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Preparedness for Open Science through Research Data Management at the University of Zambia in COVID-19 and Post-COVID Eras

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Abstract

This paper presents the findings of a study on readiness of the University of Zambia in participating in research data management services in the COVID-19 and post Covid eras. The study adopted a qualitative research method and employed purposive sampling. In-depth interviews were conducted with key informants in the University. Findings reveal a lack of awareness and knowledge about research data management among senior officers and inadequate skills among library staff. On a positive note, the University has a robust information and communication technology (ICT) infrastructure supported by qualified information technology (IT) staff. It was further discovered that the University did not have a research data management policy. This paper provides a framework for the University to operationalize research data management services. The study recommends development of a research data management policy; conducting awareness campaigns; investing in skills training for library staff, and constituting research teams to deal with issues of research data management.

Key words: Data, research, research data management (RDM), library, open access, open science, UNZA, Zambia

Introduction

COVID-19, as a global humanitarian crisis, has already shifted mindsets in the research community. From the release of full viral genome sequences and virus testing protocols, to case tracking dashboards and prediction models, to clinical trials to antiviral drugs and vaccines, data and research outcomes related to COVID-19 are being shared at a speed that has never been seen before. As researchers from across multiple disciplines grapple with the challenges of COVID-19, the open science movement and its themes of sharing well-curated, reusable data and conducting research collaboratively and transparently appear more relevant than ever.

The International Science Council (2020: 14) defines open science as "The optimal sharing of knowledge and supporting tools, such as publications, research data, software, educational resources and infrastructures, across institutional, disciplinary and national boundaries". According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2021: n.d) open science seeks to "allow scientific information, data and outputs to be more widely accessible (Open Access) and more reliably harnessed (Open Data) with the active engagement of all the stakeholders (Open to Society)". Owing to the growing recognition of the importance of research data, funding organizations and national governments have been requiring open access to research data to ensure accountability for the funding and to increase innovation in research through data sharing (Corti, et al 2012).

Research data management (RDM) is a set of activities relating to storing, accessing, and preserving data generated by a research project (Chiware & Mathe, 2016). RDM ensures research data are accurate, complete, authentic, and reliable by guiding the planning and organizing of data over the entire research cycle. Surkis and Read (2015) postulate that one strategic long-term benefit of RDM is increased research reputation for both researchers and the university as trusted providers of data by possible funders and publishers. Therefore, RDM in universities is important to achieving open science practices because it helps researchers to prepare DMPs, ensures long-term preservation of research data and serves as a vehicle for open access to research data (UNESCO, 2015).

In the global pandemic of COVID-19, sharing data is critical to speed up research activities related to the pandemic (UNESCO, 2020). RDM has already been successfully implemented in some Higher Education Institutions in many developed countries such as the United States, and Australia; the focus areas of RDM are access, retention, share, storage, and ownership (Liu, Zotoo, & Su, 2020).

The major mandate of the University of Zambia (UNZA) is to teach; produce graduates for the countries labor market and to carrying out research; to guide policy and the eventual

development of the country. UNZA is partly funded by government grants and other funding ventures including collaborative research activities with international funders. Thus through the various research projects and graduate research programs, the university generates huge volumes of research data each year. To be able to practice open science and ensure wider spread of the knowledge generated in the University, UNZA management must be thinking of developing RDM services to help researchers plan, store, share, and discover research data for reuse. Currently, UNZA does not have RDM services to support researchers with data planning and management, and ensure open science practices. This compromises the university's commitment to the tenet of open science, which is validated through open access to data and other research outputs of the university. The nonexistence of RDM services at UNZA where researchers generate numerous data in varying formats, and where funding is from government and international organizations requires immediate attention. Being able to provide RDM services is critically important in facilitating open science and collaborative research. Against this background, this research investigates the state of readiness of UNZA to establish RDM services in order to ensure the success of open science.

Research objectives

The purpose of the study was to investigate the readiness of UNZA to provide RDM services through open science in Zambia. Specific objectives were to:

1. Establish the awareness of RDM services among UNZA staff
2. Assess the skills capacity of UNZA staff for RDM establishment
3. Ascertain the adequacy of the existing infrastructure to support RDM
4. Determine what policies exist and their adequacy to support RDM services

Justification of the study

This research is significant from many fronts. First is the need to satisfy requirements for open access to data. Calls for open access to data by the international community (UNESCO, 2021), has led to increased pressure on researchers to organize data for submission into data repositories. Therefore, research into preparedness adds to the debate about RDM from the Zambia perspective. Secondly, establishment of RDM services is a return on investment opportunity. RDM makes data discoverable, accessible, and reusable, which is pertinent in the practice of open science. RDM maximizes the research potential that provides greater returns on individual and institutional research output. The result of this ripple effect is increased citation leading to high-ranking opportunities at individual and institutional level due to visibility and availability of well-managed research outputs. This serves as motivation for researchers to openly share their data and participate in open science. Thus this research contributes to the

growing research into RDM, can be used for improvement of research support at UNZA and nationally.

Conceptual framework

The paper adopts the Community Capability Model Framework (CCMF) developed by Lyon et al (2011) as a self-assessment tool for disciplinary researchers. The model provides a foundation for determining the capability of a given community for data-intensive research by profiling the current readiness or capability of the community, indicating priority areas for change and investment, and developing roadmaps for achieving a target state of readiness (Weng and Lyon, 2016). It does so by giving comprehensive and broad aspects of "data-intensive research capability" in a given environment. A community's preparedness is assessed using eight categories that describe the capability of data intensive services and the eight categories include: collaboration; skill and training; openness; technical infrastructure; common practices; economic and business model; legal, ethical and commercial factors; and academic culture. The eight (8) capability factors represent "human, technical and environmental issues" affecting the capability to research data services. Each of the eight capability factors contain a chain of characteristics that are related to the community and these are pertinent for determining the capability or readiness of the community in question to provide research data services (Lyon, et al., 2012: 22; Wang and Lyn, 2016:12). Figure 1 below shows the CCM framework and the summaries of the eight capability factors.

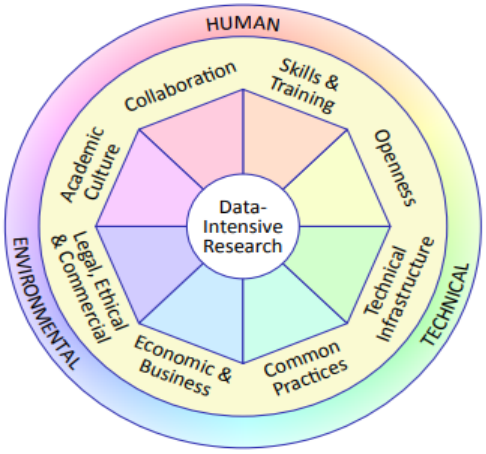

Figure 1: The Community Capability Maturity Model (CCM) Framework

1) Collaboration focuses on working relationships and its impact on the type of research that can take place. It varies from small, informal, formal and self-managed, or rigorously controlled and managed through contracts and agreements. Additionally, collaboration can be carried out within the "same-discipline"; "same sector"; "cross disciplinary"; or "cross-sectorial" collaboration.

2) Skill and training capability alludes to skills of individual researchers and the "combination and multiplication of capabilities" of different members of a research community. Training in skills such as data description and organization, developing research data plans, storage and archival, as well as use of technologies such as data analysis and storage packages (R, SPSS, N-vivo, D-space, etc.) to share and manage research data is critical to practicing open science.

3) Openness: the essence of openness is to ensure authenticity, reproducibility and reuse of data which ultimately leads to scientific progress (Lyon et al, 2012). Openness can be characterized by sharing of progress and results, sharing of results not taking place at all, or happening at a moderate level using traditional means such as conferences, or sharing of research progress or results happening publicly with full disclosure of research details.

4) Technical infrastructure addresses the tools and services that are required for use in order to meet the needs of researchers as they undertake their various research activities. This capability helps to determining how well the tools and services help in a community helps researchers do their research. A community being assessed could be a position where they do not have any of the tools or services, tools could be present but not performing enough services or tools and services could be performing adequate enough services to support research data services.

5) Common practices refer to the practices of researchers in a research community that have become standard. Examples of common practice include "data formats, data collection methods, processing workflows, data packaging and transfer protocols, data description, semantics, ontologies and vocabularies, data identifiers and APIs" (Lyon, 2012: 33).

6) Economic and business model addresses aspect of research funding and making the case for economic benefits in research. Issues concerning research funding and the sustainability of funding in a research community are considered. The purpose is to determine the ability of research institution to secure support for research data management on a sustainable basis.

7) Legal, ethical and commercial factors address the requirements to ensure that open science is carried within the legal and ethical boundaries. Legal and ethical issues have a serious bearing on an institution's capacity to share and reuse research data. An institution's capability for open science is measured in terms of none-existence, existence of a basic framework but not well-coordinated and applied, existence of a moderated coordinated framework but no made aware to

the members of staff and/or existence of a trusted framework and procedure for handling legal and ethical issues.

8) Academic culture: refers to the community's norms in a research community. If the community's culture is open and given to support research then the researcher is most like going to receive research support with data management. Lyon et al (2012) observed that "data intensive research is most likely to flourish in communities where data is valued highly: where researchers are rewarded for their data contributions and high standards are expected of data entering the research record".

Literature review

Researchers are using different methods and standards to generate, collect and analyses research data as a result storage and management of research data has become difficult. Thus to make the most of the vast data generated in research institutions and universities, there is need to establish RDM services to support researchers with data management. Jeng and Lyon (2016) used the CCMF to assess preparedness of institutions to provide support and data management practices in social sciences by asking "scholars to self-assess their current data practices and determine whether their academic environment provides enough supportive infrastructures for data related activities". The study also sought to understand and identify capabilities that are well developed from the poorly developed. Results revealed slow progress in the area of providing data curation services particularly in providing economic support and data science training courses. The study also showed a number of differences and commonalities within and between disciplines regarding researcher's perceptions of research data capability in their institutions.

RDM Awareness, Knowledge and Skills

Awareness and knowledge about RDM, and skills to manage research data are critical factors in the success of RDM. Ünal (2016) investigated the "research data management and data sharing behavior of university researchers" in three European countries using survey methods. The study revealed that open access publishing was a common practice among researchers in Europe, however, the majority of the researchers were not familiar and knowledge about RDM in Europe and therefore they were not practicing effective RDM. In Africa, Chigwada, Chiparausha, and Kasiroori, (2017), Nge'no (2018), Chiware and Becker (2018), and M'kulama and Akandelwa (2020) all observed that RDM was still in its infancy in Zimbabwe, Ghana and Zambia and the surrounding regions.

Benefits of research data management

Research data management has a number of benefits and the significant ones include long-term preservation of data, data authenticity, sharing and reuse of data, increased research impact and visibility of the research institution; and research innovation through collaboration (York, University, 2020). In the literature many have commented on the benefits which can be gleaned from research data management and those that accrue to researchers include: time and resource savings; increasing the efficacy of the research since well described and explained research data is easy to understand; facilitation of innovations and new discoveries through collaboration, and increasing the impact of the research as reach data management improves research visibility (York, University, 2020; Schöpfel and Azeroual, 2021).

Infrastructure for RDM

Literature shows existence of some national, level infrastructure for RDM such Data Intensive Research Initiative of South Africa (DIRISA), Australian National Data Service (ANDS) and the UK Data Archive and capacity building support, Digital Curation Centre (DCC). However, "the responsibility for RDM development is mostly emphasized on the institution" such as the university (Avuglah, 2019: 3). Amorim (2016) identifies a number of platforms used for establishing RDM such as Figshare, Zenodo, CKAN, DSpace, EPrints and EDUDAT. Starting a new secure data repository infrastructure can be an expensive venture; fortunately, those with already existing IRs can convert or adapt them, as there are several examples in literature that can serve as guides (Jones, Pryor and Whyte, 2013).

In the DPCMM framework, policy is listed an important infrastructure element in establishing RDM services. Therefore, institutions wishing to establish RDMs need to develop policies in order to guide the processes and procedures. A policy being a "description of the institutional principles agreed upon to guide the decisions and actions deemed necessary to achieving the desired outcomes" helps to address the expectations of the funding bodies or mother institutions. With a Policy in place, abiding by funder requirements and promotion of good research practices become relatively easy to achieve (Nottingham, 2014). The value of a policy as argued by Pryor is in expressing "publicly the statement of intent and expression of the commitment of

management and senior stakeholders" to supporting RDM (p.17). Thus, policy development is a good place to begin when developing RDM services.

Methodology

The study adopted qualitative approach and case study methods and used in-depth interviews for data collection. Gorman and Clayton (2005: 3) explained qualitative research as "a process of inquiry that draws data from the context in which events occur, in an attempt to describe these occurrences, as a means of determining the process in which events are embedded and the perspectives of those participating in the events, using induction to derive possible explanations based on observed phenomena". Five purposively sampled senior staff from strategic departments were selected to participate in the interview. The selected staff include the Librarian, Director CICT, Director DRGS and the Registrar. Further document analysis and observation of the infrastructure were used for collection of more data. In qualitative research, minute samples are adequate to collect data from in-depth interviews (Gray, 2014). An interview schedule guided the interviews. All the interviews were recorded, transcribed and analysed thematically.

Research findings

The research involved five (5) purposively sampled senior staff from UNZA. Specific variables assessed include knowledge and skills capabilities, technical infrastructure and strategic support and institutional framework. Further, analysis of documents was done to determine readiness. The following section highlights themes, which emerged from the interviews.

Knowledge and Awareness about RDM

To find out whether senior staffs were aware and knowledgeable about RDM services, participants were asked if they knew what RDM was. The findings revealed partial knowledge of RDM with majority of participants indicating they had only heard about RDM:

I have heard about it but I don't really know much, I know a bit but I wouldn't say that I am very conversant" (Participant 2).

I have heard about research data management, I would not say that I really know it but I have heard about it" (Participants 5).

However, one of the participants was well aware and knowledgeable about RDM:

I know and practice research data management at personal level. As a department, we have been keeping some data and helping researchers with their data" (Participant 1)

Perception towards starting an RDM service

To determine the perceptions of senior administrators about establishing and starting RDM services at UNZA, respondents were asked to share their views on perception towards establishing RDM services. The majority of participants perceived developing RDM as a good initiative for the university. For instance, participant 2 commented as follows:

I think it would be good because there is a lot of research going on and …some of these researches do generate many data and half of the time people just use a very small aspect of it, the rest of the data is just lying there unutilized. So if you have your common platform, other people can do secondary data analysis on the data that has already been collected and there will be no need to get funding because the data is just sitting out there and all you need is time and effort to rework it and analyze it (Participant 2).

Human resource and skills capability at the UNZA

Regarding human resource skills required for administrative and support services of the RDM service, respondents were asked to share their views on the skills capacity available to support RDM services at UNZA. Results revealed availability of IT staff to handle installation and administration of the repository from the CICT department.

We have specific people, specifically assigned to deal with that [data] repository system based on their skill sets and positions so all the systems we have here we have specifically assigned people in charge of that… based on their skill and competences (Participant 1).

However, library staff felt inadequately skilled to support RDM and would therefore need training and retraining in digital data curation to support RDM. Participant 2 and 3 had the following to say regarding skills among library staff:

Maybe we have the basic human resource, I think that when you are looking at something like RDM, its not to look at a unit as such but to look at the human resource that is existing within the institution because if you find that for instance the library doesn't have that human resource, you can tap from other departments as you are trying to develop (Participant 2).

I think that we may need to train and retrain, if that happens staff in the library would be ready to provide researchers with support to manage their research data (Participant 3).

Adequacy of the existing infrastructure to support RDM services

Concerning infrastructure readiness to support RDM at UNZA, participants were asked to share their views about the state of infrastructure. All the participants were of the view that UNZA had quality and robust infrastructure to support RDM. The following were some of the statements from the participants:

I think that we have the best infrastructure so maybe there will be a need to invest in higher performance computing systems but I think that the basic infrastructure is there. "But I think once that decision has been made it's to work towards supplementing what already exists" (Participants 2)

The university has a data server (repository) now… it is there to store data in various forms. The data can be stored in text, audio format; it can be stored in video format and for now there is already a repository we have created which has not been used really that much the past five years. (Participant 1)

The in my view has adequate technology infrastructure to support storage and to manage data, all we may need is to work establishing it, of course with guidance from those who know (Participant 3).

Institutional framework to support RDM services

Regarding the existence of a research data management policy, results revealed that the university does not have a policy that specifically addressed research data management. However, the university recently approved the institutional repository open access policy that provides guidelines and mandates researchers to self-archive research publications into the university repository. Results showed lack of awareness about the policy and little knowledge about the relationship between the IR policy and the research data management:

I do know, there is a policy, which our colleagues in the library developed, and the copy is there but also we have the ICT policy, which we did. It has a component of data but the comprehensive one is the one that they did at the library. (Participant 1)

I do not know whether that policy has been passed but it has to do with the institutional repository generally, it is a requirement that people should deposit although maybe it is not in policy or maybe I am not very sure. (Participant 2)

I think so, the institutional repository policy has been passed but I am not sure, I need to look at it to make sure that it mandates everyone to deposit everything. That is where I am not very sure. (Participant 4)

Further, document analysis revealed that the university implemented the research and intellectual property policy in 2009 to provide guidelines on managing the university's intellectual output. The purpose of the research and intellectual property policy is "to promote scholarly research,

publication, commercialization and protection, and interaction between UNZA and the Zambian public, private and civil sectors" (UNZA research and IP policy, 2009: viii). However, like the institutional repository policy, UNZA's research and intellectual property policy does not address RDM.

Discussion of findings

Although the study is subject to several limitations, such as non-inclusion of all the administrative staff at the UNZA, the participants in the study could be said to constitute a representative group required to understand UNZA's readiness to establishing RDM and participate in open science during and in the post COVID 19 era. The purpose of this study was to investigate readiness of the UNZA to participating in research data management services in the COVID-19 and post COVID eras. To achieve our objectives, purposively selected heads of departments in the library, the IT department and the Academic office were chosen and interviewed to determine the knowledge and skills capacity of support staff, the state of infrastructure and institutional support for digital curation of research data. The following section discusses the findings.

Concerning knowledge and skills required to support RDM at UNZA, results showed adequate skills in the IT department to spearhead installation and operation of the research data repository system. However, there was lack of adequately skilled staff to curate research data and support data management from the library. As indicated in the CCM framework, lack of skills among library staff implies need for training and retraining in order to support data curation and preservation services. According to Chiware and Becker (2018:7) library support services in RDM involves "data documentation/metadata, data organization, data security and backup, data citation, funder requirements, ethical and legal issues, preserving digital data and sharing data and archiving data". It is clear that UNZA would need training and retraining of library staff to be able to support RDM services. These findings are similar to findings in Ghana where RDM a capabilities study revealed a lack of adequately trained staff to offer RDM support to researchers (Avuglah and Underwood, 2018). Further, Chigwada, Chiparausha and Kasiroori (2017) in Zimbabwe discovered a skills and knowledge gap in the area of RDM support staff. Senior staff at UNZA clearly indicated that supporting researchers to handle research data was rather a new phenomenon that will require training for both researchers and library staff.

Regarding policy, findings revealed that there currently is no policy addressing RDM at UNZA. The research and IP policy and the IR policy do not mention or provide guidelines about research data. Policy is earmarked as a strategic infrastructure element in the CCM framework. Lack of policy guidelines on RDM results in haphazard handling of research data since specific activities required to manage data are not addressed. According to Avuglah and Underwood (2018:5), implementing a policy is critical in developing RDM. Policies summarize the principles, expectations and roles to be played in RDM activities. Policies also "provide the mandate which drives cultural change in readiness for RDM. Several studies (Chigwada, Chiparausha and Kasiroori, 2017; Avuglah and Underwood, 2018; Chiware and Becker, 2018; M'kulama and Akakandelwa, 2020) about RDM in Africa reveal similar situations, where RDM is either operated without policies or is completely nonexistent.

Concerning technical infrastructure, there was consensus among participants that UNZA owns state of the art, modern technical infrastructure capable to support a robust RDM. Among the infrastructure elements listed in the CCM model is the repository, strategy and open/neutral standard software. It was evident in that UNZA is operating a successful institutional repository service developed on the Dspace (open source/neutral standard) platform for hosting thesis, dissertations and e-prints. Additionally, the University boasts of a modern cloud storage service under the care and maintenance of the CICT. Other technical infrastructure at UNZA is the robust networking and security system for software and data storage. Technical infrastructure is important in ensuring that all aspects of the RDM service are successful (Beitz, et al., 2014).

Perceived challenges regarding RDM establishment at UNZA include lack of a policy, and inadequate support staff and skills. Lack of policy to guide how researchers must handle research data and how the research data repository should be operated when established makes RDM development challenging. Avuglah and Underwood (2018) also observed that lack of policy made RDM development challenging at the University of Ghana. To establish RDM, institutions require "human capital, technical capabilities, financial resources, and policy direction without which RDM development fails (Whyte et al., 2014; Avuglah and Underwood, 2018).

Conclusion and recommendations

The purpose of the study was to investigate readiness of the UNZA in participating in RDM services in the COVID-19 and post Covid eras. Findings reveal that RDM is still a new concept

at UNZA. Further, results show a lack of awareness and knowledge about RDM among senior officers and inadequate skills among library staff. On a positive note, the University has a robust Information and Communication Technology infrastructure supported by qualified staff. However, it was observed that currently there is no policy addressing RDM and existing policies (research and IP policy and IR policy) do not address RDM. The infrastructure was found to be adequate and robust enough to support establishment of RDM. The study concludes that UNZA is partially ready to practice open science. Based on the findings of the study, the following recommendations are proposed:

- Organize awareness campaigns and training to educate university staff about open science and RDM
- Constitute a team to spearhead open science practices and development of RDM service
- Develop a policy to address RDM needs of the university. Preferably, the policy must be in line with the IP and research policy as well as the IR policy and all should promote open science at the UNZA.

REFERENCES

Amorim, R.C. et al (2016). A comparison of research data management platforms: architecture, flexible metadata and interoperability. Universal Access in the Information Society, 16, 851-862.

Avuglah, B. K and Underwood, P. G., (2019.) "Research Data Management (RDM) Capabilities at the University of Ghana, Legon". Library Philosophy and Practice (e-journal). 2258. https://digitalcommons.unl.edu/libphilprac/2258

Ball, A. (2010). Review of the State of the Art of the Digital Curation of Research Data. (ERIM Project Document; No. ERIM Project Document erim1rep091103ab12). University of Bath.

Beitz, A., Groenewegen, D., Harboe-Ree, C., Macmillan, W., and Searle, S. (2014), "Case Study 3: Monash University, a strategic approach", in G. Pryor, S. Jones and A. Whyte (eds), Delivering Research Data Management Services: Fundamentals of good practice, Facet Publishing, London, pp. 89–114.

Chigwada, J., Chiparausha, B. and Kasiroori, J., 2017. Research Data Management in Research Institutions in Zimbabwe. Data Science Journal, 16, p.31. DOI: http://doi.org/10.5334/dsj-2017-031

Chiware, E., & Mathe, Z. (2016). Academic libraries' role in research data management services: a South African perspective. South African Journal of Libraries and Information Science, 81(2). Doi:https://doi.org/10.7553/81-2-1563

Cohen, L., Manion, L., & Morrison, K. (2007). Research Methods in Education. In Education. https://doi.org/10.1111/j.1467-8527.2007.00388_4.x

Corti, L. et al (2014). Managing and Sharing Research Data: A Guide to Good Practice. SAGE publications; London

Cox, A. M., & Pinfield, S. (2013). Universities of Leeds, Sheffield and York Research data management and libraries : Current activities and future priorities. doi: 10.1177/0961000613492542.

Cox, A.M. (2014), "Delivering Research Data Management Services: Fundamentals of Good Practice", Program: electronic library and information systems, Vol. 48 No. 4, pp. 419-420. https://doi.org/10.1108/PROG-10-2013-0018

Horowitz, B. M (2019). Policy Issues Regarding Implementations of Cyber Attack: Resilience Solutions for Cyber Physical Systems. https://doi.org/10.1016/B978-0-12-817636-8.00005-3

International Science Council (2020). Open Infrastructures for Open Science. Horizon 2020 consultation report. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.422.6056&rep=rep1&type=pdf

Jones, S., Pryor, G. and Whyte, A. 2013. How to develop research data management services – aguide for HEIs. DCC how-to guides. Edinburgh: Digital Curation Centre. Available: http://www.dcc.ac.uk/sites/default/files/documents/publications/How-to-develop-RDMservices_finalMay2013rev.pdf [accessed 29 April 2018].

"Keeping Up With… Research Data Management", American Library Association, April 17, 2018. http://www.ala.org/acrl/publications/keeping_up_with/rdm (Accessed October 12, 2021)

Lewis, M. J (2010) Libraries and the management of research data. In: McKnight, S editor. Envisioning future academic library services. London: Facet. Available: http://eprints.whiterose.ac.uk/11171/1/LEWIS_Chapter_v10.pdf.[Accessed 9th August 2021]

Lyon, L., Ball, A., Duke, M., and Day, M. (2012).Community Capability Model for Data-Intensive Research. Available at: http://communitymodel.sharepoint.com/

Lyon, L., Patel, M., &Tekeda, K. (2013). Assessing requirements for research data management support in academic libraries: introducing a new multifaceted capability tool.

M'kulama A. C. M & Akakandelwa, A. (2020). Research Data Sharing and Reuse Through Open Data: Assessing Researcher Awareness and Perceptions at the Zambia Agricultural Research Institute (ZARI). In: Priti, J., Mnjama, N & Oladokun, O. Open Access Implications for Sustainable Social, Political, and Economic Development. DOI: 10.4018/978-1-7998-5018-2.ch015. Available at: https://www.researchgate.net/publication/348120297_Research_Data_Sharing_and_Reuse_Through_Open_Data_Assessing_Researcher_Awareness_and_Perceptions_at_the_Zambia_Agricultural_Research_Institute_ZARI [Accessed 4 June 2021]

Nge'no, E. J. (2018). Research Data Management in Kenya's Agricultural Research Institutes. PhD Thesis. https://researchspace.ukzn.ac.za/xmlui/bitstream/handle/10413/15908/Ng'eno_Emily_Jeruto_Ng'eno_2018.pdf?isAllowed=y&sequence=1. Accessed (18 July 2020)

Qin, J (2013). Infrastructure, Standards, and Policies for Research Data Management. In: Sharing of Scientific and Technical Resources in the Era of Big Data: The Proceedings of COINFO 2013, pp. 214-219. Beijing: Science Press

Ray, M. J. (2014). Research data Management: Practical Strategies for Informational Professionals. Purdue University Press: West Lafayette, Indiana

Schöpfel, J., & Azeroual, O (2021). Rewarding Research Data Management. Sci-K 2021: 1st International Workshop on Scientific Knowledge Representation, Discovery, and Assessment, Apr 19 – 23, 2021, Ljubljana, Slovenia, 2021, Ljubljana, Slovenia. ff10.1145/1122445.1122456ff.

Surkis, A., and Read K. (2015). Research data management. J Med Libr Assoc. 2015 Jul; 103(3):154-6. doi: 10.3163/1536-5050.103.3.011. PMID: 26213510; PMCID: PMC4511058.

Tenopir, C., Talja, S., Horstmann, W., Late, E., Hughes, D., & Pollock, D (2017). Research data Services in European academic research libraries. Liber Q. 27(1). 10.18352/lq.10180

Tenopir, C., Sandusky, R. J., Allard, S., & Birch, B (2014). Research data management services in academic research libraries and perceptions of librarians. Library & Information Science Research 36 (2014) 84–90

The University of Zambia, Directorate of Research and Graduate studies (2009). Research and intellectual property policy. Available online at: https://graduate.unza.zm/images/files/research_policy.pdf

Ünal, Y and Kurbanoğlu, S (2016). Research data management practices of academic researchers in turkey. Available online at: https://digital.library.unt.edu/ark:/67531/metadc1036573/m2/1/high_res_d/Yurdagul_Unal and Serap Kurbanoglu.pdf [Accessed 29 December 2020]

UNESCO (2021). Open Science. Available at: https://en.unesco.org/science-sustainable-future/open-science [Accessed 29 December 2020]

University of York (2021). Benefits of research data management. Available online at: https://www.library.yorku.ca/web/open/overview/rdmbenefits/ [Accessed 18th July 2021].

Whyte, A., Tedds, J. (2011). 'Making the Case for Research Data Management'. DCC Briefing Papers. Edinburgh: Digital Curation Centre. Available online: http://www.dcc.ac.uk/resources/briefing-papers. [Accessed 9 December 2020]