share RDM skills and ideas

This means technology and skills acquired by IT staff have a crucial role to play in creating bridges between collaborators and researchers. There is also need to understand the various RDM services in academic libraries as observed in the next section

#### **2.4 RDM services in academic libraries**

A number of funding institutions, library and information organizations and various stakeholders linked to the library community have seen the importance of offering research data services to academic researches. This move is aimed at ensuring the preservation and access to multi-scale and multi-disciplinary data. Various RDM services in academic libraries are discussed as seen below.



### **2.4.1 RDM Consultancy services**

Customized support and extra hands on training is required by researchers for purposes of checking if their data management skills and techniques are appropriate. Detailed technical support such as designing the database may be needed in the course of the project (Jones, Pryor and Whyte, 2013:10). Reliable technical support is necessary for research projects. Some institutions have got a committed research support team to address technical issues on the project. Technical staffs are usually consulted in the course of bid development. Specialist support rendered by legal advisors, ethics boards, library professionals, and data experts is required by researchers. This determines the success of RDM as researchers get certain about the expertise and application required (University of Glasgow, 2017).

Services provided by of librarians, researchers and IT staff require skilled professionals who ensure that researchers are given dedicated consultation services in terms of storage, management, archiving and sharing data. Additionally experienced staff are in position to support researchers to enable them comprehend and meet funder requirements, identify suitable active data storage, help to draft and review data management plans, choose repositories and prepare data for appropriate archiving (Jones ,2011:3)

Consultation services are necessary for researchers as they provide best practices to ensure the availability of research data in the future. However libraries need to RDM guidance and help desk services as discussed in the next section.

### **2.4.2 RDM guidance and help desk**

To Jones, Pryor and Whyte (2013:8) sufficient RDM guidance through institutional Web pages and training services need to be provided to address the needs of different audiences. One-on-one consultation services enable researchers to ask detailed and specific questions. This arrangement supports researchers to acquire suitable approaches and skills relating to creation management and sharing of their data.

Several institutions have created websites to purposely collect best practice as well as provide local support to researchers. Using RDM related terms such as repository, backup, storage and data ownership, aids getting relevant content when searching websites. Additionally support services are provided through interviews, workshops and emails (Jones, 2012; DCC 2017).

General email addresses are effective in addressing RDM related queries. Helpdesk systems need to be utilized and at the same time provide RDM schema questions to assist researchers when making enquiries. Researchers also feel comfortable to work with named contacts. All these avenues can be provided by the library as a way of supporting RDM services. This discussion has similar views with Jones, Pryor and Whyte 2013. Although RDM guidance and helpdesk are important services for RDM support, the library can as well provide data preparation for publication as discussed in the next section.

### **2.4.3 Preparing data for publication**

Information is the life –blood of any institution. For institutions to effectively manage their information and information system, three questions need to be addressed; what is information, what relevance it has to the organization, and how people utilize it in the organization. Information resources cover all the specialists, hardware and software, equipment which institutions employ in the collection, handling, storing, disseminating and using its data and information. Information resource management encompasses policies, actions and procedures relating to both automated and non-automated information that is established by management to address the entire current and future needs of the institution (Knox, 2007:2; Horton, 1981)

Information management requires balancing the concerns of introducing information technology with prioritizing information as a key resource. When preparing data there is need to manage information as objects. This support identification, collection and organization of other information.

Basing on the amount of effort and expense attached to data curation, one would wonder why curate research data? Some scholars such as Day (2010:4-9) and Boock & Chadwell (2010:2-3) explain why it is necessary:

- Data curation is an integral part of the research process, where by validation and replication of research is achieved. The authors note that some disciplines take sharing and openness as an important aspect.
- Research data has got extrinsic and intrinsic value that can be protected by data curation. Institutions invest heavily in the capture and analysing of data. Data curation ensures data safety during usage.

- Data curation creates an opportunity for researchers to create new knowledge from the available data. This practice is more evident through re-using data, data mining and re-analysing analysing data.
- Research funding bodies require all their beneficiaries to apply data curation when dealing with research data. This practice would be ideal when open access becomes a requirement for all research oriented institutions.
- Data curation earns credit to the institutions, the research group or a particular researcher. Through re-using research data, the visibility and research impact is promoted.

Research data is observed as an asset. For research led institution to be recognized there is need to store both research data and the publications. This practice is ideal for data-intensive sciences. It is worthy introducing data curation arrangement at the onset of the project.

Simbulan (2013:494) argues that effective data curation involves documenting the context in which data was created including the protocols and instruments used. Researchers are expected to openly avail research data as required by funders. However, to ensure that data are accessible, searchable and retrievable, special curation actions must be taken to prepare them for reusing as well as

- “quality assurance,
- file integrity checks,
- document review,
- metadata creation for discoverability, and
- file transformations into archival formats” (Data Curation Network, 2016:1).

Research data generated by institutions is heterogeneous and multidisciplinary in nature. This implies data curation cannot be conducted by few experts. Beside the need for data curation experts, University of Bath (2011:2) emphasizes the preparation of explanatory metadata alongside research data. This supports researchers with quick retrieval of the required data. Citations need to be created and given to depositing authors for their respective papers. After publication of such papers, a link should be made to the respective dataset catalogue.

Effective preparation requires assigning persistent and unique identifiers to the data to ensure easy retrieval. Passing the identifier through the Digital Object Identifiers, Handles and resolver service, access to the correct version of data are assured. Preparing data for publication is a

good practice for researchers and the entire institution. However, planning for data management is also important.

#### **2.4.4 Data management planning (DMP)**

Planning for data management is a collective action which calls for effective communication and involves teams like the research community members, data librarians, and members from research office (Jones, Pryor and Whyte, 2013:12). DMPs are required by funders as an integral element of research grant application (DCC, 2017). Although each funder has a different area of concern, emphasis is put on the collection, management, sharing and preservation of data (Jones, Pryor and Whyte, 2013:11).

Universities are requesting researchers to develop DMPs. However, institutions need to provide templates and guidance on what should be reflected in the plan. These act as data checklists and pointers in relation to the development of DMPs.

University of Bath (2012) through the research360 project, a very popular template for postgraduates was developed which is expected to be concise, relevant and useful as a teaching aid. According to the University of Wisconsin-Madison (2011), another template known as the 'What's your data plan?' was developed to assist in describing data management plan as required by the NSF grant application.

These are in form of detailed lists of questions that are observed as well as a series of guidance notes intended to aid in the completion of a DMP.

Suitable guidance on the storage and management of data are expected to be offered by institutions. This enables researchers to get familiar with the prevailing support and services (Jones, Pryor and Whyte, 2013:11). Provision of the related guidance and examples is worthy to be shared as a way of raising awareness and at the same time meet funder requirements. Planning for the management of data ensures quick access and retrieval of data thus supporting future continuation of research findings. However, libraries need to provide data selection criteria as discussed in the section below.

#### **2.4.5 Establishing criteria for selection decision**

Having a road map that aids selection of data is essential for research oriented institutions. According to Whyte and Wilson (2010:4) seven criteria were proposed as observed below:

- Data contents should be relevant to the mission of the institution, and in line with funder's policies as well as any legal requirement, and to be kept past its immediate use.
- Data should be associated with social, scientific and cultural significance. This can be determined by anticipating the future of data basing on contemporary research and relevance to education.
- Exceptional data should be considered for selection. Unique data can be subjected to categories such as extinction if not accepted and being the most complete source of information.
- The ability to redistribute is yet another aspect that qualifies data to be selected. Integrity, usability and reliability can be established through the given technical criteria and intellectual property.
- Data considered for selection should not be subjected to replications because it would not make any economic sense.
- Financial assurance leads to the consideration of data resources. Data with future can secure economic support meant for the management and preservation of data.
- Fully documented data resource can be considered for selection. Such data can be instrumental in future discovery, access and reuse with support from metadata, provenance as well as the context.

It is practically impossible to store all digital data. The practice of selecting is the clear distinction between primary purpose and secondary purpose for which data was created and for which data will be preserved respectively. In the process of developing a data selection criteria there is need to identify the various stakeholders who should be involved.

Data librarians play an important role in the development of selection criteria. Consulting other communities like local data managers is necessary. Such stakeholders are in position to determine what makes data an asset as well as ensuring data longevity (Whyte & Wilson, 2010:3). Besides the involvement of stakeholders, organizations provide guidelines to both researchers and institutional data repositories. Maintaining high standards of responsible research and observing retention periods support in the development of selection criteria (Australian Government, 2007:10:12).

Complying with the funder's data policies is important. Technical personnel are necessary during selection. They assist in selecting which data to retain, why and for how long. Primary data and research evidence is always retained and made accessible for a period of ten years

whereas research subjected to clinical, major social, and environment is retained for 20 years plus. Establishing a selection criterion determines which kind of data will be preserved for posterity. Although this process is very important in the identifying significant and relevant data, it is also necessary to identify and discuss RDM services that require sustainability.

## **2.5 RDM services that would require sustainability planning**

It appears that several components of RDM need very specific planning for sustainability. Each of these is discussed in more detail below:

### **2.5.1 IT infrastructure**

Having a clear understating of what is needed by whom and ensuring that everyone involved in resourcing and supporting the infrastructure is aware of the importance of implementing it (University of Oxford, 2014:5) is significant. Researchers belong to various disciplinary background, as the result they tend to have different views on the necessity or requirement in relation to the development of RDM service. RDM services are due to the increasing collaborative nature among researchers (Jones, Pryor, Whyte, 2013:2). This enables researchers to exchange data across platforms.

### **2.5.2 RDM platforms**

Creating an effective RDM platform, various requirements have to be observed and they include:

- using the prevailing current information systems of the University ;
- providing a friendly interface for depositing data and intuitive in nature;
- allowing metadata only records and research data stored elsewhere;
- allowing the embargo research data until the specified time period;
- creating Digital Object Identifier upon research data publication;
- preserving research data for at least ten years; and
- providing easy searching of metadata and metrics on access (Brewerton, 2015).

The common requirement that seem to come into view is ensuring a globally-accessible cross-platform file store that enables all collaborators to access to access data, regardless of their geographical location. However most organizations are operating under pressure hence a need for High Performance Computing to reduce costs and increase efficiency as well as making better and faster decisions.

### **2.5.3 Data catalogues**

Research oriented organizations are required to have a comprehensive list of the research data being held and at the same time provide online access of the metadata so that discoverability and reuse is assured. To ensure easy discovery and effective usage of research data by other researchers, satisfactory metadata needs to be captured and made openly available to support comprehension and reuse of data. Additionally an instructional manual aiding data access should be published together with the results; to understand the kind of research data that is available, why, when and how it was generated data catalogues need to have adequate metadata (Jones, Pryor and Whyte, 2013:19). Data catalogues use metadata schema to ensure accuracy and consistency when identifying, citing and retrieving data (DataCite Schema, 2016).

The practice of assigning persistent identifiers to datasets ensures the development of an infrastructure that aids friendly and effective means of citing, discovering and accessing data (Research councils UK, 2015). Jones, Pryor and Whyte (2013) agrees with the discussion that data finding initiatives such as providing compulsory administrative information like grant number, funder details and discipline specific metadata is ideal for describing big volumes of data generated by institutions. Although libraries can provide data catalogues to support in recording research data and make it available and accessible for easy discoverability and reuse, data repositories is yet another RDM aspect the library could pay attention too.

### **2.5.4 Data repositories**

Data repositories are ideal for the preservation, management and providing access to digital materials in various formats. It is necessary to select a suitable data repository that suits both the generated data and the intended users (MONASH University, 2017). However it is vital to establish submission requirements, data documentation, metadata standards and intellectual property rights concerning data repositories; locating data and long term preservation is assured. Researchers and graduate students professionally collaborate via data repositories. This is evident through controlling their research findings, uploading any file format, describing their own data and enabling data citation through the Digital Object Identifier (Austin et al., 2015:3).

Funded discipline specific repositories support the co-existence of both research data and data from the same discipline. However, for institutional research data to be effectively managed,

there is need to develop and maintain institutional data repository, liaise with external research data repositories and indicate relevant services for researchers (Strasser et al. 2012:4).

Repositories are set up to manage research publication in line with standard metadata guidelines, and their technical infrastructure can be readjusted to suit an effective and efficient RDM service. However this involves consulting institutions which are already using similar repositories. Alternatively, joining research professional bodies aiming at promoting the management of repositories would be ideal in discussing and exchanging experience and knowledge to develop RDM service (Jones, Pryor and Whyte, 2013:18). Data repositories cannot solely support the development of RDM service. Data catalogues are also instrumental in the discovery of research data.

### **2.5.5 Cloud Storage Services**

According to the University of Sheffield (2017); The National Archives (2014:8); JISC (2014); Jones, Pryor, Whyte (2013:13), researchers from different disciplines, institutions and private corporation collaborate professionally through the cloud. Cloud storage is associated with benefits such as limited cost with great output, flexibility, online access, recoverability option in case of a disaster, innovative options and allowing real time collaboration. As institutions are pressurized to improve RDM, cloud computing is observed as a long-lasting solution that can reduce costs and increase performance.

Universities resort to cloud services as an option to reduce capital investment and at the same time establish in-house service. If cloud services are perfectly developed, a solid platform for RDM will be attained thus attracting more research projects. In the development of an effective RDM service various stakeholders are involved however the library is regarded as a key stakeholder because it is in charge of receiving data for curation.

## **2.6 The role of the library in keeping track of the legal requirements**

### **2.6.1 Importance of working across legal jurisdictions**

Research data under legal jurisdictions is associated with benefits such as; making subject access requests, avoiding causing damage when processing, and addressing compensation and destroying inaccurate data. MONASH University (2017); JISC, (2016); JISC, ( 2014) note that since 1998, researchers were expected to comply with the Data Protection Act.1998.



According to University of Strathclyde Glasgow (2012) the Data Protection Act 1998(UK) enables researchers to maintain privacy over their personal details. Supervisors and their candidates must observe research data planning thus documenting copyright ownership, ethical requirements, retention periods, secure storage, restricted access and detailed metadata. Personal creative works are protected from manipulation. Liabilities arising from copyright infringement between researchers and employers are easily addressed.

According to JISC (2014), data subjects have got numerous rights that need to be observed and failure can cause the data controller to face criminal charges.

### **2.6.2 Legislative requirements for RDM**

Research funders require funded research to be made available for discovery and examinations by other researchers; open data enables comparative studies and data mining thus discovering new and quality knowledge (Research Council UK, 2015:18). Releasing research data without clear legislation in reference to usage of data in a given context can cause conflicts among research. Making research data open is more complex as it is associated with varying field values, field names, and structure.

The practice of making data open deters fraud, and encourages learning from both success and mistakes related to research; Interfaces for entering data, data reports and visualizations are usually treated differently; therefore researchers need to be conversant with legal restrictions (Ball, 2014:2) although technology advancement has influenced the way data are created, and accessed.

Legal issues ensure that researchers are certain of the existing regulatory environment, observe the management of sensitive data and intellectual property rights; making data available alongside associated tools and protocols ensures research efficiency by reducing costs associated with collecting data and the chances of duplication (McGeever, Whyte, Molloy .2015:3). Operating across legal jurisdictions with RDM in Uganda is yet another crucial aspect worth to be discussed in the next section.

### **2.6.3 Ugandan legislation relevant to RDM**

Intellectual property rights give the right to prevent others from copying, manufacturing, and importing an invention minus the owner's permission (JISC, 2014). Universities have resorted to protecting research data, research outputs and innovation (Makerere University, 2008:3).

Through the Intellectual Property Management Policy, innovative ideas have been supported and promoted. The policy stipulates that all staff involved in approved research must submit a copy of their findings to the concerned Intellectual Property unit (Makerere University, 2008:8).

Legislations ensure data availability to peer researchers, indicate the various avenues through which access to data can be granted, how the applications will be evaluated and how data will be availed if data sharing application is accepted (Uganda Virus Research Institute,2016:2).This ensures data are shared after anonymisation, controlled public access after a screen process, and exclusive access by primary researchers. Recording and storing new discoveries, inventing new formula, acquiring indigenous knowledge, and upgrading machines are assured. The research office is significant in the development RDM service.

## **2.7 In summary**

All research-led institutions should integrate RDM practices in their research activities. RDM practices come along with benefits such as compliance with funding and regulatory requirements, research integrity and validation. Discoverability of research data and datasets is assured thereby supporting further research outputs.

Policies and procedures are necessary for RDM. With the ever-skyrocketing volumes of research data there is a need to have governing policies to ensure that every stakeholder complies with the stipulated policies

Advocating for the introduction of RDM practices is fundamental in determining the acceptance of an RDM initiative. Convincing the various stakeholders before implementation helps to reduce resistance to the new initiative that needs to be rolled out to the institution.

Several phases for the development of RDM were identified. These include; assessing RDM needs, building RDM partnership, RDM capacity building and the formulation of an RDM policy - which is the most crucial phase amongst all. This is because the policy drives all RDM-related activities in the institution.

Aligning the RDM strategy with the organisation's research strategy is another wise move that encourages top administrators to provide the necessary support in terms of finances and permission to operate. Additionally, alignment clearly indicates that data management remains an integral part of the lifecycle of all research output.

Various role players are instrumental in the development of RDM practices. The University management, funders, researchers, ICT and librarians support and complement each other in the development of an effective RDM eco system.

Capacity building is necessary for an effective RDM initiative. This is because academic staff, postgraduate students, librarians and IT specialists need to keep up with the latest developments in terms of improving RDM services and also getting to know new RDM products and service that are readily available in the market.

RDM technologies should operate as an integrated system because if one technology (for example the repository) breaks down RDM will be inefficient. A case in point: If data storage is not systematic and controlled, data retrieval, through data catalogues, will be complex- even impossible.

## CHAPTER THREE: RESEARCH METHODOLOGY

### 3.1. Introduction

This chapter describes the research design and methods for this particular study. It identifies the processes of gathering, analysing and interpreting data that will be used to answer the research questions that guide this study. This chapter starts with the research design, which describes the research methodology followed. It will further describe the population of this study. It will attempt to look at the data collection tools that will be used in the process of collecting data.

In order to investigate about the role academic libraries should play in developing RDM services at Makerere University Library, the following research questions will have to be answered:

Which of the library's RDM services would require sustainability planning if introduced at Makerere University?

What are our top researchers currently doing with their data and how would the suggested library services be of use to them and their students?

### 3.2. Research design

Research designs provide direction on how research is to be conducted (Sarantakos, 2005:106). Research design is very vital in directing research and explains time usage and resources required to accomplish research. In addition research design provides a plan on how research participants will be selected and how information will be acquired from them (Welman, Kruger & Mitchell, 2005:52).

Creswell (2014:3-4) notes that there are two commonly used approaches to research, namely qualitative and quantitative research and when these two are combined it is known as mixed methods. Qualitative research aims at understanding the meaning human beings allocate to social problems.

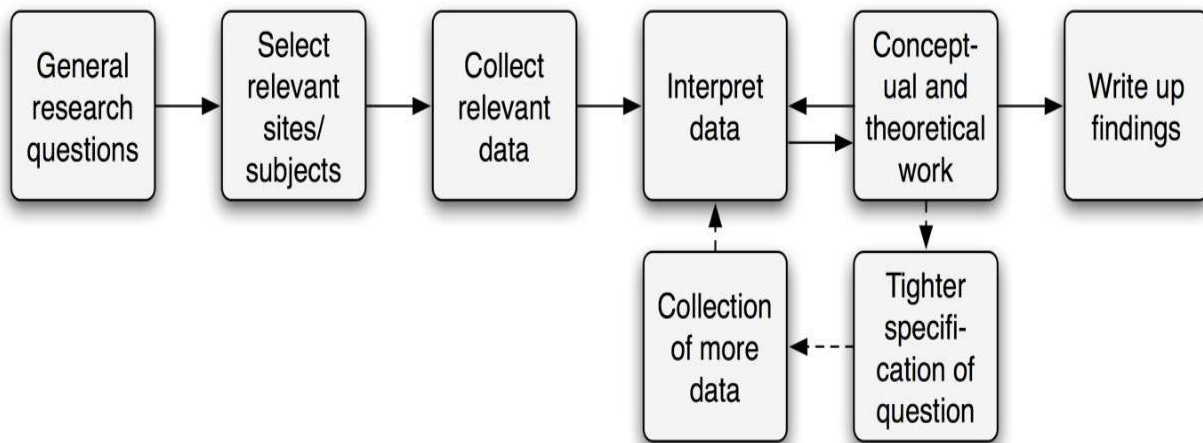
Qualitative research explores issues conducted in a natural environment to comprehend phenomena and be in position to respond to questions using detailed studies of small groups of people. Qualitative research studies are regarded appropriate:

- when the researcher intends to acquire recent insights about a specific phenomenon;
- If a researcher intends to test the validity of certain generalized research;

- If the researcher intends to establish the effectiveness of certain policies, innovations or practices (Leedy & Ormond, 2013:140).

Sarantako (2005:106-112) explains that the nature of a research problem determines the type of research design to be applied. Unlike qualitative research design which is flexible in relation to the set plan of investigation, quantitative research design is rigid in following the set plan of investigation. For example, in qualitative research the practice of navigating between data collection and data analysis steps (see Figure 1) is permissible, thereby enabling the usage of new information to elaborate more about the concepts, sampling techniques and data analysis. The combination of both qualitative and quantitative design results into a mixed method research design.

**Figure5: Steps of flexible qualitative design process**



**(Source: Copernicus Consulting, 2009)**

Sarantakos (2005:45) notes that qualitative research approach is associated with features such as:

- Small sample size of people for the study;
- Holistic attention extended to the entire study object;
- Non-numerical descriptive data are often presented;
- Research designs, methods and processes which are subjected to change;
- Interaction between the researcher and selected participants for the study is possible in order to gain a clear understanding of the people's views and meanings;

- Exploration of issues, understating social phenomena and exposition of causes of a particular problem. Emphasis is not put on measuring people but to understand them.

Quantitative research scrutinizes social phenomena by measuring various variables in terms of numerical analysis. Through tables, numbers and percentages qualitative data are presented. However, results obtained from qualitative research are presented in descriptive and narrative form (Babbie, 2009:35). The nature of investigated problem or study determines the approach to be used for a particular study.

This particular research used a qualitative research design for the following reasons: The design is flexible and allows for an iterative data analysis process. RDM is a new concept at Makerere University and at the design stage of the research it was anticipated that it would be better to gain in-depth knowledge about the understanding and the championing required to make a success of RDM services.

### **3.3 Research methodology**

Researchers are exposed to different research methodologies that give them specific direction for conducting research based upon the research design used. Qualitative research is subjected to methodologies such as narrative research, ethnographies, phenomenology, grounded theory studies and case studies.

**Narrative research:** This type of research is based on stories told by human beings. Through such conversations, past and present actions as well as imagined world experiences are explained and interpreted. These narrative stories are filled with social and cultural meaning; the meaning we give to our lives and to all what happens around us (Mendieta, 2013:136).

**Ethnographies:** This is a style of research rather than a single method and uses a variety of techniques to collect data. According to Brewer (2000:10) ethnographies is the study of people in naturally occurring settings or fields by means of methods which capture their social meanings and ordinary activities, involving the researcher participating directly in the setting, if not also the activities, in order to collect data in a systematic manner but without meaning being imposed on them externally.

**Phenomenology:** Is concerned with the study of experience from the perspective of the individual, 'bracketing' taken-for-granted assumptions and usual ways of perceiving. Phenomenological methods are particularly effective at bringing to the fore the experiences and

perceptions of individuals from their own perspectives, and therefore at challenging structural or normative assumptions (Lester, n.d.).

Grounded theory studies: Among interpretive and qualitative research methods, grounded theory “is an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data”(Martin and Turner, 1986:141).

However, in the process of performing qualitative research in social sciences, **case study research** is observed to be the most appropriate (Leedy & Ormond, 2013: 141-148).

According to Leedy and Ormrod (2013: 141), a case study is defined as “a particular individual, program, or event studied in-depth for a defined period of time.” A case study enables a researcher to clearly understand how a particular person, a group or social setting performs through gathering detailed information about the subject. A case study is performed in a natural environment, suitable for conducting detailed analysis and in most cases calls for a single or few cases. Minimal interference between the study population and researcher can be supported by a case study strategy, and various data collection methods such as observation, questionnaires, interviews and data analysis can be used. Case studies support intensive data analysis because although the sample size of the study population could be small the ‘case’ is investigated in much detail. Case studies can either be associated with descriptive, exploratory or explanatory features.

In spite of the numerous contributions case study research has extended to various disciplines. Many researchers have continuously regarded case study methodology unsuitable for conducting research. According to Sarantakos (2005:212) a case study is often an exploratory study prior to conducting quantitative research. Researchers also emphasize that scientific generalization of research findings cannot be supported by case study research because research findings are restricted to a specific community at a particular time. Kumar (2011:126) further explains that a case study includes identifying specific instances and only some cases are studied intensively.

This was a perfect match in the proposed research that wanted to carefully study the role academic libraries should play in the development of RDM services at Makerere University Library. A case study research strategy was therefore adopted because it enabled exploration

and analysis of the life of a given social environment such as exploring and analysing the role of academic libraries should play in the development of RDM services at Makerere University.

### **3.4 Research target population**

According to Gerring (2012:75), a population is “the universe of phenomena that a hypothesis seeks to describe or explain”. Welman, Kruger & Mitchell (2005:52) further explains that research population includes organizations, groups of people and individuals who are regarded to be objects under study. The target population refers to a group of people or community a research intends to investigate.

When the target population is too large to include in the investigation a sample is often identified from the research population. Research questions enable the researcher to steer both the data collection site and study population. However it is important to always ensure the accessibility of the target population before selecting the population (Berg, 2009:46). The population under study should have the same characteristics to support generalization.

The research target population for this particular study is the top researchers that are actively engaged in the generation of research data at Makerere University. There are nine colleges which include; College of Agricultural and Environmental Sciences, College of Business and Management Sciences, College of Computing and Information Sciences, College of Education and External Studies, College of Engineering, Design, Art and Technology, College of Health Sciences, College of Humanities and Social Sciences, College of Natural Sciences, College of Veterinary Medicine, Animal Resources & Bio-security, and The school of law. These colleges accommodate postgraduate students who generate research data. In total the target population is one hundred people. Given the time and resource limitations for this study it was decided to select a sample population.

### **3.5 Sample size and technique**

Sampling is a process of selecting a specific number of individuals or objects from the study population whereby the selected individual or objects have similar characteristics to that of the entire population (Kombo and Trombo, 2006:77; Odiya, 2009:159).

Sampling enables a researcher to study a smaller portion of the target population in order to achieve data that represents the whole target population. A sample therefore symbolizes part of the population to be studied. According to Welman, Kruger & Mitchell (2005:52) in order to



generalize results, a sample has to be representative of the whole population. Researchers have to determine the respondents to be studied, the environment where research will be performed as well as time before deciding on the type of sampling to apply.

Sampling is observed to be necessary because:

- Time is saved during data collection since collection is done from the entire population;
- Less financial resources are required compare in regard to techniques like printed questionnaires;
- Proper investigation, better supervision and accurate data analysis is easily achieved (Blumberg, Cooper and Schindler, 2008:228).

However sampling is associated with limitations such as intense planning and administration as noted by (Sarantakos, 2005:153).

There are two types of sampling methods. According to (Berg, 2009:50) qualitative research is aligned with non-probability sampling. On the other hand quantitative research is applicable to exploratory research and qualitative data analysis.

To determine sample size the following requirements need to be observed;

- Smaller samples for qualitative research are unlike quantitative research;
- Nature of the study, for instance case studies call for small samples yet surveys require a large sample;
- Adequate time and financial resources need to be available;
- The target population needs to be homogenous.

Cohen, Manion & Morrison (2007:113) note that non-probability sampling methods include quota sampling, snowballing sampling, convenience sampling, and purposive sampling.

Quota sampling: This is a type of non-probability sample in which the researcher selects people according to some fixed quota. Under this arrangement, the researcher uses his judgment to select from the population of the study. The researcher first stratifies the population into groups on the basis of pre-specified characteristics (age, race, place, status, and many more) before using personal judgment to select from each strata based on a given number to represent the sample (Yang,K and Banamah, A. 2013:5).

Snowballing sampling: This is a research technique through survey and data registration which is usually used in sociology, psychology, or management studies, and recommended when: the population cannot be strictly detailed for instance homeless people (Dragan,I. and Isaic-Maniu,A., 2013:160).

Convenience sampling: This Convenience sampling alternatively known as availability sampling is a specific type of non-probability sampling method that relies on data collection from population members who are conveniently available to participate in the study. Facebook polls serve as a good example for convenience sampling. In this case the first available data will be used for research without additional requirements (Farrokhi and Mahmoudi-Hamidabad, 2012:785).

In order to select the sample, this study shall employ **purposive sampling**. According to (Berg,2009:50) researchers that adopt purposive sampling base on their judgment to select respondents that are suitable to the study.

According to Neuman (2012:149) purposive sampling is ideal in the following situations:

- When detailed investigation is needed.
- In case the research participants or units of analysis are informative.
- When the target population is not easily reached.

Flicker (2009:124) notes that based on the nature of the study, and challenges associated to individuals, time and finance, all employees from the entire population can hardly be interviewed. Therefore the researcher shall use a purposive sample of ten (10) interviewees from the nine colleges and one school of law at Makerere University who actively engaged in the management of research data. These shall be selected basing on the interviewees' knowledge of both management and operational activities of the previous or prevailing RDM projects. For instance; an interviewee from each college and the school of law, will be expected to have knowledge about the concept of RDM, academic libraries and their roles in RDM, various RDM services libraries can provide, which of the RDM services require sustainability planning and how research data are currently dealt with, and how will the proposed service library services be of use to them and their students.

### 3.6 Data collection methods

The researcher is required to identify and apply data collection methods to collect data that responds to the research question(s). There are specific data collection methods associated with qualitative research (Ellis, 2010:33; Yin, 2011:130; Sauro, 2015) and these include:

- Content analysis which enables the study of human recorded information. Additionally (Kohlbacher, 2006) gives detailed information concerning content analysis as a method meant for qualitative research.
- Interviews which are regarded as a dialogue between the interviewer and the interviewee with the purpose of gathering data relating to specific topics (Harrell and Bradley,2009:6) highlighted more about interviews as a method of data collection
- Participant observation, under this method, physical interaction is not involved in the process of collecting data. However, According to Harrell and Bradley (2009:6) participants tend to be uncomfortable once they realize the presence of the researcher.

According to (Kombo and Tromp 2006:92; Odiya, 2009:173) interviewing is a method of research data collection, which involves one-on-one interactions between the researcher and the participants or interviewee whereby researchers asks questions and the respondent reply's orally. Interviews take different forms which include:

- Structured interviews –Questions meant to be asked as well as their order is established before the interview. The interviewer should not deviate from the structured schedule (Ellis, 2010:48).
- Semi- structured interviews – Are based on an interview guide that allows the researcher to seek for information if there is need.
- Unstructured interview - the question is subjected to change and altered based on the needs of the researcher (Kombo and Tromp, 2006:92).

In relation to this research, a semi-structured interview was used and a list of questions which the researcher intends to cover was developed (see Appendix B). The researcher had the liberty to modify the questions whenever the need to collect more required data surfaced as Kombo and Tromp (2006:92) also explained.

Semi-structured interviews will be regarded to be appropriate for this study because:

- The Interviewer has a chance to further clarify the question in case of misrepresentation and misunderstanding the question.
- They have both open and closed ended questions.
- Collection of in-depth information is possible since the researcher has a chance to ask for more information.
- The interviewer is in position to supplement information collected from interviews with the information attained through observing RDM activities and processes (Kumar, 2011:150; Kombo & Tromp, 2006:93-94; Babbie, 2010:274, Ellis, 2010:43).

### **3.7 Data collection tool**

The researcher designed an interview guide (**See appendix B**). An interview guide is a document that provides information to steer the research process (Odiya, 2009:186). It can also be defined as a group of logically set questions that the researcher wants to ask the participants (Patton, 2002:343)

An interview guide was preferred because the participants can seek clarification from the researcher that results into exploring into issues leading to deeper searching as noted by Odiya (2009:187)

### **3.8 Data analysis and interpretation**

Data analysis entails organizing data in an acceptable manner to ease interpretation of the study findings. At the data analysis stage the researcher identifies patterns and builds generalizations. With support from data analysis, researchers will make judgments based on evidence and reach conclusions so that the research questions could be answered. Qualitative data are presented in written words, symbols that describe individuals, and actions in social life (Neuman, 2012:352). Too much data collection makes qualitative data analysis complex. Qualitative data requires reducing and changing into understandable information that can result into different patterns for easy analysis. (Neuman, 2012:354).

Data were analysed by listening to audio recordings and then transcribing the interviews into Microsoft Word. Thereafter data was entered into Microsoft Excel because tabular representation was required at one point. Themes were assigned to the qualitative data (answers to the open ended questions This technique was noted by both Sarantakos (2005:345) and Flick (2009:232).

### **3.9 Ethical considerations**

The research observed specific codes of ethics before data was collected. According to Flick (2009:36), the code of ethics is formulated to manage the relationship between the researcher, the research field and the participants from whom data are collected.

In order to adhere to the research ethics, the researcher shall seek clearance from the University of Pretoria as a permit to support the data collection process prior to the approval of the data collection instrument. According to Odiya (2009:98) research permit is required by the researcher before data collection.

The researcher obtained consent from the participants in the form of an informed consent form that was signed to ensure that the researcher was permitted to collect the relevant data. Kombo and Tromp (2006:82) and Flick (2009:37) explain that the consent form ensures interviewees participate willingly in research activities.

The research shall also maintain anonymity and confidentiality of the participants whereby during presentation of the findings the identity of interviewees cannot be identified.

### **3.10 In summary**

Chapter three describes the research methodology, the design and the approach that were used to guide the research. The target population identification and sampling techniques were described and the data collection method, the data collection instrument, namely an interview schedule, as well as the data analysis and interpretation techniques were discussed in some detail. The chapter concluded with a brief description of the ethical considerations.

## **CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION**

### **4.1 Introduction**

This chapter presents the data that was gathered and interpreted to extract meaning for purposes of finding solutions to the central research question and the related sub questions that sought to identify the following:

1. What are the different RDM services that could be offered by an academic library such as Makerere University Library?
2. Which of these services would require sustainability planning if introduced at Makerere University?
3. What are the top researchers currently doing with their data and how would the suggested library services be of use to them and their students?

Data collected was also compared to the literature reviewed in chapter two to ascertain the relationship between the primary data, as obtained from interviews, and the secondary data identified in the literature that was interrogated.

Nine colleges and one school of law at Makerere University were selected to establish the role the academic library could play in developing Research Data Services at Makerere University.

As earlier indicated in section 3.5, these colleges were selected because they are actively involved in research projects and the researcher anticipated that he would be able to collect sufficient knowledge concerning the sub questions from these units so he would be able to answer the central research question.

The researcher planned to interview ten (10) respondents but due to time constraints only eight respondents A, B, C, D, E, F, G and H participated in this research. However, this did not interfere with the findings because the respondents I and J that belong to colleges which were left out do not actively engage in research at Makerere University. These colleges include the College of Education where research is optional and the School of Law which mainly deals in law cases.

### **4.2 Data analysis**

The data analysis section that follows kept to the structure of the interview schedule (see Appendix A) that was used to collect data from the eight college representatives. The data were

anonymised and respondents were identified by alphabetical letters (that is A, B, C, D, E, F, G, and H). Commitment to the respondents and ethical behaviour require the researcher not to disclose the names of the respondents from whom data was collected. Although the analysis was done in the order of the questions asked during the interviews certain situations led to questions being combined to ensure that ideas can flow logically. These responses were later transformed into themes as was recommended by Sarantakos, (2005:345) and Flick, (2009:232) and was discussed in section 3.8 of chapter three).

The interview schedule was subdivided into six sections (A to F) – each with an associated number of questions. Section 4.3 below addresses the questions asked in section A – the concept RDM.

### **4.3 Concept of RDM**

During the interviews, the researcher wanted to determine how various respondents understand the concept of managing research data (RDM) and a smaller number only three (A, C, and H) of the eight respondents demonstrated knowledge of the concept (which was defined in Chapter 2 as the organization and description of data, from its entry to the research cycle through dissemination and archiving of valuable assets). The researcher listened for phrases such as; management of data throughout its lifecycle or cleaning the data and terms such as; collection, analysis, storage, code, protect, preservation or archiving and documenting data for future research as these were expected in the responses got from the interviewees and in line with the discussion in section 2.2 of chapter two.

It is therefore possible to assume that RDM is still a new concept at Makerere University. It was possible to observe that respondents who are directly engaged in research (A, C, and H) have several publications also had more knowledge about the concept of RDM. Respondents with limited knowledge about the concept of RDM (B, D, E, G, and H) were less engaged in research activities and had not published for a while. This implies that the concept of managing research data are more familiar to researchers who have continuously published than their counterparts who publish once in a while during the last five years.

It was also noted that respondents (A, C, and H) who are actively participating in research were aware about the significance of effective management of data, as they reported a need to comply with funder's requirements, engage in research reproducibility, protect data and create a

strong foundation for future research. These requirements were aligned to those stated by the University of BRISTOL (2012) and that were recorded in section 2.2.1.

Section 2.2.2 of this document discusses the various role players in detail. Respondents (B and E) were aware of the various role players required to together develop RDM services in academic institutions. Respondents (B) noted that researchers need to be engaged in the development of research data services whereas the other respondent (E) noted that librarians need to play a leading role in orienting researchers about the importance of managing and sharing research data. It therefore appears that championing the RDM initiative could be an opportunity for academic libraries. It could create avenues for librarians to be more involved in research activities and to establish a role in the RDM initiative.

After attaining the views of RDM from the various respondents, the researcher was interested in knowing the extent to which both staff and post-graduates, linked to various colleges in the university, manage their own research data. This aspect is addressed in the next section.

#### **4.3.1 The extent to which researchers manage their data**

In section B of the interview schedule the researcher wanted to establish what the current RDM practice is at Makerere University. The findings revealed that data are currently managed by the owners themselves as they indicated that most of the researchers manage their own data individually by keeping the data on their personal computers, laptops, and external drives, and as well as on paper questionnaires. While conducting the interviews it was possible to also observe that researchers stack boxes with questionnaires, sometimes not even labelled, and more often folders containing completed questionnaires in a corner of the office. The manner in which data are currently managed is not aligned with good research practice. The proper management of data, by the respective owners, affects accessibility, discoverability and sharing of the valuable datasets. The current management of data does not meet international standards – refer to section 2.2.1.

It appears that managing and sharing research data, which are in form of pictures, audio files, video files and paper-based questionnaires may be a general problem across the entire university. It appears that utmost care is given to research data up to the level of analysis. Research data are then abandoned and in many cases destroyed completely. It appears that researchers are after results and do not think about reusing that same raw data. This means



that data are not shared, archived in the repositories thus making data discovery difficult when a need for data reuse arises. This implies that access to available research data are still a challenge considering that most of the research data are still under guardianship of the researchers. The situation at Makerere University is not unique as similar issues were stated by Chigwada, Chiparausha and Kasiroor (2017:5) – as was reported in section 2.2.

The researcher observed that respondents, who clearly understood the concept of RDM, could comfortably explain the extent to which data are managed in their respective colleges. On the other hand respondents, who were not familiar with the concept of RDM, struggled to clearly explain the extent to which research data was managed. This implies that active researchers could perhaps more easily establish the extent to which data are managed compared to the researchers who are less engaged in research.

#### **4.3.2 Research funders and data management plans**

In this section, the researcher was interested in identifying the different funders for researchers in their respective disciplines and to determine whether a data management plan is a requirement for funding or not. The discussions revealed that researchers respond to calls for application from different funders. It was also observed that different colleges receive grants from specific funders. For example, College of Health Sciences (CHS) applies for funding to:

- National Institutes of Health from America;
- Grand challenges from Canada;
- GlaxoSmithKline;
- Goethe Institution;
- MRC South Africa;
- Welcome Trust; and
- MRC UK.

The College of Engineering Design and Art (CEDAT) requests funding from:

- NORAD,
- World Bank;
- World Vision; and
- SIDA/SERAC,

The College of Computing and Information Sciences (COCIS) applies for funding from:

- The Bill and Melinda Gates Foundation;
- SAIDE(South African Institute for Distance Education); and
- RUFORUM (Regional Universities Forum for Capacity Building in Agriculture;

The College of Veterinary Animal and Bio Security (COVAB) makes use of:

- Drugs for neglected diseases initiative;
- World Health Organization;
- Government of Uganda;
- FORGHATY;
- Global Health;
- UNICEF.

The researcher observed that most of the research, across all disciplines, is supported by international bodies with limited support from within the country (Uganda). This could imply that the government of Uganda is yet to fully appreciate the significance of research as well as managing data.

It was further observed that most of the funders require a data management plan. Respondents (B, D, E, and H) noted that usually agreements are signed between the funder and the researcher to ensure data will be effectively managed for a given number of years depending on the project. Respondents (A and G) stated that only a detailed progressive report other than a data management plan is required. Funders from Nordic countries do not require data management plans as noted by respondent (F). Respondent(C) said MRC –Medical Research Council has an online data management plan known as ORION where data are deposited. The researcher also noted that generating a DMP as a funding requirement is more common in health related disciplines than in other disciplines. Funders from the United States of America and the United Kingdom have realised the importance of managing data and are very strict with the effective management of health research data compared to Nordic countries and Uganda.

It is however, safe to assume that researchers at Makerere University will have to adhere to the RDM requirements of several funders in the not too distant future.

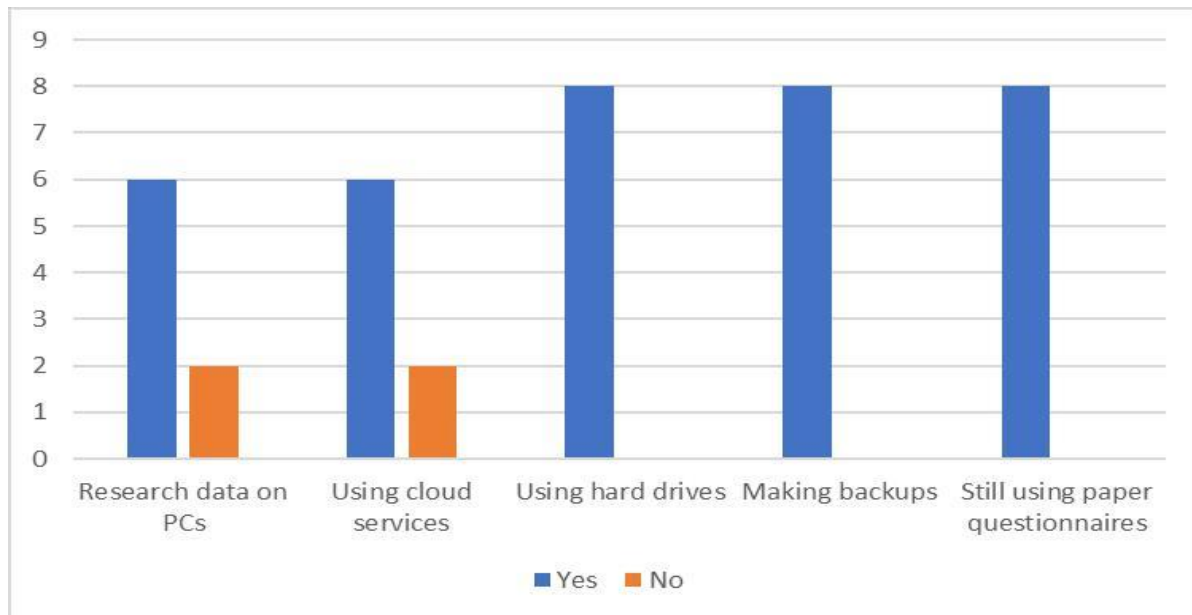
#### **4.4 RDM at Makerere University**

After determining that so few (only three respondents) were able to discuss RDM, further prompting questions were asked. Responses were presented in a tabular form (see Table 1).

Table 1: RDM issues discussed

		Respondents								
		A	B	C	D	E	F	G	H	Analysis
Issues	Shared server / PCs?	PCs	PCs	PCs	Server	PCs	PCs	PCs	Server	6 PCs
	Cloud services?	YES	YES	YES	NO	YES	NO	YES	YES	6 Cloud
	Flash disk (FD) / Hard drive (HD)?	HD	HD	HD	HD	HD	HD	HD	HD	8 HD
	Backups required?	YES	YES	YES	YES	YES	YES	YES	YES	8 Yes
	Paper questionnaires?	YES	YES	YES	YES	YES	YES	YES	YES	8 Yes

Figure 6: An analysis of the general RDM issues discussed



The findings in table 1 revealed that researchers themselves are in total control of the generated research data as explained below:

#### **4.4.1 Shared server or Personal computer (PCs)**

Respondents (A, B, C, E, F, and G) indicated the general use of personal computers to store research data. This is apparently because the safety of research data are questionable once stored on a shared server. This may imply that the researchers feel that their data are more secure when it is kept on personal computers than on any other platform such as a shared server. Respondent (D and H) indicted the use of a shared server to store data. Respondent (C) noted that there is poor coordination in terms of data management and that post graduate students manage their data individually. Respondent (D) said that plans of getting a shared server are underway. It is clear that accessibility of research data is affected resulting into limited usage. Again research practice is not aligned with common principles on data management as was documented in section 2.2.2.

#### **4.4.2 Cloud services**

The discussions further revealed respondents (A, B, C, E, G and H) use cloud-based services. Three respondents (A, B, and E) keep research papers in the cloud but not raw data. This is because researchers are not certain who is responsible for the management and safety of research data in the cloud. On the other hand, respondent (C) indicated that he uses cloud services to be able to collaborate with international colleagues not necessarily to store or manage data. Respondent (D) noted that he isn't familiar with how cloud services work and is also not sure how raw data are managed in the cloud. Respondent (F) noted that cloud services appear to be a good plat form for managing data and worth recommending. The same respondent further noted that large volumes of data are generated in the department of Civil and Environmental Engineering and that the process of uploading and downloading data to the cloud is complex due to limited bandwidth. Respondent (H) noted that the Microsoft cloud system, known as AZURE, has just been introduced and access to data is restricted.

It appears that majority of the researchers are familiar with cloud services but do not store their data in the cloud for various reasons. Most researchers believe that cloud services are ideal for the management of data but not safe for storing their data. It was clarified that user names and passwords are issued so that access to individual accounts is restricted to only the account holder. This, therefore, makes cloud services more secure than hard drives. The current

practice exposes data to high risk of data loss and failure to recover data in case of any disaster.

Again, practice at Makerere University appears to not be in line with that which was reported in section 2.5.5 of the literature review.

#### **4.4.3 Flash disk / external hard drive**

Findings revealed that researchers store the generated research data on external hard drives. Respondents (A, C, D, and F) noted that data are stored on external hard drives to ensure maximum control, access and management. Respondents (B and G) said that researchers are not ready to share the collected data and as a result raw data are kept on external hard drives to properly restrict access. Respondents (E and H) noted that storing data on removable devices depends on the kind of the research project. For instance data for clinical trials are not stored on external hard drives, but for individualized studies researchers have the liberty to keep research data on external hard drives. Respondents (G) said that raw data generated with the support of gadgets such as mobile phones, video cameras and tape recorders are stored on hard drives as a way of ensuring the safety of such data. Keeping data on removable devices exposes data to the high risk of getting lost. External hard drives can be stolen and data are more susceptible to viruses. This implies that although researchers appreciate the importance of keeping data safe, the risk linked to where the data stored is stored is underestimated.

#### **4.4.4 Backups required?**

All the eight respondents indicated that backups are required when dealing with data. Respondents (A and D) said that research data need to be backed up on external hard drives. Respondents (H and B) noted that backups are required because data are susceptible to virus attacks or unintentional data loss and because data are important for audit queries. Respondents (F and G) said backups are ideal because the process of generating data are so expensive and time consuming, so losing data are a great loss to the entire project. Respondent (C) said, data are backed upon external hard drives, especially when travelling as a way of ensuring that data are safe whereas the other respondent (E) indicated that backups are required because continuity is ensured in case data are lost.

From the detail above it is possible to say that researchers in all probability understand the need to create backups for data. However, the media on which data are stored is not secure and data

loss is a very real liability. The practice of backing up research data does guarantee project continuity in case of a catastrophe but backups are not the same as RDM.

#### **4.4.5 Paper questionnaires**

It appears that all researchers still make use of paper questionnaires as instruments to collect research data. Respondents (A, B, C, D, E, and F) noted that all researchers in the entire university still apply paper questionnaires in the process of collecting data. Respondent (C) stated that the use of paper questionnaires can be attributed to the small grants that are inadequate to purchase the expensive palm tops and tablets that help in the electronic data collection. Respondents (G) noted that paper questionnaires are still applicable to postgraduate students, although a few prefer online questionnaires but supervisors are more comfortable with paper questionnaires. Respondent (H) said that paper questionnaires are partially used alongside new technologies such as data fax scans. This converts questionnaires into soft copies to support online analysis.

This section of the interview schedule also asked a question that is related to research funder requirements for data management planning.

#### **4.5 Academic libraries and their role in RDM**

One of the researcher's interests was to determine whether the library supported respondents while managing their research data. From the discussions, it was revealed that the respondents do not make use of the library in the process of managing research data. This is either due to a lack of information on what the library offers or the library currently offers no RDM services.

The researcher then asked respondents how academic libraries could support the management of research data. Respondents (A, B, D, and G) noted that libraries need to be at the forefront in creating awareness about the importance of RDM, developing RDM training programs so as to equip researchers with skills as well as RDM policy development to address the curation, preservation, and access of research data. Respondents (C and H) also said that restricting access to data, providing data analysis systems, and conducting data sharing sensitization are some of the roles academic libraries should take a leading role. Respondent (E) noted that libraries need to support researchers in regard to the development of research instruments such as questionnaires whereas Respondent (F) noted that data repositories need to be developed in the various college libraries to ensure easy management and access of research data. This implies that an academic library is a suitable stakeholder whose role is very instrumental in the

development of RDS in the entire institution as indicated in section 2.3 by Cox and Pinfield (2013).

After identifying the role of academic libraries in the management of research data as indicated in section 4.5 above, the researcher then investigated the need for various RDM services that could be provided by academic libraries.

#### **4.6 RDM services in academic libraries**

The researcher tested the opinions of the respondents regarding the various possible RDM services which Makerere University Library could provide to support the RDM initiative.

Ten RDM services were presented to the respondents. These included; (1) Find, organize, manage and evaluate scholarly data,(2) training on RDM, (3) seek grant / funding opportunities, (4) data analysis,(5) data discovery, (6) data and metadata collecting, (7) data archiving, (8) data sharing, (9) proposal planning writing, and (10) project start up.

Respondents were asked to rate each of these possible services on a scale of one (1) to four (4), whereby 'strongly agree' was equivalent to 1, 'good idea' was equivalent to 2,'I don't think so' was equivalent to 3 and 'definitely do not support' was equivalent to 4.

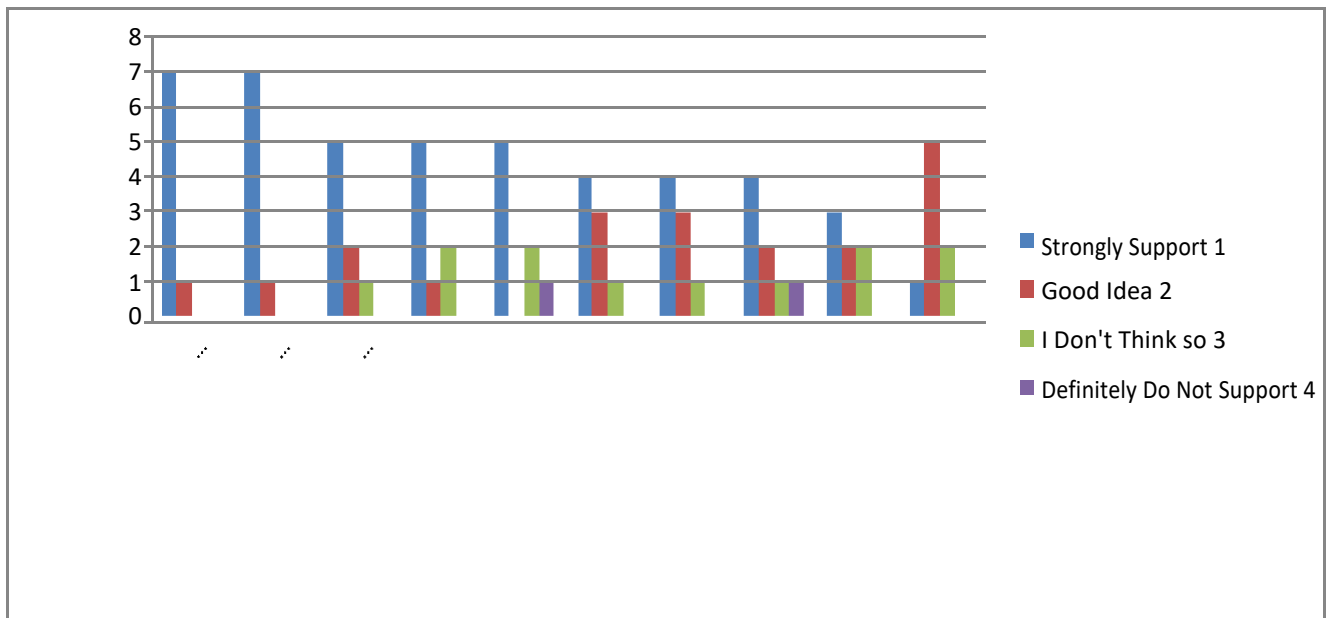
The RDM services below were rearranged into four categories based upon the way these services were rated. The first category (in high demand) included two services that is finding, organizing, managing & evaluating scholarly data, and training on RDM. The second category (good demand) included three services and these were ; seeking grant / funding opportunities, data analysis, and data discovery. The third category (fair demand) also included three services namely; data and metadata collecting, data archiving, data sharing. The fourth category (low demand) included proposal planning writing and project start up.

Demand was calculated by counting the number of responses for each RDM service which were counted, added together and represented. Focus was put on the first two ratings that are strongly support 1 and good idea 2as observed in table 2 below and the subsequent explanation.

Table 2: Views of researchers and RDM services in academic libraries

SERVICES											
		Find, organize, manage & evaluate scholarly data	Training on Research Data Management	Seek grant / funding opportunities	Data analysis	Data discovery	Data and Metadata collecting	Data archiving	Data sharing	Proposal planning writing	Project start up
RATING	Strongly Support 1	7	7	5	5	5	4	4	4	3	1
	Good Idea 2	1	1	2	1	0	3	3	2	2	5
	I Don't Think so 3	0	0	1	2	2	1	1	1	2	2
	Not Support 4 Definitely Do	0	0	0	0	1	0	0	1	0	0

Figure 7: Analysis of the views of researchers and RDM services





#### **4.6.1 Category one: High demand**

Results revealed that seven respondents strongly supported RDM training as well as on the finding, organizing, managing and evaluation of scholarly data as services to be required in the library. One respondent noted that services concerning finding, organizing, managing and evaluating scholarly data as well as training on RDM were a good idea. RDM training enables researchers to professionally manage data and keeps abreast with new developments in regard to RDM. In the next section the willingness to pay aspect was tested. It was established that the largest number of respondents were also willingly to pay for RDM training as can be observed in Table 3 below.

#### **4.6.2 Category two: Good demand**

Results in Table 2 above further revealed that five respondents strongly supported seek grant / funding opportunities, data analysis, and data discovery as services required in the library. Two respondents noted that seeking grant / funding opportunities is a good idea whereas one respondent said data analysis is a good idea. This explains why in Table 3, six respondents were willing to pay for data analysis as a service whereas four respondents were willing to pay for data discovery as well as seek grant / funding opportunities as services. It therefore appears that services noted above could be fundamental for future service provision.

#### **4.6.3 Category three: Fair demand**

In this section, results revealed that four respondents strongly supported the implementation of data and metadata collecting, data archiving, data sharing as services provided by the library. Three respondents noted that the provision of data and metadata collecting as well as data archiving in the library is a good idea whereas two respondents indicated that data sharing is a good idea. This does not fully explain why in Table 3, seven respondents were willing to pay for data and metadata collecting as well as data archiving. Four respondents also were willing to pay for data sharing. This perhaps implies that researchers face challenges with creating useful datasets and metadata, using tools and resources to easily organize and share data to meet compliance needs, place and preserving data in repositories. These services may need to be investigated further but there is definitely also a demand for such services.

#### **4.6.4 Category four: Lower demand**

Results revealed that three respondents strongly supported proposal planning writing and one respondent strongly supported project start up. Two respondents noted that it is a good idea to provide proposal planning writing services whereas five respondents said project start up is a good idea. According to table 3, four respondents indicated that they are willing to pay for proposal planning writing and project start up. When setting priorities, the library may wish to leave the development of these services for last. Because researchers appear to be willing to pay for these services there must be demand for such support.

After determining the RDM services that are in demand and that should be considered by the Makerere library it was investigated whether these services would require sustainability planning.

#### **4.7 RDM services that require sustainability planning**

The researcher listed some of the services in the previous section, and was interested in knowing which services the researchers would be willing to pay for. Willingness to pay was seen as an indicator of services that could be sustained even if the organization was not willing to fund the service. A service that is in high demand but for which staff would not be willing to pay would then need very careful sustainability planning or a decision could be made not to develop such a service.

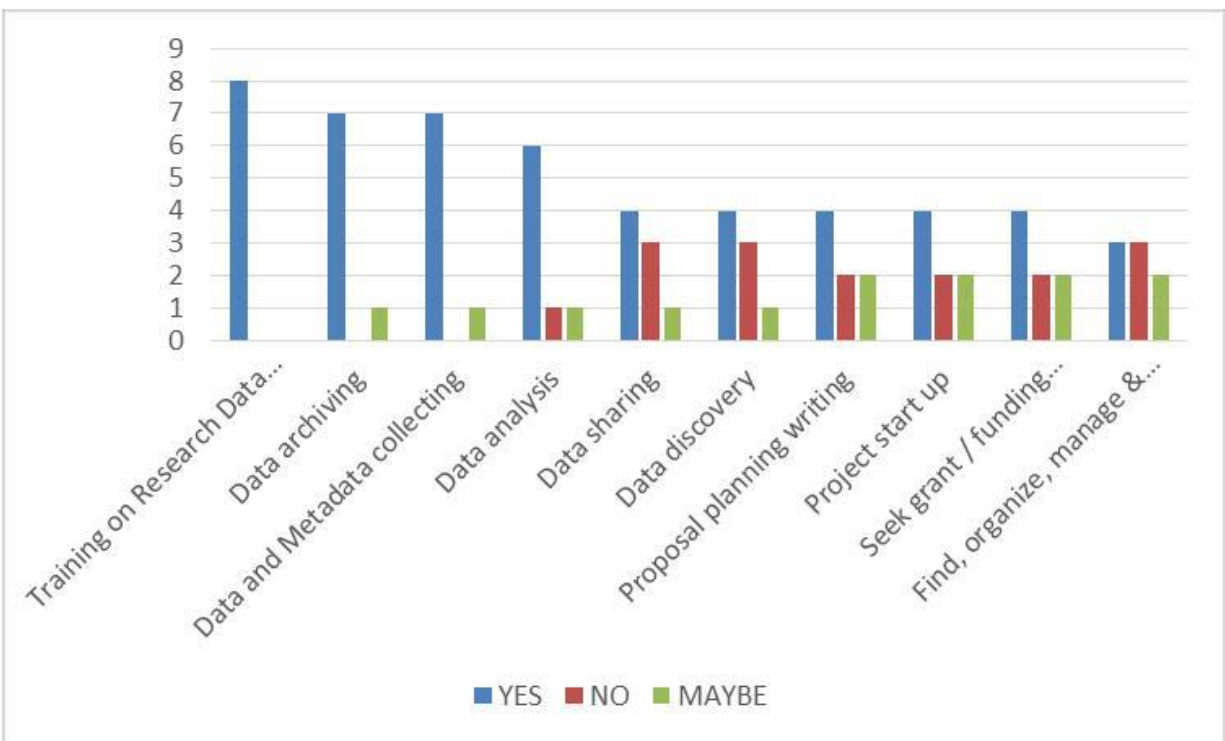
The same process was followed as with the previous section (section 4.6). Three categories were created – (1) where the majority would definitely pay (between eight and six respondents indicated they would definitely pay), (2) where staff would in all probability pay (between four and five indicated they would pay, and (3) where less than four would be willing to pay. Category one included; training on RDM, data archiving, data and metadata collecting, data analysis. Category two included; data sharing, data discovery, proposal planning writing, project start up, seeks grant / funding opportunities. Category three only included; find, organize, manage & evaluate scholarly data.

In the process of establishing RDM services that require sustainability planning, three options were provided to the respondents and these included; Yes [we would be prepared to pay], No and Maybe. The responses were consolidated and are displayed in the Table 3 on the next page:

**Table 3: Research data management services that require sustainability planning**

		SERVICES									
		Training on Research Data Management	Data archiving	Data and Metadata collecting	Data analysis	Data sharing	Data discovery	Proposal planning writing	Project start up	Seek grant / funding opportunities	Find, organize, manage & evaluate
MAYBE	0	1	1	1	1	1	1	2	2	2	2
YES	8	7	7	6	4	4	4	4	4	4	3
NO	0	0	0	1	3	3	2	2	2	2	3

**Figure 8: Analysis of RDM services and sustainability planning**



#### **4.7.1 Category one: Would definitely pay**

The findings revealed that all the eight respondents were willingly to pay for RDM training. Seven respondents were willing to pay for both data archiving as well as data metadata collecting. Six respondents were willingly to pay for data analysis. It would therefore be appropriate for the library to start developing the capacity and skills to provide these services.

#### **4.7.2 Category two: Will most probably pay**

Results revealed that only four respondents were willing to pay for the following services:

- Data sharing;
- Data discovery;
- Project start up;
- Proposal planning writing;
- How to seek for grant/ funding opportunities.

This means that some researchers can manage to do these activities themselves but some may be willing to pay for extra assistance.

#### **4.7.3 Category three: Would most probably not be willing to pay**

Results revealed that three respondents were willing to pay to find, organize, manage and evaluate scholarly data. Table 3 indicates that only three respondents were willing to pay for such a service. This is therefore not really a sustainable service and would need careful planning to ensure that the service becomes sustainable in the longer run,

Lastly, the researcher was also prompted to find out if there was a pressing issue that was not addressed. As a result respondents were asked if there were pending issues in regard to RDM.

#### **4.8 Any other issues related to RDM**

Findings revealed that respondents kept on repeating what was provided already. This implies that the ten questions subjected to respondents were very exhaustive. This further explains why similar answers already submitted were resubmitted in response to any other issues concerning RDM.

#### **4.4 In summary**

It was established that RDM is a relatively new concept at Makerere University. The concept of managing research data is more familiar to staff who have published continuously than to their counterparts who published only once in a while during the last five years. Furthermore managers who are themselves engaged in research and article publication, have more knowledge about the concept of RDM than those managers who are not still active in research.

It was noted that researchers who understood the concept of RDM, could comfortably explain the extent to which data are managed in their respective colleges. On the other hand respondents who were not familiar with the concept of RDM also found it difficult to clearly explain the extent to which research data was being managed.

Researchers appear to be of the opinion that their data are more secure when it is kept on personal computers than on any other platform (such as a shared server).The majority of the researchers are familiar with cloud-based services but do not store their data in the cloud for various reasons. Most researchers believe that cloud services are not safe for their data although the cloud is seen as an ideal solution for the management of data. Researchers appreciate the importance of keeping data safe but the risk, to which data stored on external drives is exposed, is underestimated. The media on which data are stored is not secure and is more likely to show data loss.

In addition paper questionnaires are still being used by postgraduate students/researchers. Although a few researchers prefer online questionnaires their supervisors appear to be more comfortable with paper questionnaires. It is not clear how these paper data sets are being stored because data management plans are not being completed.

It appears that funders from the United Kingdom and the United States of America are more strict with data management plan requirements than funders from the Nordic countries and elsewhere. Fortunately - engaging researchers in the RDM initiatives, such as data management planning, is definitely seen as important.

Lastly - respondents indicated that the academic library is a stakeholder with an instrumental role to play in the development of RDM activities for the entire institution.

## **CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS**

### **5.1 Introduction**

This is the final chapter of the research report and it covers the research intent, a review of the main research question, the research sub –questions, the key findings and recommendations that arise out of the findings, recommendations for further research and a summary of the entire chapter. All these aspects are aimed at capturing the recommendations for developing RDM services at Makerere University Library. Each of the sections is further discussed below:

### **5.2 Research intent**

The researcher intended to identify Research Data Services that would work best when managing research data generated across the university. The study could be regarded as successful because all the research questions could all be addressed.

Looking in more detail at the research that was conducted it is worth to report that the investigation was successful when looking for information in areas like the extent to which researchers manage their research data, funders are linked to the various colleges, funders require data management planning, the current management of research data, the level of data management services in academic libraries as well as sustainability planning for RDM are all relevant and linked topics.

However, the researcher struggled to find sufficient information regarding the concept of RDM and the support librarians should be giving in the process of managing the active research data.

The data collected was adequate for the researcher to guide him in defining the role that academic libraries could play in developing RDM services - hence the conclusion was reached that the study was successful.

For the purpose of ensuring that the above conclusion is correct the next section will review the main and sub – research questions and the results achieved.

#### **5.2.1 Main research question:**

For this particular study, the researcher aimed at answering the research question as stated below:

*What Research Data Management (RDM) services could Makerere University be developing?*

The above question was underpinned by a number of sub-questions as indicated in the section below.

### **5.2.2 Sub – questions**

As indicated in the previous section, the research question was divided into sub-questions as stated below:

1. *What is meant by RDM?*

Section 2.2 of this report discusses this concept in detail. The research resulted into a need to further explore the concept of RDM as was reported in section 5.3.2 below.

2. *What role could an academic library play in a university's effort to manage its research data?*

This question was addressed in detail in Chapter 2 (see section 2.6). Section 5.3.3 below clarifies the role that the Makerere University Library specifically could expect to play.

3. *What are the different RDM services that could be offered by an academic library such as Makerere University Library?*

Possible RDM services were identified and discussed in detail in section 2.4 of this report. The most important of these are provided in section 5.3.1 below.

4. *Which of these services would require sustainability planning if introduced at Makerere University?*

The sustainability of RDM services was investigated and reported in section 2.5 of Chapter 2. A number of specific recommendations for Makerere University were recorded in section 5.3.5 below.

5. *What are the top researchers currently doing with their data and how would the suggested library services be of use to them and their students?*

Sections 4.3 and 4.4 report extensively on the level of awareness of RDM among researchers as well as their general behaviour when it comes to RDM. Section 5.3. contains several recommendations on how the library could support and assist the researchers and the post graduate students so that they could align to international good practice.

The next section briefly reports on the main findings and then provides the conclusions and recommendations that resulted from the data analysed in Chapter 4.

### **5.3 Main findings, conclusions and recommendations**

The findings of the study changed the researcher's general view about the research data service development process and as such, new ideas were generated, conclusions reached and recommendations were made regarding RDM as a library activity - as discussed below. One thing is clear: Science/Research is becoming more collaborative, data-intensive, and computational, and researchers at Makerere University are faced with a range of data management needs as RDM is becoming an integral part of research activities. Therefore there is need to advocate for financial aid to support research activities - specifically then RDM.

#### **5.3.1 The RDM services that Makerere University Library should develop**

Researchers across the university generate large volumes of research data. Data are primarily managed and controlled by the various researchers themselves using different removable devices. Researchers are storing research data in cloud services without understanding the risks and are making backups on external hard drives, they have access to shared servers but think that storing data on personal computers is the best strategy for managing data throughout the research process (refer to section 4.4 for the detail). Therefore, it is necessary for the library to collect and make available information that would sensitize researchers on how to safely use cloud services for more secure data storage. The library could perhaps develop training material on how to open up and properly maintain accounts with cloud services.

The backups on personal computers and external hard drives have to be managed properly. The library could make available and manage a central data storage facility. This facility could assure access to reliable data in case the internet goes down or in case of any disasters - as was indicated by Jones, Pryor, and Whyte (2013:13) and recorded in section 2.5.4.

In addition there is need to introduce RDM skill development as a service to all stakeholders - as was advised by Carlson (2013:17-18) and recorded in section 2.3.5. Training/skills development needs to be sustainable and is addressed in more detail in section 5.3.5 below.

There is a wide range of RDM activities and tasks that could be performed by academic libraries. These include; (1) long term preservation of research data, (2) assisting researchers to comply with funders' policies, and (3) the development of metadata to mention just a few. The fourth activity is that academic libraries need to keep abreast with the developments with regard to RDM and to share this information with researchers. To ensure sustainable services from



academic libraries in terms of RDM services, there is a need for the librarians themselves to continuously up-grade their own knowledge – to build capacity which comprises the fifth activity.

The sixth and seventh activities are; to find, organize, evaluate scholarly data, and to conduct RDM-related training respectively.

Librarians need to emphasise technical hands on training, so that RDM training programs can be developed to support researchers in the management of data as indicated by Creamer et al. (2012:18) in section 2.3.5.2.

It is recommended that Makerere University Library concentrates on the seven services identified and numbered above and that these are services are developed as areas of expertise for the library.

### **5.3.2 The concept RDM and the extent to which data are being managed**

It appears that researchers take care of their research data until analysis has taken place. Research data are then abandoned and in many cases destroyed completely. It was established that very few of the respondents had prior knowledge regarding the concept RDM. It also appears that managing and sharing research data, which are in form of pictures, audio files, video files and paper-based questionnaires may be a general problem across the entire university (see section 4.3 for more detail). These findings point to the fact that the concept is not known or at the very least well understood. It is therefore recommended that Makerere University Library develops awareness creation material and embarks on a process to inform and enable researchers and post-graduate students of this requirement of good research practice.

### **5.3.3 The role Makerere University Library should play in RDM**

There are various RDM services required in academic libraries. This puts academic libraries in position to play an enormous role in terms of training and providing advisory services concerning RDM. It is recommended that Makerere University Library develops the ability to take on the role of trainer and advisor for all matters concerning RDM. Researchers should be assisted to be in position to acquire basic skills in collecting and identifying very useful data and should also be taught how to describe the data properly (metadata). The training on RDM should further enable researchers to develop and contribute to both computational and

statistical expertise in analysing data as was stated by Austin et al. (2015:17) and documented in section 2.5.3.

There is a need to develop a RDM policy for Makerere University. The RDM policy formulation initiative will require effective communication and coordination among the different stakeholders. The library could play the role of a facilitator to ensure that the process takes place. The academic library should play a leading role in getting the policy developed because it is well connected to all the role players.

#### **5.3.4 Sustainability**

Several of the identified services do not really need an additional financial investment. However, there are some RDM services that definitely require sustainability planning. Referring back to section 5.3.1 above: Training on RDM, storage, long term preservation and archiving of research data, and metadata allocation all require additional resources.

All RDM stakeholders need training in RDM. The respondents indicated that they would even be willing to pay for training (see section 4.6.1), Sufficient funding and time should therefore be made available to address the need for RDM capacity building. There is a need to develop for and provide RDM training to librarians, ICT staff, and researchers as was noted in the literature recorded in section (2.3.4). Formal education, in-house training and informal learning serve as the main training avenues through which librarians acquire and remain relevant to the ever changing needs of patrons as indicated by Simons and Searle (2014:10) and as was recorded in section 2.3.4 of Chapter 2.

It is advisable that Makerere University Library makes provision for a permanent staff member to take care of the RDM skills development. The financial implication would be the associated salary and a training facility.

Planning for sufficient central storage and for data preservation and archiving will require substantial investment. Planning should enable IT personnel to create the very support platforms that manage research data for as long as it is required and should also allow for the data to be archived when it no longer in demand.

The extent to which research data are managed across the entire institution is not yet on par with the international RDM standard practices - which aim to address the reproducibility crisis. Based upon the existing situation, the author recommends that the proper management of

research data needs to be rewarded. This would instil the discipline of conducting reliable world class research.

#### **5.4 Suggestions for further research**

RDM is still a relatively new concept in African research and academic institutions compared to research and academic institutions in the developed countries. Therefore, it is necessary for researchers and other key stakeholders to explore the concept of RDM more. This will enable stakeholders such as the government and funders, university leadership, researchers and research support units to assess and improve RDM practices across the continent.

Additionally the above situation presents a unique opportunity for the library to play an even more active role in the research process in various ways. And these include;

- Provide infrastructure for data storage and curation;
- Provision of consulting services related to RDM and curation;
- Encourage librarians to join research grant proposal teams as data curation consultants

The composition of consultative services and how such services could be provided serves as an area for further research.

Research Data Services require professional librarians who are adequately knowledgeable and flexible to learn new skills. This will then prompt the library to provide opportunities for staff to learn more about RDS, otherwise new staff with the required experience can be hired to execute research data related duties. However if staff are reassigned and new staff are hired, the question for future research remains what library services will be excluded to accommodate new RDS?

Developing RDS in an academic library calls for adequate resources. These may be in form of personnel, time, skills, finance or support. Creating partnership is one of the lasting solutions that can address the issue of limited resources. For instance the office of the Vice chancellor in charge of research and academic affairs can spearhead research and grant proposal activities while the library focuses on data management training as well as repository of finished data management plans. Exploring more about the various partners that together support the development of RDS is an area for further research.

The full cost associated with storing, managing and archiving data in the longer term needs to be investigated extensively.

## 5.4 In summary

Researchers across the entire institution carry out research activities, but the management of research data is yet to be given adequate attention. Some research funders as well as the government of Uganda are yet to fully appreciate the importance of effective RDM. RDM is still a relatively new concept at an academic institution such as Makerere University - compared to research and academic institutions in developed countries. This calls for RDM training for librarians, ICT staff, and researchers as noted in the literature in sections (2.3.5.1, 2.3.5.2, and 2.3.5.3).

Following an analysis of the data collected for Makerere University, the extent to which research data are being managed across the entire institution is not yet fully aligned with the international RDM standard practices which aim at addressing the reproducibility crisis.

Although researchers, from across the entire university, generate big volumes of research data it appears that researchers themselves manage, control and store their data, making use of different removable devices. This is risky. So there is a need for all stakeholders to develop RDM skills. It does appear though that the researchers at Makerere University would be willing the support of RDM services if these are developed by the library.

The RDM services that researchers would support as well as those that would require sustainability planning were identified and could now be developed over a period of time.

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## Appendix A: Ethical clearance from the University of Pretoria

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2017-08-02

### ETHICAL CLEARANCE FOR JOSEPH SSEBULIME

**Dissertation Title: The role academic libraries should play in developing Research  
Data Management Services: A case of Makerere University Library**

This is to confirm that the Research Committee of the Department of Information Science approved the application by Joseph Ssebulime for ethical clearance. Mr Ssebulime complied with the standard requirements for ethical clearance as set out by the University of Pretoria's Faculty of Engineering, Built Environment and Information Technology (EBIT), as follows:

- He signed and submitted all the application forms required for ethical clearance;
- He submitted her data collection instruments for vetting by both the Research and Ethics Committees; and
- He implemented all corrections recommended by the above-mentioned committees.

The Research Committee of the Department of Information Science therefore requests permission for Mr Ssebulime to collect the data he needs in order to complete and submit his mini-dissertation for examination. The Committee further appreciates any effort by appropriate authorities to expedite this process, and expresses its gratitude in anticipation.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'M. Holmner', written over a horizontal dotted line.

Dr Marlene Holmner

Dr Marlene Holmner

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Academic Coordinator: Carnegie MIT  
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## **Appendix B: Interview schedule**

### **A. Concept of Research Data Management**

1. What do you understand when I use the phrase Research Data Management (RDM)?

(The researcher will provide some detail on what RDM entails if the interviewee is not familiar with the concept)

2. To what extent, in your opinion, do researchers (both staff and post-graduates linked to your school/department/faculty) manage their research data?

3. Which research funders do your school/department/faculty make use of?

4. Which of those funders require a data management plan?

### **B. Research Data Management at Makerere University**

5. How do your researchers currently manage their research data?

**If he/she does not know the following will be asked:**

Do you know if they use a shared server or just their own PCs?

Do they make use of cloud services?

Do you allow them to take their data home on removable storage devices (flash drives / hard drives)?

Are backups required?

Do they still use paper questionnaires?

### **C. Academic libraries and their role in RDM**

6. Have you ever been supported by the library/ a librarian in the process of managing your own research data?

7. **If yes**, please tell me about your experience?

8. If no, how could academic libraries be of support in the management of research data?

**D. Research Data Management services in academic libraries**

9. I would like to share a list of possible RDM services the Makerere University library could provide with you. In each instance please indicate the extent to which you would support the development of the service. I am providing you with a rating scale where 1 (one) means you strongly support the idea and 4 (four) means you definitely do not support the development of that service in the library.

SERVICE	STORNGLY SUPPORT 1	GOOD IDEA 2	I DON'T THINK SO 3	DEFINITELY DO NOT SUPPORT 4
Find, organize, manage & evaluate scholarly data				
Training on Research Data Management				
Proposal planning writing				
Project start up				
Seek grant / funding opportunities				
Data and Metada collecting				
Data analysis				
Data sharing				
Data archiving				
Data discovery				



**E. Research Data Management services that require sustainability planning**

10. Some of the services listed in the previous section require sustainability planning (finance and staffing). For which of the services would you be willing to pay?

<b>SERVICE</b>	<b>YES</b>	<b>NO</b>	<b>MAY BE</b>
Find, organize, manage & evaluate scholarly data			
Training on Research Data Management			
Proposal planning writing			
Project start up			
Seek grant / funding opportunities			
Data and Metadata collecting			
Data analysis			
Data sharing			
Data archiving			
Data discovery			

**F. Any other issues related to Research Data management**

11. Are there any other issues related to development of sustainable RDM services that you would like to discuss?

### **Closing Remarks**

12. I am confident that the information you have shared with me will be very useful in the development of RDM Service at Makerere University Library.

I am grateful that you have availed yourself for this interview. Your contribution will be of great help in ensuring that the research will be successful. I request that you permit me to contact you in the future should a need for further questions and clarification arises.