



## Analyses of a Decade of Research Gap in Data Management Practices in Academic Libraries: A Social Science Perspectives

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### **Abstract**

Recent studies considered research data management practices and serviced an emerging and innovative area for improving academic and research library services. The changing needs of academic library users require services such as research data management, data sharing, data stewardship, linked data technology, big data, knowledge of data management and policies to be included in the library and information science curriculum, and professional training for effective service delivery in academic libraries in the developing countries specifically in Africa. Despite the value and benefits of RDM services for researchers and patrons of academic libraries in developing countries, RDM services could have been better implemented for use among researchers in academic libraries in Africa and sub-regions. However, the idea met RDM practices in academic libraries met with the complex information needs of various users, becoming more personalised and detailed. This study aimed to identify the research gap in studies investigating the research data management practices in academic libraries from a social science perspective to inform the best method of meeting clients' information needs in the 21st century. The study sought to answer the questions such as: What is the role of data librarians in research data management service providers in addressing the changing information needs of users of academic libraries? What strategies were used to provide efficient research data management practices to inform the changing needs of users of academic libraries in the previous decade? What are the current practices and training requirements to ensure efficient Research data management provision in academic libraries within the last decade? Library and Information Science Source and Scopus databases were searched for articles published between 2013 and 2022. Within the last decade, articles focusing on the role of data librarians in research data management and information services provided to address the changing information needs of users of academic libraries are limited in the databases. The few available articles addressing the changing needs of researchers were published between 2017 and 2021. Current practices in RDM services focus on data literacy, evaluating data quality and citations, data curation, data sharing and preservations. Strategies for adequate information provision and RDM services and practices to inform the changing needs of users of academic libraries include awareness of the benefits of RDM and bibliographic control

services, emphasis on collaboration and support, digital technology management and training, engaging and aligning with international LIS institutions for better training in data management and curation skills acquisition in response to the changing needs of clients. Understanding the complexities involved in the use of data and the role of data librarians is crucial to effective data management services provided for users of academic and research libraries. Current practices involve acquiring data management skills, given that it is essential in helping data librarians address the changing needs of library clients. Strategies for best practices in research data management practices in academic libraries in Africa include awareness of the benefits of RDM, data literacy and skill acquisition, adoption of digital technologies, and practical communication skills to stay relevant in this increasingly digital world.

## **Limitation/Implications:**

The literature search was limited to articles published between 2013 and 2022. Data management practices are essential for knowledge sharing, Open Science enhancement and initiatives, and best RDM practices in Africa and developing countries.

**Keywords:** *Research Data Management; Academic Libraries; Library Services; Data Librarians; Knowledge Management*

## **1.0 Introduction**

Research data management (RDM) is increasingly gaining significant value among researchers and academic library users (Ashiq, Usmani, and Naeem, 2020). The development and implementation of RDM initiatives are linked to meeting the changing information needs of researchers and users of academic and research libraries from social science scholars' perspectives. A researcher generates primary research data during data collection or when the researchers are executing a research activity or project. According to Tripathi, Shukla, and Sonkar (2017), data may be generated in text formats through images, tape recordings, musical compositions, verbal communication, experimental readings, simulations, codes and so on; therefore, must be preserved for future use. The knowledge of data management is essential for efficient information service delivery in academic libraries (Mavodza & Ngulube, 2011). It is equally essential that data librarians understand the current practices in RDM management in developed countries and the complexities involved in using data and management strategies to address the changing information needs of users of academic libraries. The best practices in RDM practices can only be ensured by addressing the changing needs of researchers using academic libraries in an African context and other developing countries.

This literature analysis document focuses on research data management practices in academic libraries using social science scholars' perspectives to inform changing information needs of researchers in the African context. The purpose was to identify a research gap in studies investigating the role of data librarians in RDM practices concerning the changing information needs, current practices and training requirements, and strategies for effective RDM practices and information provision to inform the changing needs of users of academic library users. The analyses were used to establish the area of focus of this study, and the trends of methodical applications in literature focusing on the changing needs of researchers using academic libraries in developing countries, especially in Africa.

Based on the growing trends of RDM practices in academic libraries, and the concerns regarding the changing research needs of users in Africa, it is worth noting that RDM practices will continue to be a promising area of activity in the future, where responsibilities and practices within university and research libraries are highly needed. Despite challenges facing the full implementation of RDM practices in

African regions, it is hoped that there will be progress in research outputs addressing the concerns of this study regarding RDM services in academic libraries in the African regions (Corrall, 2012).

## **2.0. Statement of Problem**

Recent studies recognised the importance of RDM for data sharing for advancing science, the economy and society in developed and developing countries (Bourke, 2022). The services are highly valued among researchers and patrons of academic libraries in Africa and sub-regions (Ashiq, Usmani, & Naeem, 2020). However, despite the enormous benefits of RDM to researchers, most academic libraries are yet to implement RDM in many libraries in developing countries. Many are yet to strategize the full implementations of RDM in academic libraries in the African regions. The few African countries (South Africa, Ghana) that have implemented RDM are still struggling with meeting the changing needs of their clients and researchers (Masenyaa, 2021). Others need institutional policies or guidelines to protect their data stored in the cloud (Atuase, 2019). Findings indicated that the challenges facing effective implementations are associated with the inability of librarians to acquire the necessary professional skills to enable librarians and information providers to meet clients' changing needs and provide RDM services (Ashiq, Usmani, & Naeem, 2020). Consequently, some researchers that have data sets need more knowledge, awareness and professional experience for managing them (Renwick, Winter, & Gill, 2017). In some academic libraries planning to implement RDM, the librarians in such libraries need to have adequate data management skills to provide efficient services. Data librarianship courses run in African libraries and information study schools are limited (Chiwara, 2020b).

Assessment of the changing research and information needs of researchers in African regions is essential, given that the applications of digital technologies to library services within the last decade have changed the nature of information services provision for librarians', which in turn has changed the research data management landscape as well as the role of academic librarians in some developing countries (Kahn et al., 2014). University libraries, therefore, need to sensitise researchers about what data planning and managing research data entail and provide technical assistance with actual data storage. Some researchers expressed concern about sharing their primary data due to fear of legal and ethical issues and implications, data misuse and misrepresentations of data (Majid, Foo, & Zhang, 2018). Some shared sentiments regarding the lack of confidentiality and data misuse and were reluctant to share their primary data (Elsyed & Saleh, 2018). Most academic libraries in developing countries still need to be ready for RDM services provisions. Despite having technological infrastructure and economic resources, the non-availability of a legal framework and skills to provide RDM services hindered the full implementations in academic libraries (Nhendodzashe & Pasipamire, 2017).

The role of data librarians in providing RDM services in academic and research libraries in Africa remains crucial in universities. However, despite the importance of the role of data librarians in supporting teaching, learning and research, academic libraries in African regions are experiencing a shortage of personnel with limited RDM skills to provide research data management services. In addition, only some academic institutions have data librarianship courses (Mushi et al., 2020). Most African LIS scholars rely on data librarians' courses in advanced countries (Chiwara, 2020a; Chawinga & Zinn, 2020; Mushi et al., 2020). Sadly, most academic libraries and data librarians need to understand the complexities of using the research data, management and required skills in an African context. They also need adequate training and skills to manage the resources. Adopting working strategies for tackling the challenges faced with practical RDM implementations in academic libraries is essential. It must be considered from different dimensions to ensure practical implementations of RDM in African regions (Horstmann & Witt, 2017).

On this note, this paper examines a decade of research gap in data management practices in academic libraries from the social science perspective, given that data management practices are among the primary responsibilities of data librarians in academic libraries in an African context. The purpose was to identify a gap in literature addressing the changing information needs of users of researchers accessing RDM services in academic libraries in Africa.

### **3.0. Purpose and The Research Questions**

The article aimed to identify the research gap in studies investigating the research data management practices in academic libraries from a social science perspective to inform the best practices for meeting changing clients' information needs in the 21<sup>st</sup> century. The research questions are as follows:

- What is the role of data librarians in research data management practices and service provision in addressing the changing information needs of users of academic libraries?
- What are the current practices and training requirements to ensure efficient Research data management provision in academic libraries within the last decade?
- What strategies were used to ensure efficient research data management practices to inform the changing needs of users of academic libraries in the last decade?

### **4.0. Literature Review**

#### **4.1. Research Data Management and Services Provision in Academic Libraries**

The idea of data management in academic libraries originated with the social science scholars Gothberg and Riggs (1988) and Schoolman and Lindberg (1988). The debate centred on time management practices and training for library managers to ensure a practical library and information service provision for scholars in academic institutions. Other early social science scholars, such as Schoolman and Lindberg (1988), focus on bibliographic services, therefore on the idea of developing Index Medicus and Computerised MEDLARS promoted in the early 60s. Data librarians' provision of RDM services started gaining popularity among library and information sciences (LIS) scholars (Semeler et al., 2019). In the last decade, they witnessed many initiatives in developing and managing research data in university libraries to support learning and research activities in developed and developing countries worldwide. The emergence of the Fourth Industrial Revolution (4IR) brought about new opportunities and possibilities for effective research data management in academic libraries (Akwang & Chimah, 2021). The 4IR technologies use innovations such as robotic systems, artificial intelligence, automation, machine learning, smart cities, and humans to enhance library service delivery (Akwang & Chimah, 2021). However, despite notable advancements and innovations with 4IR, this literature analysis agrees with scholars that 4IR is only sometimes used in LIS research (Ocholla & Ocholla, 2020). The benefits of 4IR applications to library services for information retrieval, sharing, supporting learning and research purposes must be considered in the African context. At the same time, the new generation of researchers has embraced the idea within the last decade (Owolabi et al., 2022). However, findings revealed that some university libraries in Africa are still reluctant to use AI to provide RDM and alternative services for their patrons (Okunlaya, Abdullah, & Alias, 2022).

Currently, RMD services provisions, some academic libraries in Africa still maintained their traditional role of collecting information, preserving, and disseminating intellectual output in printed or digital formats to their clients, while some focus on generating data at their universities' departments and laboratories for reuse or sharing (Tripathi, Shukla, & Sonkar, 2017). Notably, research outputs submitted to academic libraries are still reproduced, stored, and disseminated in print or digital forms, while digital

data are stored in much larger volumes than text (Sanjeeva, 2018). Analysis shows that RDM has been used in academic libraries in developed and developing countries to support learning, research, and innovations by researchers and other library users (Masenya, 2021; Asante & Ngulube, 2020; Ashiq, Usmani & Naeem, 2020). Unfortunately, the implementation has not been widespread in other African regions (Nigeria and Ghana).

Undoubtedly, library managers in Africa must understand that successful implementation of RDM requires active collaboration among stakeholders and university services departments as practised in advanced countries, to figure out how to solve challenges and issues (Ashiq et al., 2020). Information provisions for the efficient use of RDM services in academic libraries, and the use of the specific suitable model for RDM services provision is essential for university libraries in developing countries to facilitate further deployment and effective implementations of RDM services in Africa (Tripathi et al., 2017). These strategies will assist managers of academic libraries in their determination to use RDM services for data sharing among African researchers for easy access and use for future research (Elsayed & Saleh, 2018). Researchers must understand that data-sharing practices can only take place if the researchers submit their raw data generated from their primary data, and used research findings are shared for further use as indicated by funding bodies and many international research funding agencies.

Access to research data deposited to open access data repositories is crucial for easy access and information sharing (García-Barriocanal & Sánchez-Alonso, 2017). Access to research data is crucial for researchers to promptly discover, and use the dataset for further studies (Tripathi, Shukla, & Sonkar, 2017). To create easy accessibility, funding agencies such as NSF mandated researchers to share their primary data and other supporting materials generated during research projects sponsored by the same funding bodies. The purpose is that future researchers could access, browse, consult, use and build upon the primary data for future academic work, research and scientific purposes. Without access to research data, data management plans cannot be completed. On the other hand, grant applications and research proposals cannot be completed and submitted without access to adequate information (Tripathi et al., 2017).

Collaborative research is essential when it comes to RDM practices and service provisions globally to enable researchers to work across disciplines, institutions and borders. Through collaborations, data sharing is possible given that it helps researchers facilitate research publishing, handling, de-identifying, using and discovering datasets. Based on current practices for managing and sharing research data, a study shows that the majority of researchers in developed countries engaged in research data sharing (primary data) to contribute to scientific progress, increasing research citations and increasing the visibility of studies (Elsayed & Saleh, 2018). Some shared sentiments regarding the lack of confidentiality and data misuse and were reluctant to share their primary data (Elsayed & Saleh, 2018). Chigwada, Chiparausha, & Kasiroori, 2017) investigated the research data management practices using SurveyMonkey and telephone interviews in research institutions in Zimbabwe. The result indicated that researchers were managing their research data. Most researchers face challenges such as a lack of proper guidelines for good research practices, lack of financial support, absence of research data management policies and lack of support by institutional authorities (Chigwada et al., 2017). Many benefits are attributed to primary research data sharing. These include: helping the researchers re-analyse, re-evaluate and revalidate the reported research findings (Tripathi et al., 2017). Data sharing provides an opportunity for the researchers to add to the body of knowledge or build on existing knowledge by adding their viewpoints, which may assist in generating new knowledge or ideas. It could also help researchers avoid wasting time and effort on data collection.

Data librarians in academic libraries have crucial roles in research data management for information services provision in academic libraries. Some notable organisations are responsible for storing research data apart from academic libraries in developed countries and data services provisions

(Webster & Kim, 2018). These include The National Data Service (NDS); Australian National Data Services (ANDS); FAIR sharing.org, OAD (Open Access Directory of Data Repositories); Digital Curation Centre (DCC) (Tripathi, Shukla, & Sonkar, 2017). However, many academic libraries in universities know the need to support researchers in managing research data (Renwick, Winter, & Gill, 2017). There is a need to establish current practices in managing research data to determine the best practices in developed countries for effective information provision services in academic libraries (Renwick et al., 2017). Libraries must be proactive as service providers and influence and shape scholarly communication.

The role of librarians in RDM is crucial for effective data management, given that it is essential as part of the global research knowledge base (Sanjeeva, 2018). Given the low awareness and knowledge of RDM in academic libraries in developed countries, data librarians have a significant role in supporting researchers in university libraries in developing countries, especially in African regions (Renwick et al., 2017). It is mandatory that academic libraries provide access to the published part of the knowledge base and also pay attention to improving infrastructures, skill acquisitions and training. Library services must be user-friendly and accessible. Libraries must redefine their role in supporting academic research and maintain closer relationships while supporting their research community (Corrall, 2012). Academic libraries in Africa must be proactive to support research within the research communities fully. Data awareness must be increased among researchers in academic institutions. Librarians must provide archiving and preservation services for data within institutions through their repositories. Developing new programs for library professionals in data librarianship is crucial to enabling librarians to handle data management effectively. These programmes include data management and data curation with hybrid degree programs that can merge LIS training with scientific discipline (Lewis, 2010; Lyon, 2007).

According to Walter and Skinners (2011), the new role of librarians for effective research data management must include digital curation, data acquisitions and rights advisers, system builders, content producers and disseminators, organisational designers, collaborative network creators, and participants. It is equally essential that librarians provide user education to researchers and stakeholders in research development on how to access and use datasets or digital collections.

#### **4.2. Meeting The Changing Information and Research Needs of Academic and Research Library Users: The Librarians ' Role.**

Current studies revealed that users' information needs of academic and research libraries vary based on contexts and environmental factors. Therefore, libraries and librarians must provide information based on their changing needs and circumstances (Renwick et al., 2017; Corrall, 2012; Bailin, 2011; Corrall, 2010). According to Corrall (2010), meeting the changing information needs of users of academic and research libraries and stakeholders in research requires a combination of continuous incremental development with a periodic fundamental review, solid professional focus, and the blend of multidisciplinary expertise found in a research-led school to enable professional perform their roles effectively. A qualitative investigation into students' satisfaction with the Library's Bailin (2011) noted that the digital environment continues to become more critical in their lives due to the changing needs of library users. Therefore, academic libraries must adapt to the digital environment to ensure services remain relevant to users' needs. The basic needs of researchers currently revolve around needs for collaborative learning, individual physical study space, spatial design; social space; technology; noise levels; and Help Zone, among others. Research shows that users require all these facilities to provide an enabling environment that welcomes researchers and provisions of modern facilities (Bailin, 2011).

From the social science perspective, librarians are saddled with the responsibility of provision of information resources that are accessible in a hybrid format which must capture traditional users' needs

combined with electronic or digital formats (Walters & Skinners, 2011). These also need to include creating the enabling environment for collaborative networks and participants, helping researchers deposit their research outputs, and securing it long-term (Corrall, 2012). Libraries must develop a model for data collection methods, management, and accessibility (Newton et al., 2010). The data management process must include stages such as: identifying, selecting, describing, preserving and presenting data resources for use (Carroll, 2012, p. 111).

Findings revealed that most academic researchers relied on Google for their research work. They were confident they could manage their research independently and relied heavily on electronic sources for information. Some indicated they needed more contact with the library and more knowledge about the value and competence librarians could add to the body of knowledge (Haglund & Olsson, 2008). Based on social science researchers' perspectives, access to resources by visiting physical library infrastructure is considered complicated, a waste of time and unnecessary, while using Google or google scholar is considered easy (Haglund & Olsson, 2008).

#### **4.3. Strategies for Effective Rdm Services Provision to Ensure Changing Needs of Users of Academic Libraries**

Practical implementations for effective research data management and information services providers in academic libraries require an excellent working strategy (Burgi, Blumer & Makhlof-Shabou (2017). Burgi et al. (2017) indicated that strategies for effective data management services that are most relevant to researchers' data needs were findings from document analysis and semi-structured interviews focusing on research data management in academic libraries. In addition, strategies include a policy for the data management plan, active data management solutions, long-term preservation storage options, training, and a single point of access and contact to get support (Burg et al., 2017).

The current study revealed that many researchers have basic knowledge of RDM. However, it has not been fully implemented (Wiorogórska Leśniewski, & Rozkosz, 2017). They do not know the differences between RDM practices by academic staff and research students in their institutions (Wiorogórska et al., 2017). Data literacy is significant to effective RDM service delivery in academic libraries (Wiorogórska et al., 2017).

Policy and planning are crucial to ensure effective research data management practices and service provisions in academic libraries (Piracha & Ameen, 2019). A study by Piracha and Ameen (2019) focusing on policy and planning of research data management in university libraries indicates that some library heads have only heard about RDM but need to gain knowledge and awareness of RDM. While some libraries were at the planning stage, some were unwilling to be motivated or coordinate with researchers, and the non-availability of skilful professional and support staff and poor infrastructure and networking were the significant challenges they had.

Another strategy recommended by social science scholars was the establishment of research data repositories and using repositories registered with the Registry of Research (RoR) Data Repositories to ensure that research data standards are adhered to when doing research (Chigwada et al., 2017).

#### **5.0. Methodology**

This study followed literature review guidance by Grant and Booth (2009:91), guided by a thematic analysis approach. The study was built on the social science researchers' perspectives in the previous empirical studies in the subject area. The purpose of document analyses was to help the researchers understand and position the discussion on the research gaps identified in the current area of

study. The specific gap regarding the role of data librarians in RDM practices and service provision to address the changing information needs of users of academic libraries. The researchers sought to understand the current practices and training requirements to ensure efficient RDM services provision in academic libraries within the last decade, and to identify strategies used to ensure efficient research data management practices to inform the changing needs of users of academic libraries within the last decade.

We conducted an intensive literature search from Library and Information Science Source and Scopus databases between 24<sup>th</sup> and 28<sup>th</sup> May 2022. Document analysis was used in this study to gain understanding and develop empirical knowledge (Bowen, 2009). Thematic analysis was used to analyse the result of the literature search based on the usefulness and flexibility of the method in analysing qualitative studies (Braun & Clarke, 2006). The thematic analysis approach was used to identify themes of the related studies based on the broad objectives of the literature analysis and to provide answers to specific research questions. The findings of the study were analysed based on the theme of research questions set for the study. A similar approach was used in related studies (Gómez, 2022; Elliott et al., 2022) that examined understanding the commercial determinants of health theories, methods, and insights from political science perspectives. Intensive literature searches were conducted on Library and Information Science Source (LISS) and Scopus databases. LISS has been searched as a critical subject specialised database due to the relevance and importance of the database to the topic of discussion, and Scopus was added as a peer-reviewed scientific source for document analyses. The originality of the review was ensured by strictly following the inclusion and exclusion criteria to ensure the originality of the review. We included only articles focusing on the subject and published in English; full texts were peer-reviewed using Boolean/phrase for search to avoid bias in the literature analysis. Other literature that does not meet the criteria for inclusion was not included. Most of the articles used were at the final publication stage: All Open Access, Gold, Hybrid Gold, and Green Access. Out of a total of 2315 articles identified from the two databases, 18 articles focusing on RDM practices in academic libraries addressing the changing needs of researchers were included. The articles were published in the English language between 2013 and 2022. The search strategies used include RDM, +Academic libraries, and + Social science perspectives. However, the specific search on *Research data management +Academic libraries + Africa* was used for analysis as the study context. Articles published between 2014 and 2022 in social science were the highest. Others were published in related subjects such as computer science, art and humanities. A total of 338 keywords emerged focusing on RDM: *Libraries, academic libraries, information management, organisation and management, articles and libraries, developing countries, e-learning, South Africa, University libraries, open science, research data, and digital libraries*. Table 1 illustrates the search strategies used for the literature analyses.

Table 2: Summary of selected studies focussing on RDM practices in Academic Libraries

	Author & date	Area of focus	Country	Methods adopted	Strategies for improvement	findings
1	Aslam (2021).	Changing the behaviour of Academic libraries and the Role of library professionals	Africa	literature reviews	Reforming the traditional ways to new ways of working and creating collaboration at all levels.	Librarians need help to keep up with the new competencies and adopt the innovative system and reality because diversity is rapidly changing.
2	Abduldayan, Abifarin, Oyedum, & Alhassan,	RDM practices	Nigeria.	interview	Data literacy is essential to RDM services and crucial to practising	Researchers have no trust in the preservation system. There is a fear of loss



	(2021).				African librarians.	of ownership of data to unauthorised persons or parties. No standard data management plan was used while conducting their scientific research.
3	Abduldayan, Abifarin, Oyedum, Alhassan, (2021)	Computer-based research data management system	Nigeria.	Survey	Strategies must include efforts on advocacy and training on the use of the RDMS.	The behavioural intentions to use the system were research experience and social influence.
4	Akwang, & Chimah, (2021).	RDM and Fourth Industrial Revolution (4IR) Era	Africa	Observation methods	Adoption of the 4IR technologies	The adoption of 4IR only connects librarians with machines for “smart” performance.
5	<u>Masenya, 2021</u>	<u>RDM practices and services in academic libraries</u>	South African	Review of literature	Effective RDM strategies. Protection of the financial and time investments. Avoid duplication of efforts to recreate lost data.	Difficulties in managing research data: Lack of policies and standards, inadequate standardised storage infrastructure, time constraints to organise data, limited funding, and inadequate resources.
6	Bentil, Liew, & Chawner (2021).	Electronic resource management and use in academic libraries.	Ghana	interviews	Strategies for successful implementation include improvement in the use of electronic resources or digital resource acquisition in libraries.	Researchers must be involved in selecting and assessing Electronic Resources, increasing promotional activities, and improving the documentation of ER workflow.
7	Ashiq, Usmani, & Naeem (2020)	RDM practices and services	Developing country	literature review	Active collaboration is required among stakeholders and university services departments.	Librarians have challenges with skills for better practices and services.
8	Chiware	Open research	Africa	literature	Collaboration with	Data management

	(2020).	data in African academic and research libraries		analysis	international institutions that have implemented RDM successfully is crucial.	practices in academic libraries in Africa are at a developmental stage, while challenges faced with implementations in Africa include: funding and technical challenges.
9	Chiware (2020).	Data librarianship in academic and research libraries	South Africa	survey	Introducing and inclusion of data science and analytics into the LIS curriculum are crucial—strategies to include data management skill acquisition, funders, and policies guiding research data reuse.	RDM were at the developmental stage. They needed more skilled personnel. Lack of data librarianship courses within the LIS program.
10	Chawinga & Zinn, (2020)	RDM: generation, preservation and backup; competencies; and challenges.	Africa	Survey and interviews	Strategies include adopting RDM policies, conceptualisation, popularisation, and operationalising various RDM activities within African universities.	RDM allows academic libraries to consolidate and fortify their widely viewed natural role in research data management.
11	Mushi, Pienaar, & van Deventer, (2020).	RDM implementation and services for the University Libraries	Tanzania.	Survey	Collaboration between researchers and university management to make research data accessible to the international community	The majority of African universities and research institutions are yet to implement the most basic data management services
12	Ocholla & Ocholla, (2020).	Readiness of academic libraries in South Africa to research, teaching and learning support in the Fourth	South Africa	Content analysis	Strategies for practical implementations require that academic libraries be better resourced, accessed and used virtually everywhere.	The libraries respond well to the revolution through their services, displaying remarkable innovation and creativity.

		Industrial Revolution.				
13	Atuase (2019).	Adoption of Cloud Computing by Academic Libraries for RD Protection	in African	Descriptive design	The utilisation of cloud computing services to store research data to enhance access and visibility. Need for policies and guidelines for cloud service providers and research data storage.	Academic libraries in Africa experience a low adoption rate of cloud computing.
14	Semeler, Pinto, & Rozados, (2019)	Data science in data librarianship: core competencies of a data librarian	Brazil.	Literature review	A data librarian need not become a programmer, statistician, or database manager but should be interested in learning about the languages and programming logic of computers, databases, and information retrieval tools.	Data librarians must understand the complexity and novelty of data science praxis. Data science provides new methods and practices for data librarianship.
15	Nhendodzashe & Pasipamire (2017).	Research data management services	Zimbabwe's	qualitative and quantitative methods	Data policy, legal framework and skills are provided in RDM services	The library was reasonably prepared despite having the necessary technological infrastructure and economic resources. No legal framework and skills to provide RDM services throughout the data lifecycle.
16	Chigwada, Chiparausha, & Kasiroori, (2017).	Research data management in	Zimbabwe	SurveyMonkey	Establish research data repositories. Registration with the Registry of Research Data Repositories ensures that research data standards are followed when conducting	No proper research data management practices. Researchers were managing their research data.

					research.	
17	Raju, Raju, & Johnson (2016).	Research support services in academic libraries.	South African	Literature analysis.	Analysing research landscape, research week and research engagement provision.	Provision of bibliometric, open scholarship and RDM services.
18	Kahn, Higgs, Davidson, & Jones (2014).	Research data management	South Africa:	Workshop	Digital Curation	RDM implementation needs data collection, storage and RDM support for universities.

## 6.0. Results and Discussions

### 6.1. This section summarises included literature in Table 2

African scholars' social science support has been noted through their research contributions and outputs. In the last decade, South Africa, Ghana and Nigeria are among the top ten African countries that welcome developing and implementing RDM practices in academic libraries (Asante & Ngulube, 2020; Alemna, 2019; 2018; 2015; 2014; Chiware, 2020). Analysis shows that the highest number of research outputs focussing on RDM implementations was between 2017 and 2022. After that, most articles on RDM practices in academic libraries were published between 2014 and 2022 (see Table 2) and in LIS sources such as Library Management, Library Philosophy and Practice, Journal of Academic Librarianship, Electronic Library, and Journal of Systematic Review. Other subject domains include Computer Sciences, Arts and Humanity. Also, among the top 20 significant scholars that have contributed to the RDM initiative and implementations in African regions include; Asante and Ngulube (2020), Alemna (2019; 2018; 2015; 2014), and Chiware (2020). Most of the articles published were affiliated with South African Universities (the University of South Africa, the University of KwaZulu-Natal, and the University of Pretoria), the University of Botswana, and other Universities in West African regions (the University of Ghana and Kwame Nkrumah University of Science and Technology). Funding is an essential strategy for successfully implementing RDM for academic libraries. Among the top ten funders of RDM research are Inyuvesi Yakwazulu-Natal, National Science Foundation, Australian National Data Science, and Carnegie Corporation of New York.

### 6.2. This Section Focuses On Results from Three Research Questions for the Review.

#### What Is the Role of Data Librarians in Research Data Management Practices and Service Provision in Addressing the Changing Information Needs of Users of Academic Libraries?

Within the last decade, the majority of the reviewed studies focusing on the RDM for information services provisions emphasised the need to improve the data services provisions by data librarians (Nie, Luo, & Fu, 2021; Masenya, 2021; Akwang & Chimah, 2021; Chiware, 2020; Smith, Gonzalez, & Bossart, 2018; Raju, Raju, & Johnson, 2016). Most articles were published in social science and sources by social science scholars. A recent study by Smith et al. (2018) emphasised that librarians must acquire data management and curation skills and related training with faculty, students, and staff on research data science directly or indirectly through collaborative library/faculty partnerships. The role of data librarians includes provisions of research support and services to assist faculty, students, and staff with their data management and research needs. In other to address the changing information needs of users of academic libraries, managers of universities, libraries and faculties in developing countries need to ensure that staff are trained to acquire skills in line with the data management and curation skills in collaborative

partnerships with professional bodies such as; data Science Analytics and Informatics (Semeler, Pinto, & Rozados, 2019). Skills acquisitions are crucial because they enable librarians to fit in well as they endeavour to provide research data services to researchers in academic institutions. It is equally essential that librarians understand the complexity of using and managing research data and the technical skills required by data librarians before they can effectively provide services and manage their research data in academic libraries. Introducing the concepts of data and research data management and curation into the faculty curriculum is crucial to enable the faculty to meet the needs of researchers in this 21<sup>st</sup> century (Schuster & Reyes, 2020; Semeler et al., 2019).

Furthermore, findings revealed that the role of librarians changes from time to time, given that there is a change in the research landscape regarding changes in need of researchers, the emergence of new digital technologies and policies and guidelines introduced into the data services provisions and management practices in developing countries (Jackson, 2018). According to Bourke (2022), librarians are expected to acquire knowledge of data sources and provenance, research project context, database copyright, data protection, data documentation and the guiding principles to make data findable, accessible, interoperable and reusable. In addition, bibliographic control of research dataset function has been introduced along with data management services in academic libraries and the domain of social sciences and humanities (Bourke, 2022).

Given the emergence of the 4<sup>th</sup> Industrial Revolution (4IR) globally, librarians are taking advantage of new opportunities to improve RDM services in developing countries (Akwang & Chimah, 2021). Librarians with machine learning skills can improve their services by expanding the scope, visibility, and access to research data (Akwang & Chimah, 2021). Current practices in academic libraries require that a data librarian train as a programmer, statistician, or database manager and be interested in learning about the languages and programming logic of computers, databases, and information retrieval tools (Semeler, Pinto, & Rozados, 2019). Given the crucial need to protect research data in academic libraries, several developing countries adopted cloud computing resources for data protection (Atuase, 2019). In addition, most RDM services implementations in developing countries are at the developmental stage. Despite the limited number of skilled librarians available to research data management services, librarians in such libraries recognised the need to improve their skills to provide efficient skills for their clients (Chiware, 2020b).

### **What Are the Current Practices and Training Requirements to Ensure Efficient Research Data Management Practices and Service Provisions in Academic Libraries Within the Last Decade?**

In the last era, studies have focused on library management, using electronic resources to improve library services, learning and research, and 4IR (Akwang & Chima, 2021). Most academic libraries in African regions support RDM services provision for researchers in their academic institutions (Akwang & Chimah, 2021; Masenya, 2021; Bentil, Liew, & Chawner, 2021; Chiware, 2020; Chawinga & Zinn, 2020). However, many African universities have yet to implement the most basic data management services (Mushi, Pienaar, & van Deventer, 2020). Among the African countries that have implemented were South Africa, Botswana and Ghana. In South Africa, some of the mainstream research support services provided in academic libraries include bibliometrics, open scholarship services, and research data management compared to what is available at universities in other developed countries (Raju, Raju, & Johnson, 2016; Kahn, Higgs, Davidson, & Jones, 2014). Some libraries in the African regions lamented the low adoption rate of cloud computing or electronic resources and services by academic libraries in Africa to improve information services provision (Atuase, 2019).

In some parts of Africa, data management services are still in the formative stages. Some RDM practices are still at the developmental stage, with limited skilled personnel to research data management services (Chiware, 2020). Managers of academic libraries in some parts of Africa hoped that improved

RDM status would create an opportunity for academic libraries to merge and fortify their primary role of information provision for clients with RDM (Chawinga & Zinn, 2020). Other libraries adopted 4IR to collaborate with librarians with machines for “smart” performance experiences and expand their scope, visibility, and research data access in other institutions (Akwang & Chimah, 2021). Also, Masenya (2021) argued that selection, assessment of electronic resources, increasing promotional activities, and improving the documentation of ER workflow are essential practices involved in RDM practices. Recently among those academic libraries that are providing RDM services, the majority are experiencing difficulties managing the research data. Some reported the absence of established policies and standards, inadequate standardised storage infrastructure, time constraints to organise data, limited funding, inadequate resources, and lack of skills and incentives for researchers to share their data (Bentil, Liew, & Chawner, 2021). Also, in some African regions, RDM practices are still in development. Some need helps with research infrastructures, funding and technical challenges (Chiware, 2020a). In contrast, others need more specific data librarianship courses or experts in data management within the library and library and information studies faculties. Minimal scope for the full range of data management courses is available within professional development programmes in the African region (Chiware, 2020b).

### **What Strategies Were Used to Ensure Efficient Research Data Management Practices and Services to Inform the Changing Needs of Users of Academic Libraries in the Last Decade?**

Most articles published within the last decade indicated that strategies to support adequate information provisions and RDM services and practices must include awareness of RDM and bibliographic control services to enhance RDM services for scholarly projects throughout the research data lifecycle (Bourke, 2022). Strategies are also used to protect financial and time investments by avoiding duplication of efforts invested in recreating lost data (Masenya, 2021). Effective strategies also require an adoption of the 4IR technologies (machine learning, smart cities) as well as strategic actions for academic libraries towards adoption of the 4IR technologies for improving RDM services provisions in academic libraries in African contexts (Akwang, & Chimah, (2021; Bentil, Liew, & Chawner (2021). Undoubtedly, libraries in developing countries, specifically in Africa, must continue to align with national or international institutions in responding to their client’s changing needs concerning providing data management services and improving the research infrastructures (Chiware, 2020a).

Findings further indicated that strategies for adequate RDM services provisions must include further development of course curriculum in LIS schools in the African continent to meet the changing needs of researchers, engaging with governments, funders and publishers’ by soliciting for support, access and use, and reuse of research data across research domains (Chiware, 2020b). Technology is expensive worldwide and therefore requires funding and support by funders to use technologies to manage research data and make data accessible to interested researchers. There is an opportunity for an academic library to consolidate and strengthen its widely viewed natural role in research data management (Chawinga & Zinn, 2020). They collaborated with the international community to ensure that research data were accessible to the researchers and users (Mushi, Pienaar, & van Deventer, 2020). Librarians must utilise cloud computing resources and services to store their clients’ research data to enhance access and visibility. Primary research data must be guided by policies and guidelines set by cloud resource service providers and research data storage (Atuase, 2019). Academic library managers must improve services using digital curation (Kahn, Higgs, Davidson, & Jones, 2014).

Librarians must understand the complexities of using research data, especially those prepared by another researcher. Understanding data can help data librarians understand the technical skills required to perform effective services in academic libraries (Semeler, Pinto, & Rozados, 2019).

### **Conclusion, Limitations and Implications**

This literature analysis concludes that RDM practices in academic libraries in the 21<sup>st</sup> century require an adequate understanding of the complexities involved in the use of data and the role of data librarians to ensure efficient RDM practices and services for academic and research library patrons. The finding suggests that current data management practices in this era of 4IR require additional skills acquisition by data librarians to meet the current needs of library patrons. Training, data literacy and education, policies and guidelines are essential for effective RDM development and implementation in academic libraries in African regions. Strategies for best practices in research data management and meeting the current changing needs of researchers and patrons of academic libraries in Africa and developing countries are crucial. Awareness of the benefits of RDM, to enable users to embrace digital technologies, 4IR technologies to improve access and use of library services, and collaboration with international communities and funders are crucial. Apart from trained human resources, funding is an essential factor, given that digital technologies and resources are capital-intensive and require massive capital for implementation. Moreover, engagement with government agencies and library managers for support is essential to address the changing needs of library clients in developing countries.

This literature analysis is limited to literature published between 2013 and 2022 from Scopus and LISS databases to ascertain the study's originality. Practically, this study can provide valuable insight into the best strategies that stakeholders in academic library management could adopt to improve RDM practices to adequately meet the changing needs of academic and research library patrons in Africa and other developing countries to stay relevant in this increasingly digitalised world.

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