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Research Data Management Services in Southern Africa: A Readiness Survey of Academic and Research Libraries

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Abstract

The paper reports on a study on the readiness of university and research libraries in Southern Africa to provide research data management services in their institutions. The aim of the study was to determine how ready university and research libraries are in leading and participating in research data management services. The study also determined the readiness of libraries to engage in stakeholder collaborative programmes to provide institution-wide services and systems for research data management. Various aspects relating to research data management services readiness that were included in the study are: data support services, archiving, organisational structures, staffing and training, funding, outreach and partnerships, and challenges and opportunities of research data management service provision. A questionnaire was distributed to fifty-nine university librarians and library directors in university and research libraries in eight southern Africa countries of Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe. The results show that research data management services are still in their early stages of development with various countries and institutions at different levels of readiness for service provision and with some countries and

institutions not yet ready to implement any type of services. A small number of institutions have policies in place or are planning to implement some in the near future. Existing institutional repositories are also seen as a possible extension of data management services. Recruitment of specialised personnel to manage data management projects is taking place in some institutions, and many are providing skills to existing library staff for the new services. It is recommended that there is a need to advocate for awareness of research data management within institutions with academic and research libraries taking a leading role in spearheading data management and providing training and the technical support needed to store and retrieve research output and data sets.

Keywords: Academic libraries, Research data management, Research libraries, Southern Africa.

Introduction

The growth and development of collaborative research and advanced Internet services are key drivers in the introduction of new research data management (RDM) services in university and research institutions across the world (Tenopir et al., 2012; Cox and Verbaan, 2016; Tenopir et al., 2017). The growth is also being driven by National Open Science and Open Data initiatives which advocate for research and data sharing to be more open (Borglund and Engvail, 2014; McKiernan et al 2016). The developments are evidenced by emerging institutional research data policies, setting up of RDM infrastructures, re-training of librarians to support researchers with data deposits and preservation, and mandates from funding agencies requiring elaborate

data planning and the storage and preservation of RDM in credible institutional repositories by funded researchers (Chiware and Mathe, 2015). Since the introduction of institutional repositories in Southern Africa, some academic and research libraries have provided some degree of support services for research data access and reuse. Over the last few years, many have found that they needed to extend and unify services around more aspects of data acquisition, management, dissemination, and preservation. The steady growth of eScience, Open Access and Open Data – digitally mediated research with large data sets and networked collaborative use are reasons why researchers look to their libraries for help with organising, sharing, and archiving data. It is therefore important to investigate the readiness of these institutions in providing RDM services.

Academic and research libraries are part of the collaborative efforts and at times are taking the lead in driving new RDM services. The role of academic libraries in RDM services is being documented in the literature (Pinfield et al., 2014; Chiware and Mathe, 2015; Der, 2016; Tenopir et al 2012; Cox and Verbaan, 2016; Tenopir et al 2017; Latham, 2017) as that of involvement in broader institutional and at times national RDM initiatives. The roles that academic libraries are playing in RDM services include those of assisting researchers with data management planning (DMP) tools and data storage and preservation. These roles are also seen as an extension of the existing research support and scholarly communication services of storing, curating, and disseminating knowledge. In RDM services, this extension involves engagement (Cox and Verbaan, 2016) with researchers in offering services through accompanying and assisting researchers in the entire research life cycle. This includes: assistance with the conception of a research topic, data management planning (i.e. an outline of how data will be collected, analysed, stored and preserved), data collection, data analysis, data storage and data preservation for long-term use and sharing in and across disciplines and data publishing.

As RDM services begin to mature in various environments, so are the roles of academic and research libraries and the skills sets of librarians changing as they seek to broaden their knowledge base to enable them to assist researchers in this new service area. Besides documenting the emerging role

of academic libraries, studies have also been carried out on the readiness of university entities, especially academic libraries, to offer the range of RDM services (Henty and Kingsley, 2007; Stewart and Crossley, 2013; Der, 2015; Cox et al., 2017; Tenopir et al., 2017). Stewart and Crossley (2013) recommend that before libraries embark on RDM services they should assess their RDM maturity using models based on “identifying with one of a range of statements relating to six different outcomes or aspects of RDM.” These include:

- Libraries and institutional approach to RDM;
- Knowledge about research funder policies;
- Knowledge relating to data management and curation;
- Training support and guidance for researchers;
- Advocating and advising on the use of metadata; and
- Institutional repositories for data.

The Southern Africa region can be viewed as a unique region on the African continent, one with some of the best performing economies, above average African GDPs, lower levels of unemployment, high literacy rates and well-established tertiary education institutions as well as leading research centres. The region as covered in this paper includes Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. Some of the universities in the region, though limited, have made inroads in developing RDM services (Chiware and Mathe, 2015) supported in some cases through national, regional or international initiatives. In order to understand the level of readiness in academic and research libraries in Southern Africa for implementing or preparing for RDM services, this paper reports on a study conducted in academic and research libraries in the region.

Problem Statement

The adoption and recognition of open research practices has been growing (McKiernan et al., 2016) with support from funders, publishers, scientists and other stakeholders in research (Molloy, 2011). At the forefront are the open access, open science and open data movements which are also encouraging

academic and research libraries to join in calls for supporting the management of research data in higher education and research institutions. Borglund and Engvail (2014) describe the concept of open data as that “which should make public information available for others to use”. Open access advocates for “free scientific output, mainly generated with public funds, from the economic barriers and copyright restrictions that prevent it from being freely accessible” (Serrano-Vicente, Melero and Abadal, 2016). Open science is then the over-encompassing movement to make scientific research more collaborative, make data more open and dissemination accessible to all levels of scientific engagement (Penev, 2017).

Progress is being made with the emergence of RDM institutional policies, institutional RDM working groups (Chiwere and Mathe, 2015), institutional data centres, the development of advisory eResearch services and the growth and development of disciplinary based Web open data deposit platforms. The role of libraries in RDM services is seen as a natural extension of knowledge storage, curation and dissemination. In RDM services, the academic library’s role is seen as collaborative with other institutional players such as research and innovation directorates and Information Technology, and technology transfer departments as RDM services require broader institutional approaches to make them successful (Cox and Verbaan, 2016).

The introduction of research data management services in some Southern African academic and research libraries is being driven by both new institutional requirements on better management of research data across disciplines and through national mandates requiring research data generated from publicly funded projects to be more accessible. This survey sought to answer the question: “What are the levels of readiness of academic and research libraries in the development and the delivery of RDM services?” The question is promoted by a number of factors including the philosophy of the Open Science, Open Access, and Open Data movements, institutional realisations of better management of research data and mandates and requirements arising from publicly funding agencies to make research data and other research outputs more accessible and preserved for long-term use. The question is also prompted by the changing nature of scientific

research into more collaborative multi-disciplinary, multi-institutional and international projects. The study will provide a better understanding of existing gaps and identify areas that require further development and funding to enable RDM service provision.

The research problem was addressed through further questions relating to the following issues:

- RDM policy environments
- Data support services and data archiving practices
- RDM organisational structures, staffing and training programmes
- The level of funding for RDM, types of outreach and partnerships programmes for data management
- The perceptions of librarians and the lead roles libraries play in research data management service provision.

By posing the above questions, the survey’s ultimate goal was to document the existing practices as well as the planning for RDM and furthermore reach conclusions on the level readiness for RDM services as well as recommend best practices suitable for the university and research libraries.

Literature Review

The literature review covers studies and reports on roles of academic and research libraries in RDM services, the drivers of RDM services in university libraries, the overall readiness of university libraries, skills and training needs of librarians, perceptions of librarians on challenges and opportunities of RDM services, as well as the state of RDM services in academic and research libraries in southern Africa..

The role of libraries in RDM services continues to be the subject of studies covering a range of activities that libraries are involved in (Tenopir et al., 2012; Tenopir et al., 2014; Pinfield et al., 2014; Cox, et al., 2017). Data management is seen as a natural extension of the existing library data curation support services to research (Latham, 2017). Studies on the roles of academic libraries in RDM have sought to establish issues related to institutional policy frameworks, technology infrastructures and the role of support offices (Tenopir et al., 2012; Tenopir et al., 2014; Pinfield et al., 2014). The findings from the

studies show different levels of RDM service development in various institutions, countries and regions across the world (Pinfield et al., 2014; Chiware and Mathe, 2015; Der, 2016; Tenopir et al., 2012; Cox and Verbaan, 2016; Tenopir et al., 2017; Latham, 2017). The conclusions also show that efforts are being made to better manage research data, develop the right IT infrastructure and re-train of personnel in research, IT and library clusters so that they are all better prepared to meet the new demands. Cox and Pinfield (2013) point out that the steady flow of studies in RDM services globally “has a practical value of helping librarians, other professional services and policymakers benchmark the development of library services, nationally and internationally”. Latham (2017) also indicates that RDM has been attracting a lot of attention in the literature, especially in the last year, because of the growing interest in academic and research libraries to introduce services.

The state of preparedness in terms of RDM services explores issues related to institutional policies, infrastructures, skilled personnel, national mandates, and institutional collaborations between different support services. Cox et al. (2017:2) report on an international study of RDM activities, services and capabilities in higher education libraries in Australia, Canada, Germany, Ireland, the Netherlands, New Zealand and the UK. The results of the survey indicate that “libraries have provided leadership in RDM, particularly in advocacy and policy development”. The study also shows that service development is still limited, and services are focused more on advisory and consultancy services such as data management planning and data related training. The Cox et al. (2017) report also shows that there is a lack of skills and other challenges including limited resources, absence of collaboration with other support services and getting acceptance from researchers and university management. A similar study by Tenopir et al. (2017) on research data in European academic libraries also shows that library directors agree to the introduction of RDM services. However, libraries are planning or offering consultative services rather than technical research data services. Henty and Kingsley (2007) in an earlier study indicate the views of institutional leadership in Australia as that of getting the appropriate research data management policies in place at both national and institutional levels, having need to consider

financial and economic implications, and working on the still developing technological infrastructures, skills development and the potential to consider institutional repositories as a natural extension for datasets. Furthermore, Henty and Kingsley (2007) conclude that despite increased interest on a governmental and institutional level in the management of research data arising from eResearch, there is a large void between current practice and what needs to be established and maintained. These reports and studies show the limitations in academic and research libraries’ capabilities to implement full scale RDM services. In order to introduce and implement sustainable RDM services there is need for collaboration among university support services with clear separation of roles between research offices, libraries and IT. Librarians’ perceptions of RDM services are that these services are still developing and limited to data management planning, reference and consultancy services, and with no technical support in place. Tenopir et al. (2014) point out that librarians feel that they have the subject knowledge to work with RDM services but still require more education in the field.

In Southern Africa, some studies and position papers on Research Data Management and Open Science/Open Data have been conducted, and these include: Chigwada et al. (2017), Chiware and Mathe (2016), Kahn et al. (2014) and Molutsi et al. (2016). The paper by Chigwada et al. (2017) on RDM in research institutions in Zimbabwe shows that researchers have largely been left to do their own data management without centrally provided services, and that there is a lack of institutional guidelines, inadequate human resources, technological obsolescence, insecure infrastructure and a disparity in language between researchers and librarians, absence of data management policies and the lack of funding for RDM services.

Chiware and Mathe (2016) provide a different perspective through a narrative of experiences of a South African university in implementing RDM services and highlight the key role of the university library in the process. In an earlier paper, Kahn et al. (2014) also explore the position of South Africa in relation to RDM services and conclude that while awareness of RDM is good among librarians, the areas requiring most attention were policy and skills development, as well as provision of resources. The paper also highlights the need for a consolidated national response in RDM service development.

Koopman and de Jager (2016) on South Africa observe that while some researchers are already engaged in digital archiving in repositories, neither the researchers nor their universities had implemented systematic research data management.

In Botswana, Molutsi et al. (2016) provide a position paper that promotes Open Data/Open Science approaches in Botswana in the light of the unlimited use and restrictive access to data due to cultural and technical reasons. It is also important to note that South Africa, at national level, has made significant plans in developing a national infrastructure through the Data Intensive Research in South Africa (DIRISA) to enable universities and research institutions to access facilities for data intensive projects. To date, two tenders on a Research Data Intensive Project (a regional data node) and a National eScience Postgraduate Teaching and Training Platform (NEPTT) have been awarded to two university consortiums. The Data Intensive Project which was awarded to universities in the Western Cape region (and includes the University of Cape Town, Cape Peninsula University of Technology, University of the Western Cape and Stellenbosch University, Sol Plaatjie University and Square Kilometre Array (SKA)) is expected to provide data intensive research management facilities and support. The NEPTT project which was awarded to universities in the northern parts of South Africa will play an important role in the training of scientists and other support staff working on the national shared data facilities.

Methodology

The overall objectives of this study were to assess the readiness of academic and research libraries for providing data management services in the southern African region (Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, Zambia and Zimbabwe). The study also explored the policy environment, data archiving practices, organisational structures of research data management services, staffing levels and the types of staff development in place, as well as the level of funding for RDM services. It also explored challenges, opportunities and academic and research librarians' perceptions of their future role in RDM services in the region. The study was based on a questionnaire survey

distributed to university and research libraries in the region. The study's research tool used was an adaptation from the Association of Research Libraries (ARL) – Research Data Management Services – SPEC KIT 334 by Fearon et al. (2013). The tool was found to be appropriate as it had been used in similar studies in the United States of America and some European countries. The adapted survey questionnaire was distributed using the web-based Inqwise survey tool which enables the users to create, deploy, and analyse surveys. The questionnaire's URL link was sent out through emails to 57 academic and research libraries' directors, library IT managers and library research support managers in Botswana, Lesotho, Malawi, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. The tool provided a summary of responses to each question (in both numbers and percentages) and listed all comments. The data and the comments extracted from the Inqwise tool were used for the analysis presented in the paper. Table 1 shows the distribution of the questionnaire to eight countries and fifty seven academic and research libraries in the region.

Table 1: Distribution of Questionnaire to Countries and Institutions

Country	University Libraries	Research Libraries
Botswana	2	1
Lesotho	1	0
Malawi	3	0
Namibia	3	0
Swaziland	1	0
Zambia	3	0
South Africa	23	6
Zimbabwe	12	2
Total	48	9

Results

The questionnaire was sent to a total of 57 academic and research libraries in the region and 30 responses were received of which 20 were fully completed and 10 were partially. Table 2 shows the countries and the number of institutions that responded. There were

no responses from Lesotho, Malawi, Namibia, Swaziland and Zambia.

Table 2: Distribution of Responding Institutions

Country Libraries	University Libraries	Research
Botswana	2	1
Lesotho	0	0
Malawi	0	0
Namibia	2	0
Swaziland	0	0
Zambia	0	0
South Africa	10	3
Zimbabwe	2	0
Total	16	4

Policy Environment

The development of RDM policies is an important building block in the delivery of services as they help in ensuring conformity among researchers, as well as the provision of standardised services by service providers such as libraries and IT services. The survey results show that 6 (19%) indicated their institutions had a policy in place, 13 (42%) were planning to develop a policy within the coming one to three years, 11 (35%) had no policies, and 1 (3%) was not aware of the existence of any RDM policies.

Participation in Related Activities

The survey also sought to establish how many of the responding libraries had participated in national e-Science, eResearch, Data Science, Data Management activities. The results show that 13 institutions indicated to have participated in eResearch activities, and 12 in data management activities, two participated in Data Science and ONE IN eScience activities as shown in Table 3.

Table 3: Participation in National eScience, eResearch, and Data Science and Data Management Activities

National eScience, eResearch, Data Science and Data Management Activities	Percentage	Count
eScience	3%	1
eResearch (e.g. DIRISA, EIFL, RDM sponsored activities, UN activities etc.)	48%	13
Data Science	7%	2
Data Management	41%	12

Data Support Services

The survey described RDM to participants as “support of the management and curation of research data throughout its life cycle. It includes services such as: data management plan consulting, data documentation/metadata, data organisation, data security and backup, data citation, funder requirements, ethical and legal issues, preserving digital data and sharing data and archiving data. For this survey, services are for research data, not institutional data such as departmental records keeping. It can include data in all disciplines such

as sciences, social sciences, and humanities”. Table 4 shows the type of RDM service offered or planned, including whether training was offered and the period of time the services had been offered. The responses show that 20 institutions indicated that services were either being planned or had been offered for more than three years. Among the responding institutions, 31 offered many more reference services in various areas such as institutional repositories, locating and using data sources, and copyright and patent advice, than training services (14) in locating and using data sources, general statistical software support and data analysis.

Table 4: Research Data Management Services Provided

Type of RDM service	No of Institutions offering services	Reference Services offered	Training Services offered	Service offered 1-3 years	Service offered 3+ years	Service Planned
Providing an Institutional repository	19	2	0	5	19	1
Locating and using data sources	8	6	3	0	8	8
GIS and geospatial analysis support	3	4	1	0	3	8
Data set purchase, acquisition, subscriptions	5	2	1	1	5	10
Copyright and patent advising	5	6	1	0	5	10
General statistical software support	10	3	3	1	10	4
Data visualisation support	3	1	1	1	3	11
Data analysis support	6	0	2	1	6	10
Data mining	3	2	0	1	3	12
Database design and management	5	3	1	1	5	6
Other data support services (e.g. Data Management Planning, Data Publishing)	8	2	1	1	0	9

In addition to these services, institutions also provided additional comments on related RDM services, and these included the following:

- Support with Data Management Plans (DMPs) including training support for researchers and data literacy
- Reskilling librarians to enable them to provide proper data management advice to researchers
- Reference to the utilisation of facilities such as High Performance Computing Centres

provided by government ministries or built as a collaborative effort among universities (especially in South Africa and Zimbabwe)

- Provision of dedicated Web page information regarding different RDM services
- Research data awareness seminars and workshops
- Advice on where to archive various disciplinary research data in Web-based open platforms.
- Advice on data preservation.

In response to the question on research data management (RDM) services offered, 76% (19) of respondents indicated that they planned to offer services, while 12% that indicated that they already offered the services and 12% had no plans to do so. The survey also established that two institutions initiated RDM services in 2011 and one in 2012. Most institutions had recently introduced these services with four institutions having done so in 2015 and 2016 and one in 2014.

The respondents were required to respond to why they had initiated RDM services in their libraries. The main reasons provided for the implementation of RDM services were to assist researchers requesting for help with data management, data sharing or preservation 14 (93%), and in support of an institutional initiative to support research data services 12 (86%). However, the reason for the implementation of RDM services was the library initiative to expand support to faculty research, nine (38%). The least important reason was to assist researchers requesting help with data

management, data sharing or preservation 11 (76%).

The survey also sought to establish if libraries had online resource related to Data Management Plans (DMPs) for any research grants funding agency or provide links to a DMP tool. The responses indicated that while four (17%) of libraries had Data Management Plans services, 15 (61%) indicated that no Data Management Planning services were offered by either the library or the institution, and five (22%) indicated that they had no online resources related to DMPs. In response to the question as to RDM resources, consulting or training services the libraries provide other than DMP support. The responses in Table 5 indicate that most of the institutions did not offer the listed services. They were also not in partnerships with other departments to offer the services that include data management best practices, data storage and backup planning, assistance with metadata standards, file organisation, data citation, data sharing and access or data management practices through workshops or web-based services.

Table 5: RDM Services Beyond DMP Support

Services	Offered by the library	Offered by the library and elsewhere	Offered elsewhere	Not offered
Data management best practices via website resources and links to relevant literature	3	5	0	12
Data storage and backup planning	1	3	5	10
Helping researchers identify appropriate metadata standards	3	2	2	12
Research file organisation and file naming conventions	1	2	2	15
Helping researchers apply metadata standards	3	3	0	14
Data citation	3	3	1	13
Data sharing and access	2	5	2	11
Helping with securing and anonymising data per research conduct policies and Institutional review Board advising on institutional data policies (e.g. retention, IP ownership)	1	2	5	12
Data management best practices via workshops/direct training	3	2	2	12
Other RDM services	2	0	1	8

Archiving

The libraries indicated that archiving services were either offered outside the library or not offered at all. Only one respondent indicated that the library provided an archival service; four indicated that such a service was provided by the library and elsewhere; five indicated services being offered elsewhere in the institution, and nine did not offer any services.

While seven respondents indicated that they provided direct assistance with the depositing of data at either the library or the institutional archive, six only provided assistance in locating solutions at existing data repositories for particular research domains, and three provided no assistance. With regards to the specific archiving services and the library's archiving solution, six libraries indicated that the institutional repository were being used to archive research data while three indicated the library's research data archive for data deposits and access. Only eight libraries provided an answer to the question. Only three platforms were indicated as being used for data deposits. These are DSpace, Figshare and Archivematica. DSpace is being used for institutional repositories while Archivematica is being used for a data archive. One institution indicated that it was using an in-house platform developed in collaboration with an overseas university. Three institutions indicated that they were either using or planning to use Figshare. Five institutions provided an estimate of the number of data deposits in their archives. One of these had over 1000 items; one had less than 100; and remaining three had deposits of less than 50 items.

With regards to cost of data archiving, six institutions indicated that there was no cost to the library, while three indicated the library absorbs the cost. Although one library charged researchers, none of the libraries charged end-users.

Most libraries (10) indicated that archived data was related to a publication while nine indicated that the source of data were postgraduate research in the form of theses and dissertations and seven selected data associated with a full research project. Most institutions (86%) indicated that there was no limit to the size of the data deposit. It was revealed that in some cases (five) researchers were able to self-deposit their data collections, while in four cases, the library provided assistance with data deposits; and in three cases the library deposited the data

collections on behalf of the researcher. An equal number of libraries (three) indicated that their data archiving solution either did or did not provide a persistent identifier for deposited data sets. Although institutional repositories are generally open access (with one exception), all libraries indicated that data archives had controlled access.

Organisational Structures, Staffing and Training

The study also sought to determine the organisational structures, staffing and types of training offered to librarians to provide effective RDM services. Most RDM support came from individuals based in libraries of four the institutions. This is followed by a library department (three). Only four respondents indicated RDM service provision resulted from a committee or a group of staff from the library and other institutional departments. The responding research and academic libraries indicated that staff in a total of 24 positions assisted with RDM activities. Of these, four were at library director level, six at manager level and the rest were professional librarians holding positions of Research Librarian (four), Faculty Librarian (two), Digital Curator (three), Data Services Librarian (one), and RDM developer (one). Three institutions indicated that positions had not yet been created for staff supporting RDM services. Most of the staff providing these services had library degrees and some had library and IT degrees. Of the eight responses, only two indicated having degrees in non-related fields and 6 indicated that most of the staff had degrees at Masters or Honours level. In response to a request to list the skills and training seen as most important for those who provide RDM training, ten respondents indicated digital/data curation and IT technology or service training. Only six respondents saw subject domain experience as important while four listed librarianship Master level training and two indicated that traditional archives training was important.

Although the most important skills included digital/data curation and IT technology skills, the skills seen as being the most important for library staff included identifying and applying appropriate metadata standards, as well as digital preservation with eight libraries selecting these options. These were closely followed by ethical and legal issues and data retention

policy with seven selecting each. Subject domain expertise was selected least. Most libraries indicated that they promoted RDM service training through workshop attendance and independent study (Table 6). No respondent indicated that training provided by vendors or the hiring of consultants was viable.

Table 6: Promotion of RDM Skills Development

Workshop attendance	10
Independent study	10
Conference attendance	9
Training provided by professional organisations	2
Other	2
Local courses in computer or digital technology	1
Other colleagues on campus or other librarians from other institutions	1
Training provided by vendors	0
Hired consultants	0

Funding

In the responses to questions on funding for RDM services, nine (53%) of respondents indicated that current services were funded using the regular library budget; followed by two (12%) who indicated funding

was either via a temporary budget or special projects budget; and two (12%) who indicated departmental or institutional research group funding. One (6%) respondent indicated that funding was received for RDM from researchers' grant funding. The remaining three (18%) indicated that there was no funding in place or they were still looking for suitable sources for funding RDM services.

According to predictions by the respondents, only six (20%) expect future funding to come from the library's regular budget; with a further six (20%) indicating that sources of funding had not yet been determined; four (13%) from external grant funding; six (20%) expecting funding to come from library's special research/project group funds; three (10%) from researchers' funding; one (3%) from direct administrative institutional funding, and one (3%) still unsure of any source of funding for RDM services. While eight (54%) of libraries expected their allocation of funds for RDM services to increase over the next three years, three (23%) felt the funding would decrease, and a further three (23%) expected funding remain constant.

Outreach and Partnerships

The most effective outreach method was Faculty promotion road shows (25%). The method used by all respondents, but seen as least effective was Website links cross-posted to other sites and other outreach methods not listed (see Table 7).

Table 7: RDM Services Outreach and Assessment Approaches

RDM Service Outreach and Assessment	Used	Most Effective	Total
Library staff referrals/promotion	7	1	8
Website links cross-posted to other library site pages	7	0	7
Workshop presentations to faculty or student groups	9	1	10
Direct emails to faculty/researchers	9	2	11
Website links cross-posted to administrative sites	5	1	6
Faculty promotion road shows	3	1	4
Other outreach methods	2	0	2

Only 12 libraries indicated that they had partnered with external institutions or groups to provide RDM services. Respondents also indicated that research units and departments in some institutions were involved with RDM services, while others indicated that individual faculties at their institutions were providing some level of RDM services. One institution indicated that the involvement of the Institutional IT Department. The results further indicated that very few libraries responded to these questions on service outreach and assessment, indicating a low level of both collaboration and referrals.

Research Data Management Service Provision: Challenges and Opportunities

The responding libraries provided their perceptions of challenges and opportunities in open-ended

questions on RDM service provision in open-ended questions to outline at least three challenges and opportunities for the provision of RDM services in their environments. The following responses were provided as some of the challenges that academic and research libraries face in introducing and implementing RDM services.

Challenges

The main challenges listed by 14 of the 21 responding libraries is shown in Table 8. Organisational structures and limited job descriptions without specific data management roles were the most prominent challenges mentioned.

Table 8: Ranked Order of RDM Challenges

Rank	RDM Challenges
1.	Organisational structure issues
2.	Limited job descriptions without specific data management roles
3.	None existing policies ensuring the collection of institutional research output
4.	No existing capacity building programmes to develop skills to handle data management
5.	Lack of well-defined policy framework
6.	Not enough data storage facilities or specific institutional data storage solutions
7.	No proper linkages with national initiatives
8.	No specific Staffing budget for RDM service provision
9.	Lack of IT infrastructure
10.	Lack of skilled staff to assist researchers with data storage and preservation techniques
11.	Lack of incentives from senior university management to implement RDM services
12.	Lack of understanding of the concept of RDM services by researchers

Opportunities

Nine libraries provided responses to an open-ended question on opportunities that academic and research libraries have in implementing RDMs services

(Table 9). Most opportunities were identified in South Africa, Botswana and Zimbabwe where institutions were better resourced and could be in a better position to be starting RDM services.

Table 9: Opportunities in Academic and Research Libraries for RDM Services

Opportunities	Institutions	Country
The demands by national research funding agencies for beneficiary researchers to deposit their data in accredited institutional repositories (e.g. National Research Foundation in South Africa)	7	South Africa
The increasing importance of RDM services at both institutional and national levels	6	South Africa
There are opportunities for institutional RDM through national efforts of country wide Open Science and Open Data policies	8	South Africa; Botswana
Useful for expertise sharing and training	6	South Africa
Academic libraries need to take leadership and advocacy, resources and support for RDM	10	South Africa Zimbabwe Botswana
Availability of research data which can be used for further studies	1	South Africa
Opportunity for collaboration with Post Graduate studies, research departments and researchers	1	South Africa

The leadership and advocacy role of libraries can be built on existing collaborations with faculties and departments where librarians are already actively promoting and delivering a range of library and information services. The existing relationships with other academic support departments like Information and Technology and the research offices also presents opportunities for developing RDM services.

Most respondents indicated that their future plans included developing RDM services such as training sessions on data management plans, providing online resources relating to data management plans for funding and providing direct assistance to researchers with regard to data management plans over the next year or two. A few of the respondents indicated a longer term vision of between three and five years for services such as providing online resources for research data management beyond the data management plans while a few had no current plans for providing any level of RDM service.

In alignment with the future plans, some

institutions were increasing or realigning their staffing to provide RDM services. While the most (9, 43%) of the respondents indicated they would be adding RDM roles to existing staff positions, seven (33%) indicated that no changes to that staffing were planned. Only six (24%) of the respondents indicated they would be creating new positions for the provision of RDM services. Within the libraries which were planning to add staff or change the roles of staff, the primary responsibility was indicated as being data management guidance for researchers (other than DMPs), followed by subject references services, library IT and systems administration and cataloguing/collection development.

Thirteen of the respondents indicated that no RDM services were currently being provided. The reasons given for this included: lack of demand, libraries limited IT infrastructure to enable data management services, lack of dedicated personnel and technical know-how. Some of the thirteen institutions indicated that plans were in place to introduce these services; and in some instances

RDM has been included in the current strategic plan; and in others, staff were being trained.

Although libraries indicated that either new grants/funding agency requirements 13 (17%) or growth and development of data intensive research 13 (17%) would influence their provision of RDM services in future, circumstance, such as increased recognition of the need for better data sharing 15 (19%) and more requests from faculty/researchers for assistance with data management planning 14 (18%) were more the likely reasons that would influence decisions around data management service provision.

The respondents regarded the future roles of academic and research libraries in the provision of RDM services to include:

- Support and training (4);
- Collection, organisation, facilitating access, and preservation of research output (3);
- Custody of the RDM system (2);
- An ideal, neutral space to provide generic research support (2);
- Running open source Institutional Repositories applications such as DSpace-CRIS (1);
- Advocacy for RDM across the university (1);
- Encouraging, supporting and coordinating research data management (1);
- Involvement throughout the data life cycle (1);
- Archiving the data (1); and
- Data processing, reservation and archiving as well as providing its retrieval and use (1).

Data management is seen as a natural extension of the key role of libraries with librarianship skills being extended to include data management. Awareness of RDM must be created within institutions and the libraries should take a leading role in advocating for RDM, providing training and the technical support needed to store and retrieve research outputs and data sets. However, in order to promote such activities, librarians must be trained in RDM and must be supported by their institutions to become involved in RDM activities outside the institution.

Discussion

What is notable from this study is that the majority of institutions were not yet fully ready to offer a whole of range of RDM services due to a number of resource, infrastructure and human capacity constraints. At both national and institutional levels there was need for more commitment from government and institutional management on clear road maps for research data management through the development of policies and guidelines. This should be seen as part of the broader open science, open access and open data movements' initiatives that seek to widen the accessibility of research outputs including research data storage, preservation and reuse. In some countries, notably South Africa, Botswana and Zimbabwe, there were efforts at higher levels to come up with national policies on open science, and ultimately, these should provide the necessary guidance for development of institutional policies. International donor agencies and science professional bodies such as the European Union, EIFL, the World Bank, CODATA and Research Data Alliance are actively involved in engagements and the promotion of national open science policies in various countries, including southern Africa.

The study has also established that there is also a disparity between the different countries in the region with South Africa having much more developed infrastructure, policy frameworks and national initiatives for eResearch and eScience. While one country outside South Africa and Zimbabwe, and indicated the presence of a national High Performance Computing Centre, it was clear that the necessary policy frameworks to enable the wide utilisation of the facility are not yet in place nor are researchers' guidelines on how manage their data. While Botswana reports on plans and discussions taking place towards the realisation of a national blueprint on Open Science and Open Data, there is still little visible progress in academic and research libraries. This reflects the low level of readiness in the region for RDM services. In countries such as Namibia, Malawi, Zambia, Lesotho and Swaziland there were no reported activities in relation to RDM in university and research libraries or at national level again pointing to the need for clear national guidelines on how institutions should plan and develop this important area for research support.

Although institutional repositories exist in many of the surveyed libraries, the study has shown that libraries have not explored fully the capabilities of the commonly used platforms such as DSpace to manage data sets, as well as the metadata of any data deposited in both internal and external platforms. The limitations of fully utilising open source platforms are partly due to limited IT and programming skills in libraries and the lack of communities of practice around a commonly used resource through which institutions could share experiences and have a better understanding and utilisation of these resources. There are opportunities to introduce data management linked to existing institutional repositories, especially for those that are managed through DSpace and other open source platforms.

The calls for open data are growing not only in higher education and research institutions but also in governments, civil society organisations and the private sector. It has also now been fairly established through global projects in many countries that RDM services are collaborative in nature. The study established a limited number of institutions that have participated or are actively involved in collaborative outreach programmes to promote the development of RDM services. There is need for academic and research libraries in Southern Africa to realise that introducing RDM services should be done through institutional collaborative efforts. In universities and research institutions, successful or promising RDM services are collaborative, and each stakeholder plays their important role to ensure the delivery of services, and more importantly the preservation of data and enablement for its future use.

The continuing training of librarians and organisational restructuring to align existing library research services to RDM is also very important if services are to take a meaningful shape in universities and research institutions. From other studies (Tenopir et al., 2014), it is very clear which areas academic libraries should focus on, and these include: provision of informational services, data management planning, training of researchers, managing metadata and finding and citing data sets. Attention should now be more focused on capacity building and the development of RDM skills amongst librarians as this is a commonly identified barrier.

It has also been established in many of the emerging studies that the technical aspects of RDM

services are generally missing in academic libraries, and these are better provided and managed by other service providers within universities due in part to their complex nature and requirements for specialised technical skills. This also applies to the engagement with researchers who require the assistance of the research offices which seems to have better leverage with researchers and in advocating for new complex data management services.

Conclusion

As academic and research libraries become more engaged in research support and respond to open science, open access and open data initiatives, it becomes critical for librarians to have a better understanding of all research issues. To be able to respond to research data management needs libraries there is a need to align institutional goals, build collaborations with key institutional stakeholders to respond appropriately. Beyond institutional boundaries are other national and international imperatives that libraries have to respond to if new research data management services are to be acceptable and have the correct meaning to the target audiences – the researchers. Previous studies and international best practices show that coordinated responses at national and institutional levels are the best approaches to take. The re-skilling of librarians is also important as RDM services require new skill sets to what has been traditionally offered in library schools. In future, recruitment of personnel working in RDM services in academic and research libraries will have to consider other professions, especially those graduates with IT training and more specifically those with data management training. Development of institutional infrastructures is also a big challenge that still requires substantial amounts of funding and human capacity to implement and run associated systems. The rise of open specialised domain data deposit platforms on the Internet in various fields presents a challenge to libraries and institutions, as some researchers are finding these platforms more useful and appropriate in their research work. Awareness platforms and avenues for RDM services must be created within institutions and the libraries should take a leading role in advocating for RDM, providing training and specialised advisory services required for the management of research data.

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