nentation of Research Data Management (RDM) and its Services in Academic Libraries of Professional Colleges of Goa

A Dissertation for

Course code and Course Title: LIS 651 & Dissertation

Credits: 16

Submitted in partial fulfilment of Masters / Bachelor's Degree

in M.LI.Sc. by

JAISHEEL SHIVANAND HEGDE
Seat Number

22P0010010

PRN
201707809

Under the Supervision of

Dr. Carlos M. Fernandes

D.D. Kosambi School of Social
Sciences and Behavioural Studies
Library and Information Science

Goa University

Date: April 2024

Examined by:

Dr. Carlos M. Fernandes

Seal of the School

PROGRAMME DIRECTOR
LIBRARY AND INFORMATION SCIENCE
D. D. Kosambi School of Social Sciences & Behavioural Studies
Goa University

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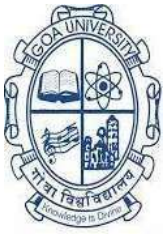

Goa University

Date: April 2024

Examined by: Seal of the School

DECLARATION BY STUDENT

I hereby declare that the data presented in this Dissertation report entitled, "Implementation of Research Data Management (RDM) and its Services in Academic Libraries of Professional Colleges of Goa" is based on the results of investigations carried out by me in the Library and Information Science at the D.D. Kosambi School of Social Sciences and Behavioural Studies, Goa University under the Supervision of Dr. Carlos M. Fernandes and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities will be not be responsible for the correctness of observations / experimental or other findings given the dissertation.

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Date:

Place: Goa University

Seat no: 22P0010010

COMPLETION CERTIFICATE

This is to certify that the dissertation report **"Implementation of Research Data Management (RDM) and its Services in Academic Libraries of Professional Colleges of Goa"** is a bonafide work carried out by **Mr. Jaisheel Shivanand Hegde** under my supervision in partial fulfilment of the requirements for the award of the degree of **M.L.I.Sc.** in the Discipline Library and Information Science at the D.D. Kosambi School of Social Sciences and Behavioural Studies, Goa University.

Date: Dr. Carlos M. Fernandes

Signature of Dean of the School/HoD of Dept School/Dept Stamp
Date:
Place: Goa University

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Any physical or digital assets developed, created, or collected during research activity are referred to as research data. The goal of research data is to analyze it, provide original discoveries, and assist the researcher in proving the legitimacy of his or her work. Depending on the aims and procedures they generate, research data might be numerical, descriptive, or graphic. Text, photos, audiotapes, videotapes, laboratory notebooks, photographs, field notebooks, and primary research data, such as questionnaires, models, photographs, films, and test responses, are all examples of research data. Research data management is a system that aids in the archiving and retrieval of research data in order to reuse and preserve it for long-term usage. Many developed-country universities have already begun to offer RDM services to their researchers and academicians. Research data curation, data curation, and data management are all terms used to describe research data management. Research data management is concerned with the organization of research data and provides service and support to researchers throughout the research cycle, from data collection to the dissemination and archiving of key findings. Research data have a far longer lifespan than research projects. Researchers can utilize the same data for any other project even after funding ends or the study is finished. In order to create or develop new research, the follow-up research project may reanalyze or add new data to an existing data set. Other researchers can utilize the same data for additional study. Data sharing makes research more legitimate, accurate, and honest. Research data sharing saves time for others, improves research efficiency, reduces the chance of data loss, validates final conclusions, and provides an opportunity for original authors to be acknowledged. Since the majority of research is supported by the government, the funding organization must also need unrestricted access to research data and availability, which must be in the public domain for fair use. Many funding agencies mandate that recipients develop a data management plan for the long-term preservation of research data and the public release of some or all of the data.

Research data management is currently a trending topic. Efficient research processes, greater research impact, data planning, data preservation through repository deposit, data maintenance and documentation throughout data life cycle, funding criteria fulfillment, discovery promotion, and open access support are the goals. They claim that science has entered a paradigm that is

increasingly data-intensive, cooperative, and computerized, and that sharing and managing research data improves the scientific method. Reliable findings verification and the creation of novel, creative research based on preexisting data are made possible by sound research data management practices (Jummai & Library, 2020). Researchers encounter a range of data management needs as science develops and evolves towards more collaborative, data-intensive, and computational research. The relevance of research data management is being recognized by governments, organizations, institutions, research funders, and legislators worldwide. RDM stands for research data documentation, curation, and preservation. RDM procedures guarantee the research data's long-term value and usefulness for fresh analysis and study replication. While some libraries have traditionally provided a range of research services, university libraries started include RDM in their offerings as digital data became more common and the need to manage them became more urgent. Needs assessments in user communities, policy creation, lobbying, awareness, and training are some of the RDM services offered. Other services include consulting services, the creation of data repositories, help desks, and data management plans (DMPs).

Any and all types of data that are produced throughout a research project are referred to as research data. These are priceless resources that the earlier researchers spent a great deal of money and effort gathering. A significant amount of data is frequently generated during the research process, and this data is used to validate the study's conclusions. The information produced during a research project is a useful resource that, with proper storage, can be retrieved, cited, and reevaluated for future academic and research needs (Tripathi et al., 2017). Research data management, or RDM, has become crucial to the growth of scholarly pursuits since, in most cases, the data from previous research in a discipline is the basis for present research operations. The achievement of effective research data management within an institution necessitates the cooperative endeavor of all relevant stakeholders, including academic staff, researchers, librarians, IT personnel, and research support office (or administrators). Reusable research data facilitates secondary data analysis and makes it possible for data analysts to obtain relevant seed data, which they may subsequently utilize, analyse, and verify to support their findings. All research stakeholders, including institutional administration, libraries and librarians, funding agencies, and the researcher themselves, must collaborate on RDM as it is a team effort (Castle, 2019). To become respected partners in supporting and managing research data for their research community, academic libraries need to work with different departments both inside and

outside of their campuses. Helping researchers manage the large datasets that come from their research will become much more difficult and complex with the introduction of big data (Pinfield et al., 2014a). Academic libraries play a crucial role in the deployment of RDM in such a setting. Academic and research libraries are providing more and more research data management services, commonly referred to as research data services (RDS). In affluent nations, academic libraries and other research stakeholders are incorporating these services more successfully, and the pace at which they are doing so is constantly increasing.

RDM is a research component that deals explicitly with organising and preserving research data in a way that makes it accessible and usable both now and in the future. RDM proponents contend that properly managed research data makes it easier to store, retrieve, share, repurpose, and maintain security. These supporters go on to say that research data advances science in a number of ways, but four stand out as particularly significant. First, students (undergraduate and graduate) can access research data for their learning and research projects. Since students are finding it more and more difficult to access survey data through official methods, using already collected data becomes a practical choice (Chawinga & Zinn, 2019; Woolfrey, 2009). Second, research findings help formulate policy, which promotes global development (Woolfrey, 2009). In actuality, although research findings are communicated through official scholarly channels like journal articles, decision makers can still benefit from informed policies that are derived from the review or reanalysis of previously collected data to ensure its accuracy. Thirdly, RDM lowers process costs by avoiding the need to commission fresh research, which is never inexpensive (Davenport & Patil, 2012) , The cost and duplication of producing research data can be decreased by reusing previously generated research. Lastly, and perhaps most significantly, RDM helps prevent research fraud, including data manipulation, which is reportedly becoming more common.

Nonetheless, there is a notable deficiency in the way that RDM is conceptualized and applied. The aspects of data management covered by templates and guidelines, for example, vary; some focus more on managing data after publication, while others record data collection and processing activities—also known as the "upstream activities of data management planning." (Williams et al., 2017). RDM services cover the handling, preservation, and retrieval of data generated during specific studies or research endeavours. The entire data lifecycle is supported

by these services, which also include digital curation, metadata development and conversion, and planning for data management. Upholding research integrity and facilitating the usage of current data for upcoming projects is another goal of the RDM services. In order to guarantee the availability, visibility, understandability, and use of research data and related information throughout the medium to long term, researchers, librarians, administrators, ethics advisers, and IT specialists all have a crucial role to play. Since these services are rendered in complicated settings, several important participants in research support services must adopt systematic and comprehensive approaches

As of now India is currently lacking even at conducting a serious study on Research Data Management (RDM). Only a handful of university or colleges are aware about the concept of RDM. There is a misconception in libraries among the librarians in many parts of the state of India between data repositories and research data repositories. Data repositories house research work and research data along with other literary works such as publications and so on, whereas a research data repository should only house the data that is collected/generated/gathered during research. One reason to establish a research data repository is that, as research includes huge amount of cost, if such a research data is misplaced or lost it is a huge loss of money invested. Along with it, the repository will help in avoiding duplication of research work as well as it will help the researcher to refer the data that were collected by earlier researcher and take the research forward on a quest for future discoveries.

It is not solely a matter of personal preference as to how much researchers choose to disclose or keep their research data private. The practices and policy have a significant impact on whether data sharing is encouraged or discouraged. A number of researchers who choose not to provide their data argued that providing raw data would require too much work. The perception is also that researchers frequently do not provide clear, well-annotated datasets (i.e., metadata) to support their research, and as a result, they may eventually lose access to and comprehension of the original dataset. This might be avoided with a well-established policy requiring authors to provide datasets to journals or public repositories at the time of publication.

1.1 Statement of problem

The growing demand for research data management (RDM) services is leading in academic libraries, to develop new research data management services for the research community. Academic libraries are components of higher education institutions/universities that operate in a highly competitive setting. Universities and higher secondary education institutions are currently focusing on research as one of the criteria for university ranking and reputation. Additionally, the growing demand for research data management (RDM) services is encouraging academic libraries to seek to offer new research data management (RDM) services. However, there is an urgent need to raise awareness of new trends in collaboration between the research community and academic libraries. There is also a requirement for new RDM skills among librarians. There has been a scarcity of study on library research data management (RDM) and its associated services in general. As a result, this study will investigate the concept of RDM and related services in the academic libraries of professional colleges in Goa.

1.2 Objective of the study

1. To ascertain the present state of RDM in terms of implementation in the academic libraries of professional colleges of Goa.
2. To understand the types of RDM services offered by academic libraries of professional colleges of Goa.
3. To determine the skills and competencies required by the library professionals to perform RDM services.
4. To acquaint with the factors affecting the library professionals in the implementation of RDM.

1.3 Hypotheses

1. There is no formal RDM Institutional Policy in place in the professional colleges of Goa.
2. There is no dedicated research data repository for storing and managing research data.
3. Research Data Management (RDM) practice or implementation is in the infancy stage in the academic libraries of professional colleges of Goa.

1.4 Scope of the study

The study will highlight the status of RDM implementation in the academic libraries of professional of Goa

1.5 Limitations of the study

The study is limited to all the professional college libraries functioning in Goa state.

1.6 Research methodology

1. A survey will be conducted in the professional college libraries of Goa.
2. To investigate the subject matter, the researcher will consult various websites, books, journals, databases, and e-resources.
3. The researcher will try to gather data using questionnaire.
4. The researcher will employ appropriate statistical approaches in data processing as well as statistics, charts, and graphs in the presentation of results to ensure that interpretation is clear and precise.

1.7 population of the study

The study will include Librarians of professional college libraries of Goa state.

1.8 Organization of the study

Chapter 1 - Introduction

Chapter 2 - Literature Review

Chapter 3 - Concepts

Chapter 4 - RDM at National and International level

Chapter 5 - Data Analysis and Interpretation

Chapter 6 - Major Findings, Suggestions, Conclusion and References

1.9 References

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CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

A literature review is an essential piece of writing that dialogues with key sources on a certain topic by gathering and analysing them. Reviews of the literature can be independent pieces of writing or be incorporated within academic articles and research papers. Unlike standard academic research publications, they serve to summarise and synthesize previous research without adding any new results. This chapter consists of most relevant research papers that were required to conduct this research.

(Zhou et al., 2023) research data management (RDM) is a crucial competency for upcoming researchers due to the intricacy and privacy concerns present in social science study data. The requirements of graduate students in the social sciences have not been adequately met by data management training. This study investigated the RDM awareness, preparation, confidence, and problems of social science graduate students in order to close this gap. It did this by using a mixed methods methodology. In a research university in the southern United States, 98 graduate students in the school of education completed a survey measuring RDM preparedness and training needs. Then, 10 randomly chosen graduate students participated in interviews to learn more about data awareness, RDM understanding, and RDM-related issues. While all participants lacked confidence in their ability to use RDM, US nationals were more confident than graduate students from other countries. The majority of participants had no idea that there were on-campus RDM services available, nor that data repositories or data sharing existed. Training needs for graduate students in social science included open access software data analysis, data preservation and security, naming conventions for version tracking, and assistance with data organisation and documentation while working together. These results are important because they point out the subjects that graduate students in social science should learn about during their RDM training. Furthermore, different populations have different levels of RDM confidence and readiness, thus understanding the histories of the students enrolled in the programme is crucial to developing student-centered learning.

(A, 2023) This in-depth review essay explores the state of research data management (RDM) procedures today and the obstacles academic libraries in different areas confront. With the use of several research and data gathered from various nations, this article seeks to give a thorough

summary of the situation of RDM services, the function of librarians, and technological developments in academic libraries. The paper looks at how important RDM is for reproducibility, data sharing, and open science. It also highlights areas that need to be developed and improved. This thorough investigation collects and synthesises data from a wide range of sources using a methodical and thorough approach. Academic journals, conference papers, case studies, and reports of RDM procedures in academic libraries are all carefully searched and reviewed as part of this process. The approach makes sure that various viewpoints and life experiences from other countries are taken into account to offer a worldwide perspective on the topic. This extensive paper offers a thorough and in-depth examination of academic libraries' research data management procedures, highlighting the vital role that these procedures play in fostering data-driven research. Through the analysis of a wide range of international studies, it pinpoints issues and makes tactical suggestions for strengthening RDM services and promoting open scientific concepts in scholarly research.

(Sinha et al., 2023) Understanding the research data management (RDM) services provided by academic libraries in South and Southeast Asian nations is the goal of this study. The purpose of this study is to assess the RDM abilities needed by library and information science workers as well as the difficulties in delivering RDM services. This study's research methodology combined purposive sampling with a survey approach. Online structured questionnaires were employed to gather data in order to assess the current status of RDM services provided in South and Southeast Asian academic libraries. The key RDM service categories offered in the South Asian and Southeast Asian regions were data repositories, training in data management, upkeep of Web resources, data analysis and study, and raising awareness of reusable data sources. The provision of consulting services for data mining, analysis, and visualisation as well as for facilitating repeatability and workflow transparency received little attention. The findings showed that the majority of respondents felt that planning skills for data management and metadata standards were necessary for RDM services in South and Southeast Asia.

(Martin-Melon et al., 2023) Research data services (RDS) are initiatives to offer guidance, training, information, technology assistance, and a regulatory framework for research data management (RDM) at every stage of the data's life cycle to researchers. One task that is becoming more and more crucial to the operations of academic and research libraries is the

adoption of RDS. The purpose of this study is to give an overview of the research data services that are available in academic libraries at public institutions in Spain, including an accounting of the quantity and variety of services offered. To find out which RDS the 48 Spanish public university libraries are using and promoting, we performed a website content analysis of their respective libraries. The findings demonstrate that libraries are implementing these new services in spite of the absence of institutional policies pertaining to research data, but inequitably with regard to the quantity and kind of help offered. The majority of services are in relation to creating a data management plan (DMP) and preserving data in repositories. This inventory serves as a starting point for understanding the degree of RDS implementation in Spanish academic libraries, offering a limited viewpoint and paving the way for more in-depth investigation of other areas in later research.

(Limani et al., 2023) Institutional Repositories (IR) are one of the instruments for managing the increasing amount of research data generated. To determine the requirements for research data management (RDM) and map them to information retrieval (IR) features in order to support them, however, specialised studies are frequently needed due to the diversity of data practices among institutions, domains, communities, etc. In this study, which included 110 participants from various departments, we looked into the data practices for a few national universities in North Macedonia. We were able to determine some of the essential RDM requirements for a range of data-related tasks thanks to the approach we used to achieve this. The six features that our participants requested in an IR solution were (1) create (meta)data and documentation, (2) distribute, share, and promote data, (3) offer access control, (4) store, (5) backup, and (6) archive. Ultimately, we translated these needs to these functionalities. If your university doesn't currently have an IR solution, this list of features may be helpful.

(Chen et al., 2023) Examining the growth of Dataverse—a global cooperative for research data management—is the aim of this study. The institutional features, the use of the related data sets, and the pertinent research data management services at the collaborating university libraries are all particularly examined by the writers. Understanding the present condition of research data management techniques in a global setting requires an evidence-based approach. 67 participants' data portals provided the information, which was gathered between December 1, 2020, and January 31, 2021. The group's current membership is made up of more than 80% of those who

joined between 2016 and 2020. Since their launch, thirty-three Dataverse portals have received fewer than 10,000 downloads in total. Three major global university rating systems involve twenty-nine member universities; research data services are provided by the libraries of eighteen of those universities. Originality/value: This project is an investigation of Dataverse, a global cooperative for the administration of research data. The results advance our knowledge of the Dataverse project's current state and the procedures followed by the involved universities. Additionally, they provide research organisations and other international higher education institutions with insights into the administration of research data. Even though this study is useful, scholars in the future who are interested in creating a framework for data work in academic libraries may find its conclusions and observations insightful.

(Mosha & Ngulube, 2023) The purpose of the study was to determine whether postgraduate students in Tanzanian higher education institutions (HLIs) could deal with their research data by offering research data management (RDM) courses. Research methodologies were triangulated in the study. Survey questionnaires were used to gather information on postgraduate students' needs and opinions regarding the RDM courses taught in HLIs. In-depth interviews with key informants—academicians, ICT specialists, and library employees—were used to learn more about their backgrounds and expertise in instructing RDM courses. The numeric data were evaluated using SPSS statistical software, while the qualitative data were analysed thematically. Postgraduate students received 70 questionnaires in all, with 44 (69%) returning them. However, interviews with twelve significant informants were conducted. 38 respondents, or 86% of the sample, had low RDM literacy. The majority of responders, 40 (91%) stated that HLIs were required to begin instructing RDM courses. The key informants shown a deficiency in abilities and comprehension related to instructing RDM courses. Online tutorials and intensive training were identified as the teaching modalities, while competency-based, adaptive, and constructive teaching strategies were chosen to teach RDM courses.

(Amanullah & Abrizah, 2023) The discussion surrounding the functions of academic librarians in research data management (RDM) services is still pertinent today, particularly in light of the need to make research data replicable, findable, accessible, and interoperable. This study intends to investigate the RDM services provided by academic libraries in Malaysia as well as the implementation process based on the roles and practices of the librarians. Three separate

methods of data collection are used in this descriptive study: an online survey measuring the academic libraries' RDM implementation progress; a semi-structured interview with three academic librarians to assess their roles and practices in RDM services; and an analysis of 20 academic libraries' websites regarding RDM services, training, and policies. Academic libraries in Malaysia offer research data management (RDM) services that are based on their core competencies, which include institutional repositories, bibliographic management tools, and the accessibility of research data. These services are offered instead of impacted RDM support services, like data analysis, data citation, data mining, or data visualisation. The practice and implementation of RDM services have not yet reached a point where they fully support the primary RDM aspects, despite the librarians' awareness of RDM and their involvement in research data services.

(Xu, 2022) The current scoping study looks at empirical studies conducted in university libraries between 2010 and 2021 as well as best practices for research data management (RDM). With a focus on RDM instruction, the current study created a comprehensive and methodical coding scheme to analyse the substantive aspects of RDM and practices, as well as established systematic database searches to find potential publications for inclusion. The present study's findings indicated that after 2011, there will be a significant need for RDM training. Moreover, studies on RDM training expanded throughout Asia Pacific, Europe, North America, and other regions. The results further demonstrated the importance of RDM training for both STEM and non-STEM fields, but they also showed that non-STEM fields, the social sciences in particular, lacked RDM training. The results of the existing literature also revealed that many RDM training programmes did not provide researchers from different domains with a comprehensive, discipline-based curriculum; instead, they concentrated on introducing RDM or providing an overview of it. This study also revealed a deficiency in quantitative research on the impact of RDM interventions, particularly statistical analysis. With the main finding that future RDM practitioners would benefit from stronger collaboration with faculty or researchers to develop more discipline-based curriculums for RDM and more application-based approaches for teaching RDM, this study adds to our comprehensive understanding of some essential elements associated with RDM training.

(Cheung et al., 2022) A consortium of experts from Canadian university libraries polled academics on their research data management (RDM) practices and attitudes, as well as their interest in data management services, ahead of the then-imminent Tri-Agency Research Data Management Policy. A nationwide dataset was created by compiling data from three surveys that were directed towards scholars in the fields of science and engineering, humanities and social sciences, and health sciences and medicine. The current study is one of the few recent multi-institutional and multidisciplinary studies on this topic, as well as the first large-scale survey examining researcher RDM practices in Canada. The results of the survey conducted to determine if researchers were prepared to comply with the requirements of the RDM policy, which include creating data management plans (DMPs) and depositing data in a digital repository, are presented in this article. In addition to highlighting national patterns, the survey results also show variations in attitudes and practices amongst disciplines. Most researchers would need to modify their RDM practices in order to comply with Tri-Agency RDM policy criteria, according to the results of our survey. Our data set offers insights that can assist institutions in setting priorities for infrastructure and service development that will satisfy the needs of researchers.

(Chiarelli et al., 2022) Over the past ten years, research data management, or RDM, has grown to be a significant concern for institutions. This case study describes the RDM service evaluation that the University of Oxford conducted between November 2019 and November 2020 in collaboration with outside experts. Its goal is to outline and talk about the procedures involved in conducting an evaluation of RDM-supporting services across the institution and creating a roadmap for their future, with a focus on the design procedures, methodological techniques, and infographics employed. At the conclusion of the consultation process, the consulting team gave the University a live copy of the future road map that they had prepared. It offers the University a recommended RDM action plan that will be revised and updated based on new internal costings, resource availability, and budget cycle reprioritization for every academic year. The information in this case study is intended to be helpful to other research-heavy universities that are interested in creating and organising RDM services to assist their researchers.

(Singh et al., 2022) This study assesses the current state of RDS or RDM service adaptation in Indian academic libraries (a total of 186 institutions, including all of India's Central Universities

(54) and Institutes of National Importance (132). For data gathering, a method triangulation approach was employed, which included a literature survey, library website study, online survey, and telephonic interview with LIS professionals from Indian academic libraries. According to the statistics, academic libraries in India have yet to catch up with those in developed nations in terms of embracing RDM services, owing to a lack of RDM policy, institutional support, and technological hurdles. The report also makes recommendations to decision-makers, higher-ups in academic institutions, and the government in order to build a robust RDM policy at both the institutional and national levels, defining the role and responsibilities of libraries in RDM. The current study investigates the current situation of RDM services in Indian academic libraries. The findings suggest that The method triangulation technique provides a full picture of RDM services in Indian academic libraries now. Despite a high level of awareness of RDM and related concepts such as DMP, data from a literature review, library website evaluation, online survey, and telephonic interview with LIS professionals from Indian academic libraries indicate a very low level of RDS or RDM service implementation.

(Xu et al., 2022) Previous studies have indicated the importance of and necessity for graduate students to have specialised training in research data management (RDM). But there isn't any RDM training specifically designed for social science fields. The impact of a four-hour online RDM instruction intervention on graduate students' RDM knowledge in social science disciplines was examined. The intervention was created based on the research data life cycle. Pre- and post-assessment results were completed by 84 students in total, 40 of whom were randomly assigned to the online teaching intervention group and 44 to the control group. The data analysis was conducted using a one-way ANCOVA. The findings showed that graduate students in social science who were taught RDM online scored considerably higher than those in the control group on RDM knowledge tests. Furthermore, the impact of the training on participants' RDM abilities differed according to their fields of study.

(Machimbidza et al., n.d.) The viability of Research Data Management (RDM) at the Zimbabwe School of Mines (ZSM) was investigated through the application of an adapted Technology, Economic, Legal, Organisational, and Schedule (TELOS) model. The research utilised a qualitative methodology. Interviews with specifically selected ZSM staff members, including the librarian, the manager of information technology (IT), and three (3) assistant librarians, were

used to gather data. Results indicate that ZSM does not yet pass the feasibility test for the TELOS model. To enable data generation, data collection and description, data storage, archiving and preservation, data access, data discovery and analysis, and data reuse and transformation, ZSM lacks a strong technological infrastructure. ZSM has not yet established a legislative framework that would allow RDM to be introduced. It lacks norms and regulations to deal with matters like copyright, confidentiality, ethics, data protection, freedom of information, and intellectual property. ZSM librarians are computer and IT literate, but they lack RDM-specific expertise. The report provides guidance for developing RDM service introduction policies, procedures, and strategies for academic libraries in Zimbabwe.

(Borkakoti & Singh, n.d.) The goal of the current study is to investigate how library professionals see research data management (RDM). The current state of research data management in libraries is described, and professional opinions are explored regarding RDM-related topics such as stakeholders, NDSAP awareness, institutional research data management policy formulation, research funding agencies' requirements for a data management plan, training areas that library professionals must complete in order to provide research data management, library professionals' motivations, and potential challenges for research data management. Data was gathered using the questionnaire approach, and as a result, an online questionnaire was created and distributed to the respondents. A quick introduction of RDM and some clarifying notes were linked to the questions to help with comprehension. A few questions were designed to highlight the answers. It has been discovered that when researchers contact the library for research data, the majority of the staff members want to make research data management easier. Among the various advantages of research data management, library personnel gave the chance to pick up new skills through RDM first priority. Experts saw the library's upskilling. hiring personnel to deliver RDM is the hardest chore of all.

(Jummai & Library, 2020) Funding agencies for research are aware of how crucial infrastructure and services are to maintaining and organising research data. It has been determined that the best places to house these research data management services are academic research libraries. Data management planning, digital curation (selection, preservation, maintenance, and archiving), and the production and conversion of metadata are all included in research data management services. But some libraries are starting to offer services for managing research data in a

structured way. As local data policies are developed, these services are beginning to have some success. Therefore, the purpose of this work is to go over the significance of research data management in Nigerian university libraries. Data generation, data collection and description, data storage, data archiving and preservation, data access, data discovery and analysis, and data reuse and transformation were all included in the article's summary of the research data management life cycle. The study also listed apps and tools for managing research data, such as DMPonline, the Data Asset framework, CARDIO (Collaborative Assessment of Research Data Infrastructure and Objectives), and the Curation Cost Exchange. The report specifically looks at key abilities needed for managing research data in academic libraries. The paper highlights several obstacles that hinder the provision of efficient research data management services, including the ageing and fragility of technology, the absence of best practices guidelines, insufficient financial and human resources for data management, and a dearth of information regarding optimal infrastructures. The study came to the conclusion that collaboration with global groups like DataCite and Research Data Alliance is essential in order to support academic libraries and research institutions in their professional management of research data.

(Masinde et al., 2021) Through the gathering, arrangement, preservation, and accessibility of research resources, university libraries have contributed to the advancement of scientific research in the field of archaeology. Scholars believe that libraries should play a prominent and central role in research data management and expand their role as curators, given the expertise they have gained from traditional cataloguing, classification, and indexing, as well as from developing and maintaining institutional repositories. As a result, university libraries are expected to gather resources, maintain, and offer research data that may be effectively shared and reused. The goal of this study was to make recommendations for better ways to manage, share, and reuse research data by looking at research librarians' experiences with RDM activities at the UON Library. The Community Capability Model Framework (CCMF) and the DCC Conservation lifecycle model provided the framework for the study, allowing the investigator to purposefully gather qualitative data from a sample of five research librarians at the UON Library. In order to create themes that helped the investigator tackle the research topic, the data was examined thematically. The results of the study showed that, despite the UON Library's policy on research data, quality assurance, and intellectual property, there were no clear guidelines to direct each step of data curation and

capability. Additionally, there were deficiencies in the technology infrastructure, training capabilities, and skill sets.

(Huang et al., 2021) The purpose of this paper is to investigate the current state of RDM at Chinese universities, focusing on how university libraries have been involved in moving the applying RDM policy. This study employs a mixed-methods approach to data gathering, drawing on a website analysis of university rules and services, a questionnaire for university librarians, and semi-structured interviews. One year after the Measures were published, a university website analysis was carried out to determine the extent of policy implementation at the university level and the corresponding services supplied by university libraries. 42 of the 122 invited libraries (108 in mainland China, 11 in Hong Kong, and 3 in Macao) have completed the questionnaire (35 from the mainland and 7 from Hong Kong), resulting in a 34% response rate. The questionnaire data was examined using descriptive statistics and comparative analysis. The findings show that Research Data Service at the local level in Chinese universities is still in its infancy. There is more evidence of development activity in data repositories than in support services. Local policy is not being developed to much extent. One reason for this could be the availability of a national-level infrastructure for specific subject fields, the lack of professionalization of librarianship, and the comparatively poor resonance of openness as an idea.

(Al-Jaradat, 2021) The goal of the current study was to ascertain the current state of affairs, including the laws, procedures, and problems and worries that librarians in Jordan's public university libraries have when it comes to gathering, processing, and preserving research data. Data is the main component of research, which serves as the foundation for the scientific advancement of society and conveys the findings and conclusions of the study. The data life cycle and the research process are inextricably linked and cannot be separated. The current study was conducted to investigate the Research Data administration (RDM) status and practices in Jordan, taking into account the significance of the curation and administration of research data as well as the insignificant policy interests of funding organisations and governments. The study employed an online questionnaire to gather the views and current conditions from the heads of the libraries at public universities and librarians. It was discovered that Jordan falls behind other countries in terms of RDM policies in both institutional and financial agency settings, which

impedes the development and expansion of RDM in university libraries. Nevertheless, despite all of the difficulties and barriers, the Jordanian Public University Libraries (JPUL) are offering RDM services, albeit on a small scale and at various levels of selecting and curating a small amount of important research data, preserving it, and granting preferred users access via online platforms that take the place of data repositories. Ineffective execution and a dearth of national and international RDM policies are present. .. Together with this, there is a larger skill gap among library employees that can be closed by regularly holding workshops and appropriate training programmes to convey the knowledge and abilities needed to oversee RDM procedures in libraries. The JPUL needs to make further improvements in order to provide effective RDM services, and this may be the case in other Middle Eastern countries as well. These improvements should include the creation of infrastructure, the framing of policies, the design of data repositories, specialised courses on data archiving, data cataloguing, data sharing, etc., all while protecting intellectual property rights.(Kim & Syn, 2021)

(Kim & Syn, 2021) With the National Institutes of Health (NIH) Library serving as a case study, this study uses a crosstab framework to analyse research data management (RDM) services and offers suggestions for libraries looking to enhance their RDM offerings. Four NIH Library data services librarians participated in semi-structured interviews with us on the library's user demographics, RDM services offered, RDM infrastructure, and collaborative experiences. We identified and examined the RDM services offered by the NIH Library using the six stages of the data lifecycle and the three kinds of RDM services established by the Online Computer Library Centre (OCLC) through the examination of interview transcripts. The results demonstrate that service shortages can be identified and an overview of an institution's present RDM services can be obtained using the crosstab framework of the two models. The NIH Library typically relies increasingly on information technology divisions for curation services while taking on a greater role in offering education and expert services. To satisfy the demands of biomedical researchers, the library offers substantial assistance for the phases of data production, analysis, and sharing. It also makes recommendations for possible areas of RDM service growth in the less supported stages of data description, storage, and preservation. In light of these results, we suggest that libraries focus on three important areas: identifying service shortages, identifying services that can be supported through partnerships, and regularly gathering user input. These findings foster discussion of topics to be taken into consideration for future improvements in RDM services and

provide a deeper understanding of RDM support based on RDM service categories and the data lifecycle.

(Wang et al., 2021) Give a brief explanation of the urgency of university scientific research data management from the standpoint of the current big data environment. Then, use this to start a discussion about the university's scientific research data management strategy in the big data environment. Finally, make a suggestion to carry out enough research on scientific research data management and pay attention to scientific research data. Techniques include dynamic management, bolstering the security and preservation of scientific research data, and increasing the publication and citation value of the outcomes of scientific research data. One of the main responsibilities of scientific research administration in universities is now gathering, storing, and managing data from scientific studies. Academic "reproduction" is reflected in the educational level of colleges and universities, but scientific research can demonstrate the intellectual calibre of educators and the learned. In order to strengthen the administration of scientific research data in universities and put the National Scientific Data administration Measures into effect, it is imperative that policies for scientific research data management be developed. Universities that create research data management policies can also gain important experience that will be useful for future research data management laws. A long-term and ongoing task in university scientific research management is the exchange and administration of scientific research data. Long-term scientific research activities at universities will be sufficiently motivated by ongoing system improvements and resource enrichment.

(Hamad et al., 2021) In order to cooperate with researchers and end users as they manage data moving ahead, library staff must collaborate and acquire new skills in research data management services. Nonetheless, there is a pressing need for librarians to acquire new research data management (RDM)-related skills as well as to become more aware of the latest developments regarding the collaboration between the academic libraries and the research community. Thus, the purpose of this study is to examine the needs, obligations, and difficulties associated with RDM services in Jordanian university libraries. The necessary information was gathered from Jordan's twenty-one university libraries using a specially designed questionnaire. The findings show that academic libraries in Jordan have a high level of perception and awareness regarding the roles and duties of RDM in libraries, as well as the requirements and difficulties involved in

providing RDM services. It was observed that the results were unaffected by any variables, including job title, experience level, and type of library.

(Joo & Schmidt, 2021) The purpose of this study is to find out how academic librarians view research data services (RDS) in settings related to academic libraries. A variety of RDS difficulties are also examined in this study from the viewpoints of academic librarians. Academic librarians working at research universities across the United States who provide data services were given access to a national online poll. Using multidimensional scaling, hierarchical clustering, and descriptive statistics, the survey responses were quantitatively examined. When providing RDS, academic librarians believed that consultation services would be more beneficial to users than technical help. As a result, participants thought that skills related to consulting services, like instructional skills and data management planning, were more significant. The findings indicated that in order to create and provide RDS, particularly technological services, academic libraries would need to look for opportunities for partnership with other campus organisations.

(Bunkar & Bhatt, 2020) The current study aims to analyse the perspectives of Parul University researchers and academicians on research data management and research data sharing. It also looks into how the researchers saved their research data for future use. It also looks at how the library might take steps to encourage and support researchers and academicians in the organization, preservation, and sharing of research data. The researcher studied the current issue using an online survey method. The structured questionnaire was created and utilized to collect data. A Google form was used to create a web-based questionnaire. 100 questionnaires were provided to investigate and study the situation and received 88 replies out of a possible 100. The study found that the majority of respondents supported research data sharing and unfettered access to research data for browsing and reusing. Researchers are enthusiastic about the library's engagement in the organization and preservation of research data. While sharing data in the public domain, researchers and faculty members are more concerned about their intellectual property rights.

(Chawinga & Zinn, 2020b) The study explores and reports on the current state of research data management at a medical school in an African underdeveloped country. The study is divided into four sections: generation, preservation and backup, competencies, and problems. A questionnaire

was distributed to 130 researchers and 20 library personnel, with 84 (64.6%) and 16 (80%) responding, respectively. The quantitative data received through a questionnaire from 84 health researchers and 16 librarians was supplemented by qualitative data gathered through structured interviews with the university's Director of Research. The study findings give the research community a better grasp of research data management perspectives among developing-country health researchers. According to the study, the current state of research data management provides a chance for an academic library to consolidate and strengthen its widely perceived natural function in research data management. Based on the findings, the paper recommends that the implementation of research data management policies is critical in inspiring the conceptualization, popularization, adoption, and operationalization of various research data management activities within the African university setting.

(Liu et al., 2020) The need for research data management (RDM) policies to enhance the calibre of research data has grown, however there isn't a set set of explicit guidelines for the procedure. This study's goal is to list the current RDM policies. In order to determine how the RDM policies differ, the study specifically contrasts and analyses the policies in three industrialised countries: the United States, the United Kingdom, and Australia. Using NVivo and SPSS, a content analysis method was carried out on the online RDM policies of one hundred universities from the three nations. The analysis's findings showed that the policies' shared fundamental truths related to access, retention, sharing, storage, and ownership. The fundamental principles that all universities adhere to when managing their research are the same. They demonstrate the importance of the Data Management Plan (DMP). The study came to the conclusion that focus area concerns account for the majority of the variations in data management. Furthermore, the duration of data preservation for research is not set in stone. Common standards for data management are suggested for policy considerations in order to guarantee compliance and address the minor inconsistencies that have been found. The study's conclusions are important for emerging nations because they further the conversation on data management regulations. Additionally, the study will make it possible for decision-makers in underdeveloped nations to base their RDM policies on empirical data from the industrialised world.

(Gowen & Meier, 2020) Numerous academic libraries have embraced research data services. The purpose of this study was to evaluate the staffing and research data management services

provided by Association of American Universities (AAU) libraries over the course of the previous five years to the RDM goals outlined in each library's strategic plan. The 60 American AAU universities' libraries were the subject of this quantitative investigation. Some of the data librarian staffing and services were measured using the Briney et al. (2015a) framework in order to look at longitudinal trends. These patterns were contrasted with the strategic aims of libraries now, as reported by Meier (2016), and with the accessible online strategic plans for 2014 and 2019. Although the number of libraries providing data services in the sample population has increased slightly, the majority of these gains have come from libraries that did not prioritise RDM in 2014. Remarkably, a few libraries that identified RDM as a top priority in 2014 have experienced a loss of data librarian posts. Now, more than half of the libraries included in this survey offer or assist with a data repository. Many library strategy plans that listed RDM as a specific goal five years ago have since dropped that inclusion. Large research university libraries now typically have data services, data repositories, and data librarian positions. However, at schools where research data services are more established, they are no longer as significant in many library strategic plans. Instead, libraries appear to be working on expanding or reconsidering the services' offerings.

(Abduldayan et al., 2021) Understanding the research data management procedures used by chemistry researchers at Nigeria's five specialised federal universities of technology was the aim of this study. Research findings can be confirmed and replicated across the scientific community when research data are managed appropriately, allowing for their reuse by subsequent users. Inadequate research data management procedures can result in irreversible data loss, a lack of data to back up study conclusions, and a decline in confidence in the scientific method. Data about the research data management procedures of Nigerian chemical researchers are gathered by an exploratory research technique that involves semi-structured, oral, face-to-face interviews. The interview questions were broken down into four main categories: comprehension of research data by chemistry researchers; experience with data loss; backup and storage methods; data protection; data preservation; and availability of a data management plan. The Provalis Qualitative Data Miner (version 5) programme was utilised to generate themes and subthemes from the coding framework and to show the results of the thematic analysis approach, which was modified from Braun and Clarke. The results showed that Nigerian chemistry researchers comprehend the notion of research data and its significance to research conclusions. Researchers

studying chemistry have seen numerous instances of data loss that is irreversible due to inadequate data security systems, backup procedures, and storage media selection. Despite the fact that libraries are the best places to store data for a long time, trust issues and the risk of data ownership being lost to uninvited parties still exist. They don't employ a proper data management plan when doing their scientific research.

(Chawinga & Zinn, 2020a) In light of the growing recognition of research data as a crucial source for both present and future scientific breakthroughs, numerous research stakeholders have collaborated to establish methods for safeguarding it. Even while Africa produces a wealth of research data, it falls behind in managing that data, which means that most of this important material may be lost. In order to provide suitable data management solutions, this study was conducted to look into the research data management procedures at a public institution in Malawi. The pragmatic school of thinking served as the study's inspiration, leading it to combine quantitative and qualitative research methods. A questionnaire was used to gather quantitative data from 150 researchers and 25 librarians, while an interview with the director of research was used to gather qualitative data. Large amounts of research data are produced by the active participation of researchers in research activities. While most researchers are willing to disclose their data, very few really do. Because the university uses high-risk data storage devices like computers, flash drives, emails, and external hard drives, data preservation is inadequate. Because there were few formal and informational training opportunities, researchers and librarians lacked fundamental research data-management competencies. There are several obstacles that hinder research data management initiatives, but the main ones are the lack of rules for research data management, the absence of incentives, the shortage of expertise, and the unavailability of data infrastructure.

(Tang & Hu, 2019) The findings of an international survey on research data management (RDM) services provided by libraries are presented in this publication. In their survey responses, over 240 active librarians described their responsibilities and levels of readiness for offering RDM services, the difficulties their libraries encounter, and the knowledge and abilities they believed were critical to advancing the RDM practice. The study's conclusions not only showed a variety of regional and organisational variations in the RDM services and tools offered, but also how the degree of development and readiness of RDM positions affected the kinds of RDM services

offered. .. The opinions of the respondents regarding the present difficulties and potential uses of RDM services were also looked at. The majority of respondents acknowledged the value of RDM and expressed a desire for additional training, but they also expressed concerns about a lack of bandwidth or capacity in this area. This indicates that institutional commitment to resources and training opportunities is essential for the expansion of RDM services. Data librarians are a new profession that requires development, mentoring, and additional training. The study argues in favour of creating an international community of practice where data librarians collaborate, share knowledge, support one another's professional development, and endeavour to enhance RDM practice globally.

(Avuglah, n.d.) This study set out to evaluate the University of Ghana's (UG) capabilities in Research Data Management (RDM). Four major components of competence were examined in this study: support services, knowledge and skills, technology infrastructure, and policy framework. It looked at how much RDM is ingrained in UG's research procedures and offered information about how ready UG is to create RDM. The study used a qualitative case study methodology, and document analysis and semi-structured interviews were used to collect data. Respondents for the evaluation came from the Research Office, IT division, library, and senior researchers. The Collaborative evaluation for Research Data Infrastructure and Objectives (CARDIO) Matrix tool served as the instrument for the assessment. The study's findings demonstrate that although RDM at UG has a lot of room to grow, it is currently underdeveloped. RDM is seen as a crucial issue for maintaining research integrity even though there isn't a formal infrastructure in place for it. In general, it was discovered that capabilities were few, disorganised, and not formally established. The study suggests that in order to communicate management's commitment to RDM and to clarify RDM ambitions, a thorough and unambiguous policy framework should be constructed. Additionally, it suggests that research support personnel receive training to increase their ability to promote and assist RDM.

(Read, Larson, et al., 2019) Improved research data management (RDM) makes it possible to replicate experiment results, build upon the findings of other researchers, and analyse data in novel ways. Many people acknowledge that librarians may be a valuable resource for helping researchers in this field; yet, the biomedical research community has not yet completely tapped into this potential. Although librarians have the general skill set required to assist RDM, they

frequently lack the expertise and time necessary to create a curriculum that is suitable for their research community. This project aimed to create and test curriculum and instructional modules for librarians to learn RDM, which they could then use to train their local research communities. We developed online modules for librarians that cover the culture and practice of biomedical research, as well as RDM best practices, resources, and legislation. Using a retrospective pre-post design, data on librarians' self-reported changes in understanding of and comfort level with RDM was gathered using questions included in the online modules. Additionally, we created a Teaching Toolkit that includes slides, a script, and an evaluation form that librarians can use to give researchers at their own universities an introductory RDM lesson. Satisfaction with the course and the intention of the researchers to apply the knowledge acquired were gathered. Seven months following the session, researchers who attended completed a follow-up survey to evaluate the actual improvements in their RDM procedures. The online course improved the self-reported RDM comprehension and comfort level of librarians. RDM procedures were enhanced when librarians used the Teaching Toolkit to instruct researchers in person. Working librarians may rapidly grasp RDM with the help of this two-tiered curriculum, which offers succinct instruction and a pre-made curriculum. They can then impart this knowledge to researchers by offering training at their own institutions.

(Read, Koos, et al., 2019) A pilot programme was created by librarians to offer medical libraries looking to start research data management (RDM) services guidance, tools, tactics, and assistance. To give them the essential background in RDM, participants had to finish eight educational modules. The next step was to mandate the adoption of two of the following three components by each participating institution: (1) a data interview template and techniques, (2) the Teaching Toolkit for instructing an RDM 101 course, or (3) hosting techniques for a data class series. Two to eight librarians from each of the six libraries that took part in the pilot were involved. Each institution's librarians finished the online training courses. Every institution offered one to five introductory RDM classes in addition to doing six to fifteen data interviews, which facilitated the development of relationships with researchers. Attendees gave all of the classes very positive reviews. A data series was undertaken by two libraries, one of which included teachers from outside the building. The pilot programme was effective in assisting librarians involved in learning about and interacting with local research communities, initiating RDM instruction, and forming institutional relationships centred around RDM services. This

pilot's practical, hands-on approach proved effective in assisting libraries with various environments in setting up RDM services. The accomplishment of this pilot offers libraries creating data services at their own institutions a tested way ahead.

(Mohammed & Ibrahim, 2019) Studies underscore the essential function of research data management (RDM) in augmenting scholarly and scientific investigations. This study looked at RDM in Iraqi universities, listed RDM's present problems, and suggested effective RDM techniques. Self-administered questionnaires were used to collect data, and they were given to 155 postgraduate students and 20 faculty members from five Iraqi universities. Research results showed that appropriate RDM is lacking. Researchers and postgraduate students were in charge of their own research data management. Lack of guidelines for best practices in research data management, inadequate human resources, outdated technology, unstable and ineffective infrastructure, financial constraints, a lack of policies governing research data management, and a lack of support from researchers and institutional authorities are the main obstacles to maintaining a strong RDM. Establishing research data repositories and cooperating with other academic institutions and research groups are advised by postgraduate students and researchers.

(Cox et al., 2019) The realisation that research data management (RDM) is necessary has been a significant development in academic libraries over the past ten years. This report aims to document the evolution of library research data services (RDS) and evaluate how this has affected academic libraries' character. An earlier data set from 2014 is contrasted with questionnaire responses from libraries in Australia, Canada, Germany, Ireland, the Netherlands, New Zealand, the UK, and the USA from 2018. A picture of the spread of RDS, particularly advisory ones, is supported by the evidence. Future aspirations, though, don't appear to have changed all that much. Organisational change appears to be sporadic at best, and talent shortages persist. The majority of service development can be described as the addition of research data to already existing library services. However, when paired with the requirements suggested by other novel services like text and data mining, bibliometrics, and artificial intelligence, there is still room for revolutionary effects. The stages at which services, structures, and abilities often grow are outlined in a revised maturity model. Practitioners operating in the RDM arena can compare their current practices and future plans to broader patterns by using the research models that illustrate how RDS are developing and reflecting on the extent to which RDM represents a

transformation of academic libraries' role. The study provides a clear picture of the evolution of research data services internationally and suggests a maturity model to capture typical stages of development. It adds to the broader discussion of how academic libraries are changing.

(Fuhr, 2019) With the Tri-Agency Research Data Management Policy currently circulating for consultation, it is imperative that Canadian health sciences information professionals offer RDM services in their libraries. Research data management (RDM) services are becoming more commonplace in health sciences libraries. A review of the literature reveals numerous strategies to provide health sciences librarians with training as they provide these new services to health sciences researchers, faculty, and students. A survey of pertinent academic papers was gathered and examined. First searches were done in MEDLINE, Scopus, Web of Science, and the discovery service of the University of Manitoba Libraries. The skills required to deliver RDM services were examined in articles, and training programmes were suggested to close skill shortages in RDM. Following preliminary searches, 2 142 articles were found and will be reviewed. 38 papers were chosen after duplicates and articles with just titles and abstracts were eliminated. These articles were chosen by a combination of reference list analysis and citation counts from Web of Science and Scopus. The selected publications emphasise a number of training recommendations, such as creating a nationwide support network, modifying post-secondary library and information studies curricula, and providing workshops for professional development. On RDM training programmes, however, no agreement is reached. Future study will confirm which training approaches are most successful in upskilling information professionals in handling research data in Canadian health sciences libraries as they are generated and documented.

(Piracha & Ameen, 2019) The purpose of this report is to evaluate the planning and policy framework for research data management (RDM) in Pakistani university libraries. Using a mixed method explanatory sequential design, data were gathered from thirty university libraries ranked highly by the Higher Education Commission. The findings show that although library directors were unaware of RDM, they had only recently learned about it. Very few libraries were in the preparatory phase. In this regard, it was discovered that there were additional significant problems, such as inadequate infrastructure and networking, a lack of skilled professionals and support staff, a lack of willingness, motivation, and collaboration with researchers. This study is

the first of its type to examine RDM planning and policy development in Pakistani university libraries.

(Schöpfel et al., 2018) This report aims to provide empirical information on the attitudes and practices of senior management level French scientists with respect to research data management (RDM). The findings are a part of a 2014 national study on scientific data and documentation that the French Research Centre CNRS carried out with 432 directors of public research facilities in France. In addition to highlighting notable discipline distinctions, the research includes actual results about data generation (types), management (human resources, IT, funding, and standards), data sharing, and related demands. Furthermore, it doesn't seem that the dedication to open access is closely connected with RDM and data sharing. The study shows that, with regard to the FAIR data principles, 68% of laboratory directors certify that at least one of the FAIR principles is followed in the generation and management of their data. However, only 26% of laboratories meet at least three of the FAIR criteria, and less than 7% meet all four. The laboratories in nuclear physics, SSH, earth sciences, and astronomy are ahead of other disciplines, particularly in terms of findability and data output availability. Remarks regarding the development of research data services and suggestions for an institutional RDM policy round out the study.

(Shelly & Jackson, 2018) This article examines the ways in which thirteen Australian institutions are supporting their researchers in handling the increasing need for increased accessibility to research data. It asks if university libraries could have a larger role to play in this area and determines which university groups are assisting staff with research data management (RDM) activities. We discovered that the 13 institutions did not all take the same approach to RDM, and that although there was generally high support for securely storing research data both during and after the project, there was a general lack of practical guidance on how to carry out this activity. Our findings raise the question of whether library employees in Australian university libraries have the necessary experience, education, and professional growth to enable them to take on a more significant role in RDM, which calls for more investigation.

(Anilkumar, 2018) The research process produces data as a byproduct, with published results serving as the final product. Research institutes are becoming more and more interested in this by-product. Statistics, experimental findings, observational data, interview recordings, and other

formats are examples of data. For every institute, organising the various forms of data is a task. This is especially true given the current state of data storage and retrieval technologies, which are always evolving. Funding agencies are requiring these datasets to be archived in order to preserve them for future generations and/or allow others to reuse them. Libraries appear to be well-suited to handle and arrange these datasets because they are an integral part of research institutes. The current study was conducted by the author to determine the extent to which Indian libraries are involved in "data management." To determine people's awareness of data curation, data archival regulations, infrastructure needs, technologies employed, etc., a survey was conducted. Fifteen national research and academic institutes in India made up the survey sample. The study demonstrated that India's libraries were still in the very early stages of developing their position in data management in research and academic institutions.

(Aydinoglu et al., 2017) The importance of research data management (RDM) to science has been brought to light by the enormous rise in research data being created daily. Not only must research data be economical, but they also need to be reusable, discoverable, accessible, and dependable. In this context, the aim of this work is to examine Turkish researchers' perspectives and methods on RDM. 532 replies to an online survey given to academic staff at 25 Turkish universities were received. The findings show that while Turkish researchers have reasonable preservation practices, are prepared to share their research data with specific parties, and are aware of the advantages of data management, they also acknowledge that they lack the technical know-how required for RDM. Furthermore, researchers receive no institutionalised assistance in the form of personnel, instruction, software, or gear.

(Tripathi et al., 2017) Data generated over the course of a research endeavour or activity is referred to as research data. Text, numbers, photos, recordings, musical compositions, spoken conversation, experimental readings, simulations, codes, and more can all be included in the data. For usage in the future, it must be conserved. In this context, the study has examined the research data management (RDM) systems that several university libraries have put in place to manage, organise, curate, and preserve research data produced in their departments and laboratories in order to facilitate sharing and reuse. To demonstrate how RDM is extended to researchers, a survey of the top 20 university libraries worldwide as well as the central university

libraries has been conducted. Moreover, it has proposed a model that the nation's university libraries should adhere to while implementing RDM services.

(Yoon & Schultz, 2017) It is important and timely for academic libraries—those at the forefront as well as those already there—to examine the landscapes of research data management services. It offers a general picture of the state and direction of the research data management programme, but it also highlights areas in need of support and improvement, as well as present practices, data management recommendations, and tool adoptions. With four primary areas of focus—service, information, education, and network—this study analysed the content of 185 library websites to look at the research data (management) services offered by academic libraries in the United States. According to the findings of the content analysis of these websites, libraries must progress and become more involved in order to offer services, give online information, and create educational offerings. Based on their online visibility, library data management systems and programmes also differ greatly from one another.

(Cox et al., 2017) An international analysis of research data management (RDM) services, capacities, and activities in higher education libraries is reported in this article. Results of a survey encompassing libraries related to higher education in Australia, Canada, Germany, Ireland, the Netherlands, New Zealand, and the UK are presented. The findings show that libraries have taken the lead in RDM, especially when it comes to policy creation and advocacy. There is still a dearth of services, with a concentration on advisory and consultancy services (like training on data management and planning help) as opposed to technical services (like maintaining an active data curation database and providing a data catalogue). Libraries are working to increase staff members' skills in data curation, although concerns persist about the lack of consistency in skills and capacities. Obtaining "buy in" from researchers and senior management, collaborating with other support services, and resource allocation are other significant obstacles. To evaluate trends and relative maturity levels, the results are compared with those of earlier research. The variety of RDM activities examined in this study are positioned on a "landscape maturity model," which represents planned and existing research data services and practices in university libraries. This serves as both a baseline for further research and a "snapshot" of current advances.

(Yu, 2017) Research data service (RDS) capacity in academic institutions is being outpaced by the ease with which research data may now be collected, thanks to the rapid advancements in computational technology and cloud-based data storage. The author combines existing research literature with survey data gathered from the Association of Research Libraries (ARL) and the Association of College and Research Libraries (ACRL) to provide a systematic review of the RDS offered in academic institutions and libraries, illustrating the opportunities and challenges in providing RDS. Furthermore, the RDS websites of the institutions that took part in the 2013 ARL survey was also looked at. The study aims to contribute to the body of knowledge on RDS development, give an environmental scan of the current level of RDS provision in academic institutions, and assist academic libraries in developing strategic RDS plans. In areas that reflect the life cycle of RDS provision, such as research data management planning, metadata consultation and tool provision, data archiving, institutional repository provision, and data sharing and access, the paper examines the strategies employed and levels of RDS provided by reviewing recent literature, utilising existing survey data from ARL and ACRL, and examining RDS websites of the 2013 ARL survey-participating institutions. ARL research-intensive institutions' overall library-led research data service offers appear to be growing. Two discernible trends in the provision of RDS by academic libraries are increased participation and greater scope and degree of services. By encouraging researchers to utilise the accessible resources in addition to their own repositories for data exchange and storage, academic libraries are making the most of open access repositories. There are either few or no discussions about RDS policy and infrastructure development.

(Higman & Pinfield, 2015) This work aims to explore the relationship between research data management (RDM) and data sharing in Higher Education Institutions (HEIs) RDM policy formation and practice improvement. Sequentially, two work streams were conducted: a content analysis of 37 RDM policies from UK HEIs, and two in-depth case studies of establishments that used distinct RDM strategies, derived from semi-structured interviews with personnel engaged in the creation of RDM services and policies. Actor Network Theory insights are used to interpret the data. The creation of RDM policies and services has led to the emergence of a complex web of networks both inside and outside of institutions, encompassing a variety of professional organisations whose goals and priorities range greatly. Although data sharing is seen as a significant activity in the policies and services of the HEIs under study, the majority of the time,

its significance may be traced to the stances taken by major research funders. The case studies highlight a range of problems and difficulties faced more generally, especially in the UK, however they cannot be taken to be generally relevant because the research is based on qualitative data. The study could contribute to the establishment of RDM practices and policies in HEIs and funding agencies. This work adds early to the body of knowledge in RDM on the particular subject of the interaction between openness and RDM policy and services—a topic that has gotten little attention up to this point.

(Goldman et al., 2015) to comprehend the ways in which scientific research data management and community services are being handled by New England medical libraries. There are seventeen Resource Libraries in the National Network of Libraries of Medicine, New England Region (NN/LM NER). The New England Regional Medical Library (RML) is housed at the University of Massachusetts Medical School. A total of sixteen NER Resource Libraries responded to this questionnaire. A 40-item online survey evaluated the programmes and services offered by libraries for training and assistance with research data management. Libraries discussed their aspirations for the future and the institutional difficulties they are facing in creating data services. This study illustrates the region's utilisation of resources supplied by the NN/LM NER RML at the University of Massachusetts Medical School and demonstrates how few NER Resource Libraries now incorporate scientific research data management into their services and programmes. Planning professional development programmes that support efficient biomedical research data services and keeping the NN/LM NER informed about the eScience learning needs of New England medical librarians are made easier with an understanding of the sorts of data services offered at NER libraries.

(Pinfield et al., 2014a) One of the biggest challenges facing research groups nowadays is managing their research data. Universities are producing vast amounts of born-digital data at a fast pace in a wide range of formats. The significance of academic libraries to research data management (RDM) within a larger institutional framework is examined in this paper. Specifically, it looks at the relationships and roles that are a part of RDM, breaks down an RDM programme into its constituent parts, assesses what motivates RDM actions, and investigates the major variables that determine RDM advancements. The study, which examines data from 26 semi-structured interviews with library employees from various UK institutions, is written from

the viewpoint of library professionals. This early qualitative addition to the field complements the case study and quantitative methods already in use. The findings indicate that while libraries are an important component of RDM, there is ambiguity and variability in the relationships with other stakeholders, including research support offices and IT services. RDM initiatives are now focusing on developing policies and guidelines, with some preliminary work on supporting services and technological infrastructures. Storage, security, quality, compliance, preservation, and sharing with libraries most directly related to the last three are the main forces behind improvements. The report also identifies a "jurisdictional" driver that libraries are utilising to assert their influence in this area. Numerous elements, such as talents, resources, and governance, are found to have an impact on current developments. Based on the study, a model is created that aims to encompass the key elements of an institutional RDM strategy. With the identification of levels of activity, numerous stakeholders and drivers, and a plethora of elements impacting the implementation of every endeavour, this model aids in the clarification of the various challenges related to RDM. Institutions can inform ongoing RDM action by usefully benchmarking their activities against the data and model.

(Cox & Pinfield, 2014) In order to fully understand the ways that libraries are now involved in research data management (RDM) and the degree to which the development of RDM services is a strategic goal for them, a survey of UK universities was conducted at the end of 2012, and the results are reported in this paper. According to the report, libraries were only partially providing RDM services, with major, research-intensive institutions having the highest levels of participation. The issues of resource scarcity, cultural shift, and skills limitations were significant obstacles. Nonetheless, libraries recognise this as a crucial component of their future function and are already working on creating new institutional RDM policies and services. Emerging priorities include offering training and consultation services related to RDM. To provide a comprehensive picture of activities and trends, a methodical comparison between these findings and those of other recent studies is conducted. Abbott's theory of professions is utilised to get insight into how libraries are vying to extend their jurisdiction while also working collaboratively with other stakeholders. An innovation hype-cycle framework is employed to comprehend prospective futures.

(Tenopir et al., 2013) Academic research libraries have been designated as sites to establish these research data services (RDS). Research funding bodies acknowledge the need of infrastructure and services to organise and protect research data. Planning for data management, digital curation (selection, preservation, upkeep, and archiving), and the generation and conversion of metadata are all included in research data services. In order to create a baseline of librarian participation at this early stage of widespread service development, we report the findings of an empirical inquiry into the RDS practices of librarians in academic research libraries in the US and Canada. This paper specifically looks at the survey respondents' perspectives on their background, education, and level of preparedness to provide RDS, as well as their attitudes towards the value of RDS for their libraries and institutions and the elements that support or impede librarian participation in RDS.

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CHAPTER 3

CONCEPTS

3.0 Introduction

This chapter's primary goal is to give a brief synopsis of the theoretical framework pertaining to work satisfaction. This chapter explores the definition of research data management along with several associated terms and theories. Furthermore, we investigate some models developed by diverse scholars, following which we examine the characteristics, benefits and advantages, tools and infrastructure, and so on.

The organization of research data is a concern of research data management, which also offers assistance and support to researchers at every stage of the research cycle, from data entry to the distribution and preservation of important findings. The goal of the RDMS is to optimize the research process while meeting the requirements and criteria of the research funding agency. The data sharing policies of funding agencies, researchers dedicated to open science, which promotes open verification and replication of research data, and the development of cyber infrastructures are all contributing to the establishment and support of RDM services in response to the shifting landscape of scientific research. The whole research lifecycle is supported by research data management services, which include electronic curation, metadata development and transmission, and data management preparation. This makes it possible for new and creative works based on existing data and helps to ensure that discoveries are verified accurately. Research data management describes the process of gathering data and how it is organized, preserved, shared, and used in a research project. This covers the ongoing management of research data over the course of a project. Recommendations for data sharing and maintenance after the project is finished are also necessary. Other names for research data management include data curation, data management, and research data curation.

3.1 Definitions

1. According to the definition given by National Library of Medicine (Research Data Management, n.d.), –Research data management is the organization, documentation, storage, and preservation of the data resulting from the research process, where data can be broadly defined as the outcome of experiments or observations that validate research

findings, and can take a variety of forms including numerical output (quantitative data), qualitative data, documentation, images, audio, and video.‖

2. According to the definition given by (Bouchrika, 2020), ‒Research data management describes a way to organize and store the data that a research project has accumulated in the most efficient way possible. It manages data gathered during the entire lifetime of the research project by coming up with consistent conventions. It is also responsible for the sharing, access, preservation, and secure disposal of data, thus making it an integral component of the various types of resource management. And, the practice is also intertwined with the tools that allow scientists to do so. Primarily, this involves the use of scientific data management system solutions.‖

3. According to the definition given by (LibGuides: Research Data Management @ Pitt: Understanding Research Data Management, 2019) University of Pittsburgh, ‒In an academic research context, data management is primarily about how individual and small-team researchers manage their data, and computing activities generally, in order to create impactful findings. For findings to have maximum impact, underlying data should be well organized, well described, and available to other researchers for validation and replication. Of course, some also argue that findings won't be made in the first place, or a research program sustained, without effective data management practices.‖

4. According to the definition given by (Radebe, n.d.) University of Pretoria, ‒Research data management is the process of controlling the information generated during a research project. Any research will require some level of data management, and funding agencies are increasingly requiring scholars to plan and execute good data management practices. Managing data is an integral part of the research process. It can be challenging particularly when studies involve several researchers and/or when studies are conducted from multiple locations. How data is managed depends on the types of data involved, how data is collected and stored, and how it is used – throughout the research lifecycle.‖

5. According to the definition given by Imperial College London (Research Data Management | Research and Innovation | Imperial College London, n.d.), ‒Research data management refers to how you will look after the data you collect or generate during your research. It covers activities such as planning for your data management needs at the start

of your project, organising, storing and securing data during your project and ensuring long-term preservation, data sharing and reuse at the end of your project.‖

6. According to the definition given by (Backman, n.d.), ‒Research data management (RDM) means description, organization, storage, preservation, sharing, and publishing of data collected and used in a research project. Effective and responsible RDM is an integral part and essential requirement of good scientific practices and research skills.‖

7. According to (Whyte & Tedds, n.d.) ‒Research Data Management (RDM) is how you look after your data throughout your project. It covers the planning, collecting, organising, managing, storage, security, backing up, preserving, and sharing your data and ensures that research data are managed according to legal, statutory, ethical and funding body requirements"

8. **According to** (Yeo & Dong, n.d.) Singapore Management University, **"Research Data Management** (RDM) is how you look after your data throughout your project. It covers the planning, collecting, organising, managing, storage, security, backing up, preserving, and sharing your data and ensures that research data are managed according to legal, statutory, ethical and funding body requirements.‖

3.2 Characteristics

Research data management (RDM) involves the organization, storage, preservation, and sharing of data generated and used in the context of research projects. Effective research data management is crucial for maintaining the integrity, accessibility, and usability of research data. Here are some key characteristics of research data management:

- **Organization**: RDM involves structuring research data in a logical and systematic manner, making it easier to find, understand, and use. This includes developing consistent file naming conventions, folder structures, and metadata standards.
- **Documentation**: Comprehensive documentation is essential for RDM. This includes detailed descriptions of datasets, methodologies, data collection processes, and any

transformations or analyses performed on the data. Good documentation enhances reproducibility and transparency.

- **Storage**: RDM involves selecting appropriate storage solutions for research data, considering factors such as security, accessibility, scalability, and compliance with institutional or funder requirements. This may include using institutional repositories, cloud storage services, or dedicated research data management platforms.
- **Backup and Security**: Data backup and security measures are critical components of RDM. Researchers should implement regular backups to prevent data loss due to hardware failures, cyber-attacks, or other unforeseen events. Security measures should be in place to protect sensitive or confidential data from unauthorized access.
- **Data Sharing and Collaboration**: RDM promotes data sharing and collaboration among researchers. This may involve making research data openly available through repositories or archives, sharing data with collaborators, or publishing datasets alongside research publications. Data sharing enhances the impact and visibility of research and facilitates collaboration and reproducibility.
- **Data Preservation**: RDM includes strategies for long-term data preservation to ensure that research data remains accessible and usable over time. This may involve selecting appropriate file formats, documenting data preservation procedures, and depositing data in trusted repositories or archives.
- **Compliance and Ethics**: Researchers must adhere to legal and ethical requirements when managing research data, including data protection regulations, intellectual property rights, and ethical guidelines for human subjects research. RDM practices should ensure compliance with relevant laws, regulations, and institutional policies.
- **Data Reuse and Reproducibility**: RDM facilitates data reuse and reproducibility by making research data discoverable, accessible, and understandable to other researchers. This includes providing clear documentation, metadata, and access instructions to enable others to verify and build upon research findings.

- **Training and Support**: RDM requires training and support for researchers to develop the necessary skills and knowledge to effectively manage research data. This may include providing guidance on data management best practices, tools, and resources, as well as offering technical support for data management tasks.
- **Continuous Improvement**: RDM practices should be regularly reviewed and updated to reflect changes in technology, regulations, and best practices. Continuous improvement ensures that research data management remains effective and responsive to evolving needs and challenges.

By incorporating these characteristics into their research practices, researchers can ensure that their data is well-managed, secure, and accessible, thereby maximizing the impact and value of their research contributions.

3.3 Benefits of RDM

Research data management (RDM) offers a range of benefits for researchers, institutions, and the scientific community at large. Here are some key advantages of implementing effective RDM practices:

- **Improved Data Quality:** By adopting structured data management practices, researchers can enhance the quality and dependability of their data. This involves ensuring data precision, consistency, and comprehensiveness, resulting in more robust research outcomes.
- **Enhanced Research Efficiency:** RDM simplifies data management processes, making it easier for researchers to organize, store, and access their data. This improves research efficiency by reducing the time and effort needed to locate, analyze, and share research data.
- **Fostered Collaboration:** RDM encourages collaboration among researchers by providing mechanisms for sharing and accessing research data. Collaborators can work more effectively together, regardless of their location, leading to increased productivity and innovation.

- **Increased Data Accessibility:** Effective RDM practices make research data more accessible to other researchers, stakeholders, and the public. This promotes transparency and openness in science, enabling others to validate findings, replicate studies, and build upon existing research.
- **Enhanced Reproducibility:** RDM promotes reproducibility by ensuring that research data is well-documented, organized, and preserved. Other researchers can replicate experiments and analyses, fostering greater confidence in research findings and advancing scientific knowledge.
- **Preservation of Research Assets**: The preservation of research data is crucial in order to safeguard valuable research assets for future use. This helps to prevent data loss caused by hardware failures, technological obsolescence, or any unexpected events.
- **Re-Use of Data** : One of the benefits of research data management is that it allows data to be preserved in the long term, even after the original research is completed. This means that the data can continue to have an impact on research developments. Researchers can also take advantage of high-quality data collected by others and use it in their own research. Research data management encourages researchers to openly share their data with the scientific community, promoting collaboration and the reuse of data. This can lead to secondary analyses, meta-analyses, and interdisciplinary research, which maximizes the impact of research investments.
- **Support for Research Integrity**: Effective research data management practices also contribute to research integrity. By promoting transparency, accountability, and ethical conduct in data management and reporting, it helps prevent data manipulation, fabrication, or any other forms of research misconduct.
- **Facilitation of Interdisciplinary Research** Additionally, research data management facilitates interdisciplinary research by allowing researchers from different disciplines to access and integrate diverse datasets. This promotes collaboration and enables the addressing of complex research questions that require a multidisciplinary approach.
- **Chances of Funding Success**: Implementing a good research data management plan can increase the chances of securing funding. Many international funding organizations expect a data management plan to be included in grant applications to ensure that research benefits both the scientific community and society as a whole.

- **Safeguarding Good Scientific Practice**: Research data management is essential for maintaining good scientific practice. Guidelines for handling research data are included in recommendations for safeguarding good scientific practice, emphasizing the importance of proper data management in research

3.4 RDM tools and infrastructure

Research Data Management (RDM) involves the organization, storage, preservation, and sharing of research data throughout its lifecycle. Effective RDM is crucial for ensuring data integrity, reproducibility, and compliance with institutional and funder policies. Various tools and infrastructure have been developed to support researchers in managing their data. Below are some key components and examples of RDM tools and infrastructure

- **Data Repositories:**
    1. Dataverse: A web-based repository for sharing, publishing, citing, and preserving research data. It provides support for various file formats and allows researchers to describe and share their datasets with proper metadata.
    2. Figshare: A platform that enables researchers to publish and share their research outputs, including datasets, figures, and other types of research-related content.
- **Institutional Repositories:**
    1. DSpace: An open-source repository system that enables institutions to capture, store, index, preserve, and redistribute their digital assets.
- **Metadata Standards:**
    1. Dublin Core: A widely used standard for describing resources, including datasets, to facilitate interoperability and discoverability.
    2. DataCite Metadata Schema: Specifically designed for the publication and citation of datasets.
- **Data Management Planning (DMP) Tools:**

1. DMPTool: Helps researchers create data management plans that comply with funder requirements. It provides guidance on best practices and helps researchers outline how they will manage and share their data.

- **Version Control Systems:**

  Git and GitHub/GitLab/Bitbucket: While primarily designed for source code versioning, these tools can also be used to manage and version control datasets, especially for collaborative research projects.

- **Storage and Cloud Services:**

  1. Amazon S3, Google Cloud Storage, Microsoft Azure Storage: Cloud storage services that provide scalable and secure storage for research data.
  2. OwnCloud and Nextcloud: Self-hosted cloud solutions that allow institutions to create and manage their own cloud storage and file-sharing services.

- **Preservation and Archiving:**

  1. LOCKSS (Lots of Copies Keep Stuff Safe): A distributed preservation system that ensures content remains accessible over time.
  2. Archivematica: An open-source digital preservation system designed to maintain standards-based, long-term access to collections of digital objects.

- **Collaboration and Project Management:**

  1. Research Electronic Data Capture (REDCap): A secure, web-based application designed for data collection and management in research studies.
  2. Open Science Framework (OSF): A collaborative research platform that supports data management, project organization, and collaboration.

- **Training and Education:**

  1. Data Carpentry and Software Carpentry: Organizations offering workshops and training on best practices for data management, including tools like Git and R.

- **Compliance and Regulation:**

    1. Institutional Review Board (IRB) Systems: Systems that assist in managing the ethical review process for research involving human subjects.
    2. Electronic Lab Notebooks (ELNs): Digital tools that help researchers record and manage their research data in compliance with institutional and regulatory requirements.

It's important to note that the choice of tools and infrastructure depends on various factors, including the nature of the research, institutional policies, and the preferences of researchers and collaborators. Additionally, staying informed about evolving best practices and standards in research data management is crucial for effective implementation.

3.5 Models and components of RDM

3.5.1 Community Capability Model Framework (CCMF) by (Ball, n.d.)

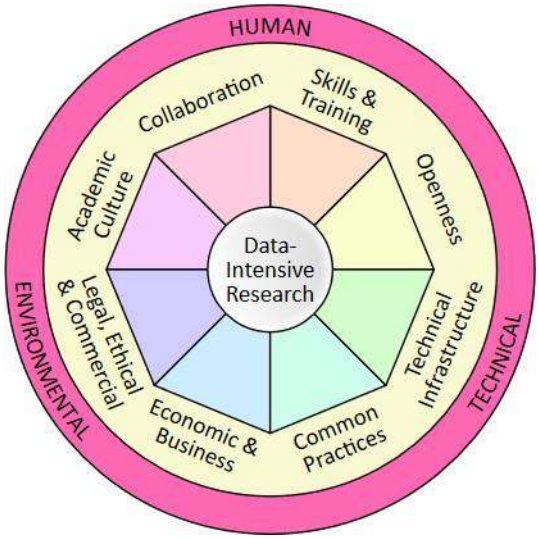

Figure 3.5.1 Community Capability Model Framework

1. Collaboration

We'll bring up again and again how resource-intensive data-driven research is: a lot of data, ideally aggregated from several sources, and a lot of processing power are required. Most of the time, that is what motivates the actions we choose. Thus, you are more likely to find data and computational resources at a scale where data-driven research can thrive in groups with a high degree of collaboration. A number of distinct forms of collaboration have been identified as potentially significant. The first is interdisciplinary collaboration, which is truly best measured as a curve plotted against research stage rather than as a single value. Next comes multidisciplinary and inter-disciplinary research. Once more, the more the better, as combining data that has never been combined before increases the likelihood of gaining novel insights. This also holds true for cross-sectoral cooperation, when increased funding also translates to improved or longer-term funding. Lastly, public can access data and processing resources from the public at a scale that is not possible for you to do otherwise. I'm thinking of projects like Galaxy Zoo, where a large group of volunteers handled the task of creating pattern recognition software, or surveys of wildlife.

2. Skills and training

Here we'll examine the competencies needed by researchers to do data-driven research.

- Competencies
- Four skill sets that we believe are critical have been identified. We then examine the extent to which these competencies are ingrained in the research community (tools and technologies, data description and identification, collaboration and communication, policy and planning); the greater the degree of ingrainedness, the better.
- Training is ingrained

3. Openness

Openness brings us back to the idea that the optimal environment for data-driven research is one in which researchers have access to a pool of publicly available data. However, the problem is not just with quantity; it's also with quality, documentation, and compatibility.

- Transparency during the study process;
- Transparency in published literature;

- Transparency in data;
- Transparency in approaches and workflows;
- Reuse of previously collected data

4. Technical infrastructure

Next up, we have platforms and tools. Although it should go without saying, a community needs a strong technical infrastructure in order to conduct data-driven research. Thus, we determined which key tasks require particular instruments and how adequate they are for use in the present and future of research.

- Data Storage,
- Curation And Preservation Support,
- Visualisations And Representations,
- Integration And Collaboration Platforms,
- Computational Tools And Algorithms,
- Data Capture And Processing Tool Support,
- Data Access And Discovery, And
- Platforms For Citizen Scientists

5. Common practices

Common Practices are guidelines and practices that facilitate the exchange, use, and repurposing of data. We've carefully worded our measurements because we believe that the number of such activities is not as important as their quantity—too many might be just as polarising as too few. Once more, we have divided this element into tasks.

The following topics are covered:

- Data Formats;
- Data Collection Techniques;
- Workflows For Processing;
- Data Packaging And Transfer Protocols;
- Data Description;
- Vocabulary, Semantics, And Ontologies;

- Data Identifiers;
- Reliable, Well-Documented Apis

6. Economic and business models

Given the amounts of data and processing power required, data-driven research can be quite expensive, therefore it's critical that money is available to support it. The sustainability, geographic scope, and amount of money for infrastructure and research are examined in the first six metrics. Keep in mind that the alignment of these many indicators might be just as crucial as the numerical values; for example, issues may arise if funds is allocated yet facilities must be located centrally. This section discusses various aspects such as

- Research Funding Sustainability,
- Funding Scale And Geography,
- Funding Size,
- Public-Private Partnerships,
- Infrastructure Funding Sustainability,
- Infrastructure Funding Size, And
- Productivity And Return On Investment.

7. Legal and ethical issues

Since legal and ethical obstacles are much more difficult to overcome than technological ones when they obstruct data sharing and reuse, we felt it was crucial to highlight them.

- Regulatory and legal structures
- Overseeing moral obligations and standards

8. Academic culture

In a way, our final factor is a catch-all for elements of academic culture that haven't been discussed before.

- Risk, innovation, and entrepreneurship;
- Researchers' reward schemes;
- Frameworks for quality assurance and validation

3.5.2 The DCC Curation Lifecycle Model by (Higgins, 2008)

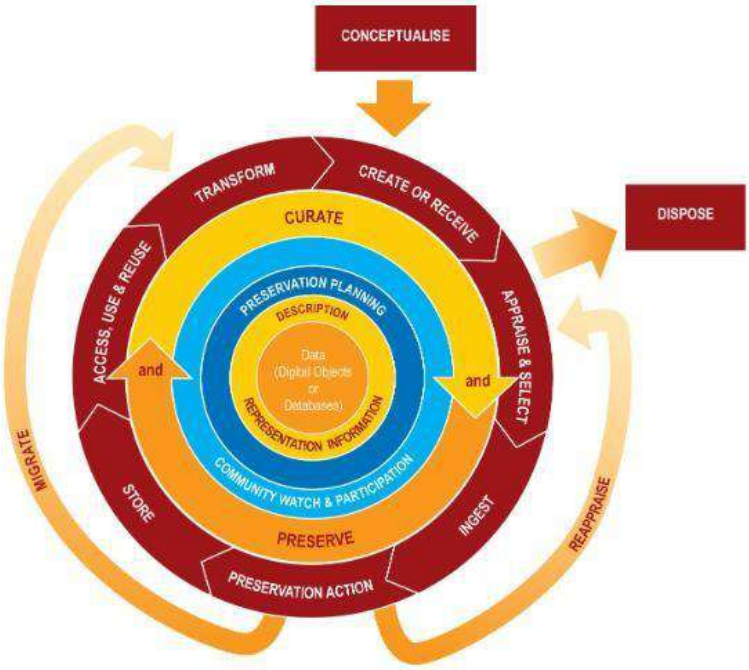

Figure 3.5.2 DCC Curation Lifecycle Model

The Curation Lifecycle

A graphical high-level overview of the steps necessary for the proper curation and preservation of data from first conceptualization or receipt is provided by the DCC Curation Lifecycle Model. The approach can be used to schedule tasks inside a group or organisation to guarantee that all required steps are completed in the right order. The model makes it possible to define roles and responsibilities, map out specific functionality against it, and create an implementable framework of standards and technologies. It can assist in finding extra steps that could be needed, or actions that some disciplines or situations do not require, as well as in making sure that procedures and regulations are sufficiently recorded.

Data (Digital Objects, or Databases)	

	Data, or any binary digital information, is the focal point of the curatorial lifecycle. This comprises:
Digital Objects	Simple Digital Objects (SDOs) are discrete digital objects, such as text files, photos, or sound files, plus the metadata and IDs that go with them. - Discrete digital items, like webpages, that are created by assembling several other digital objects are known as complex digital objects.
Databases	Organised sets of documents or information kept on file in a computer system.

Full Lifecycle Actions	
Description and Representation Information	To guarantee proper description and control over time, assign administrative, descriptive, technical, structural, and preservation metadata in accordance with the relevant standards. Gather and allocate the representational data needed to comprehend and produce the digital content along with its related metadata.
Preservation Planning	Make plans for preservation at every stage of the digital material's curation lifespan. Plans for managing and overseeing every step of the curation lifecycle would fall under this category.
Community Watch and Participation	Keep an eye on proper community activities and take part in the creation of common

	standards, instruments, and software.
Curate and Preserve	Throughout the curation lifespan, be aware of and carry out the management and administrative measures intended to support curation and preservation.

Sequential Actions	
Conceptualise	Conceive and organise the process of creating data, including the means of capture and available storage.
Create and Receive	- Provide metadata for your data that is administrative, descriptive, structural, and technical. At creation, preservation metadata may also be added. - Acquire data from data makers, other archives, repositories, or data centres in compliance with established collection policies. If necessary, assign relevant metadata.
Appraise and Select	Analyse the data and make decisions on long-term preservation and curation. Respect established guidelines, rules, or legal mandates.
Ingest	Move data to a data centre, archive, repository, or other custodian. Respect established guidelines, rules, or legal mandates.

Preservation Action	Take steps to guarantee that data's authoritative quality is maintained throughout the long term. Data integrity should be preserved while preserving authenticity, dependability, and use, according to preservation procedures. Data cleansing, validation, representation information assignment, preservation metadata assignment, and file format or data structure acceptance are among the actions.
Store	Keep the information safe while following all applicable regulations.
Access, Use and Reuse	Make ensuring that on a daily basis, data is available to both authorised users and reusers. Information that has been published and made accessible to the public may be this. It may be necessary to implement strong access controls and authentication protocols.
Transform	For instance, migrate the old data into a new format to create new data from it. - By selecting or querying a subset to produce newly generated findings, possibly for publication.

Occasional Actions	
Dispose	Get rid of any data that hasn't been chosen for

	long-term curation and preservation in line with established guidelines, regulations, or legal obligations. Generally, information can be moved to a different data centre, archive, repository, or custodian. Sometimes there is data destruction. Due to the nature of the data, secure destruction may be required for legal reasons.
Reappraise	Return data that doesn't pass validation processes so that it can be evaluated and reselected.
Migrate	Transform data into an other format. This could be done to protect the data from software or hardware obsolescence or to comply with the storage environment.

3.5.3 The Capability Maturity Model by (Paulk et al., 1993)

Developed in 1986 as a result of an analysis of data gathered from businesses under contract with the U.S. Department of Defence, which provided funding for the study, the Capability Maturity Model (CMM) is a development model. The concept of "maturity" describes the level of formality and process optimisation, ranging from ad hoc methods to officially specified procedures, monitored result metrics, and active process optimisation. The model can be used for different processes, but its primary goal is to enhance the software development processes that are currently in place. The Capability Maturity Model Integration, created in 2006 by Carnegie Mellon University's Software Engineering Institute, mainly replaced the CMM and addressed some of its shortcomings. (Wikipedia Contributors, 2018)

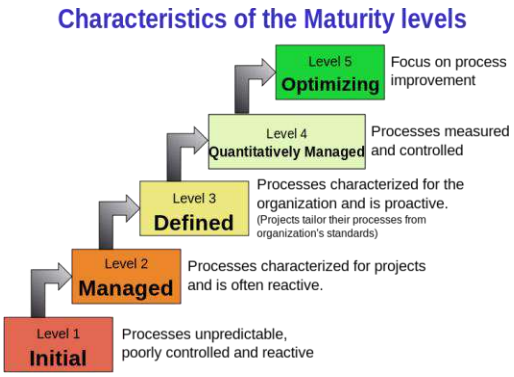

Figure 3.5.3 The Capability Maturity Model

1. **Initial:** The software development process is described as ad hoc and sometimes even chaotic. There aren't many established processes, therefore each person's work counts.
2. **Repeatable:** The main goals of project management procedures are to monitor budget, time, and functionality. The process discipline required to replicate past achievements on projects with comparable applications is in place.
3. **Defined:** The organization's standard software process incorporates the established, standardised software processes for both engineering and management tasks. The organization's standard software methodology for developing and maintaining software is adapted and authorised for usage in all projects.
4. **Managed:** There is a collection of precise metrics related to the software process and product quality. The products and the software process are both quantitatively known and managed.
5. **Optimizing:** Piloting novel concepts and technologies as well as receiving quantitative feedback from the process facilitate continuous process improvement.

3.5.4 The Capability Maturity Model for Scientific Data Management by (Crowston & Qin, 2011)

Figure 3.5.4 Capability Maturity Model for Scientific Data Management

Level 1: SDM is needs-based, ad hoc, and typically carried out intuitively at this level. Instead of formalised procedures, SDM's efficacy is dependent on capable individuals and bravery. The efficacy of data management is restricted by the expertise of those working in the sector and their particular abilities. There is a risk that the SDM won't be maintained if those people leave or divert their attention to other projects; these staff changes will significantly affect the results (e.g., the data collection process will alter depending on the person doing it).

Level 2: At this level of development, the research team has deliberated and created an SDM strategy. Examples of things that could be documented are directory organisation structures and local data file naming rules. At this point, creating a new project necessitates revamping procedures, which could jeopardise SDM's efficacy. It is probable that as researchers transition from one project to another, they will need to acquire new procedures. Moreover, the disparities in techniques throughout projects will make it more difficult to aggregate or share data across numerous initiatives.

Level 3: At this point, a company can launch new initiatives knowing that procedures will be carried out consistently and reliably. Projects at this level, for instance, most likely use a metadata standard with best practice standards. Formal semantic structures (controlled

vocabulary, ontology, or taxonomies) are used to represent data sets and products; however, these standards can be modified to suit specific project needs. Adopting a metadata standard, for instance, to describe datasets frequently necessitates customising and changing the standard to suit project requirements.

Level 4: To assess the processes, information is systematically gathered, examined, and the processes are instrumented.

Level 5: The organisation is committed to streamlining its procedures; flaws are found and fixed early on. Procedures that are implemented at these stages of development cover general methods for process enhancement. As previously said, our analysis yielded no examples of these processes, which we believe indicates the current maturity level of SDM.

3.5.5 Pyramid model of nine areas of RDM activity for libraries by (Lewis, 2010)

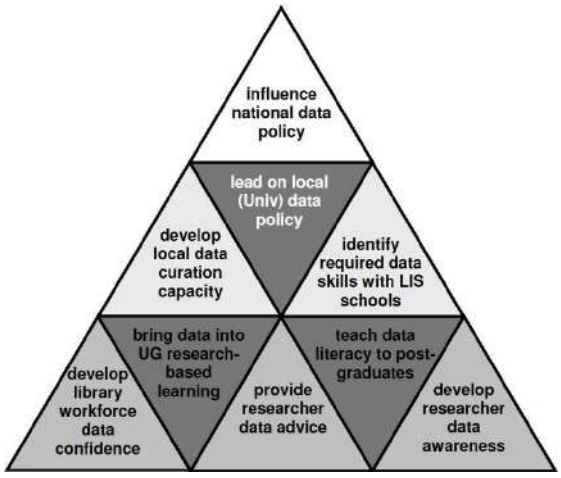

Figure 3.5.5 Pyramid model of nine areas of RDM activity for libraries

- **Develop library workforce data confidence**

The focus of this heading is on educating academic library staff members about e-research and data management concerns. It highlights how crucial it is to keep up with current information, make use of outside seminars and courses, and create professional practice networks. It also

emphasises the necessity of communicating with academic staff members who might not be completely engaged with study data.

- **Provide researcher data advice**

It's possible that university libraries aren't yet equipped to handle digital datasets locally. But once they get involved with the matter and broaden the knowledge of their liaison staff, they may advise researchers on data management both informally and formally through formal content on library websites. In order to handle data-intensive research, libraries and IT services should collaborate closely, influencing researchers' methods both before projects begin and during the proposal-writing stages.

- **Develop researcher data awareness**

Academic libraries are essential in bringing attention to issues related to data management in their respective universities. Considering the wide range of interests in data issues, they ought to start conversations about them. Researchers are discouraged from investing in data management due to a variety of reasons, such as unfamiliarity with the procedures, worries about demands for information, ambiguity regarding permissions, and fear of unauthorised alteration. These are important elements to take into account when libraries communicate with other institutional stakeholders, such as research administrators.

- **Teach data literacy to postgraduate research students**

Postgraduate research training is essential for research data management because it shapes the way that data will be used by future researchers. Understanding the alternatives for storage and curation as well as how data will be generated, used, and maintained is a necessary component of data literacy.

- **Bring data into undergraduate research-based learning**

Undergraduate programmes that require a dissertation can help postgraduate students gain experience with data management. By giving students access to actual research data in a classroom setting, this approach can enhance undergraduate education by supporting inquiry- and problem-based learning methodologies. "Research-led" learning can be advantageous for research-intensive universities, improving the educational experience for students.

- **Develop local data curation capacity**

Libraries should make investments in data curation and storage capabilities while taking the influence of research funding policies and advocacy on researcher conduct into account. Budgetary restrictions, the need for innovation, and the demands of content procurement make the business case difficult. Decisions are informed by case studies, which frequently curate material from institutional sources.

- **Identify required data skills with LIS schools**

In order to create new training materials, library managers work with LIS schools to identify skills gaps in research data curation. According to a lot of university library directors, libraries ought to help create new data management courses since professional practice has evolved more quickly than LIS programmes.

- **Lead on local data policy**

By interacting with researchers and other stakeholders, the library can take the lead in university policy. Senior management teams and research committees at universities must comprehend the advantages and disadvantages of data management before approving investment business cases. Library directors need to discuss the issue and their recommended solutions with more senior staff members.

- **Influence national data policy**

Librarians can and should expect to be players in their national policy arenas for research data – where these exist.

3.5.6 A library-oriented model of institutional RDM by (Pinfield et al., 2014b)

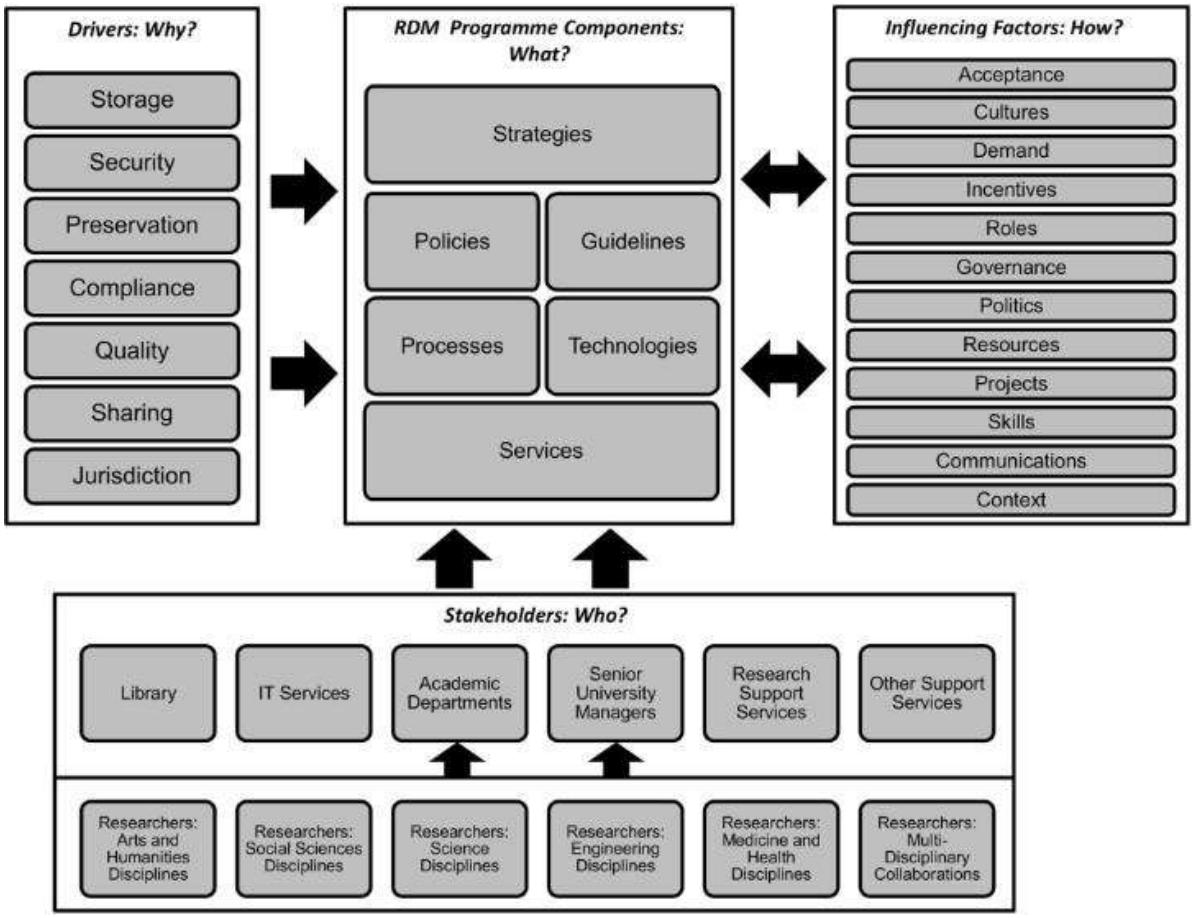

Figure 3.5.6 A library-oriented model of institutional RDM.

Factors such as drivers (why), components (what), influencing factors (how), and stakeholders (who) are included in the model. Institutional entities including the library, IT services, academic departments, senior university managers, research support services, and other support services are included in the stakeholder area. Stakeholders include researchers from different fields. Storage, security, preservation, compliance, quality, sharing, jurisdiction are a few examples of drivers. Acceptance, culture, demands, incentives, roles, governance, politics, resources, project, skills, communications and context are some of the influencing factors. While the programme components include strategies, policies, technologies, processes, services and guidelines.

3.5.7 Research lifecycle model by (Lyon, 2012)

This viewpoint is obviously institutional in nature. Although it is acknowledged that different libraries offer distinct services, the focus is still on the institutional functions. This may appear differently in different situations. Additionally, it is a library-centric model that, whilst emphasising collaboration, may underrepresent two things: first, the degree to which other services could lead or even contribute to various RDM features; and second, the autonomous operations of departments or faculties. Nonetheless, Lyon does a good job of clearly defining a number of responsibilities according to the organisational level and unit of the library, outlining the relationships and talents needed in each situation.

1. RDM Requirements: Using data audit and assessment tools like the Data Audit Framework (DAF) and CARDIO from the Digital Curation Centre (DCC), departments will be supported in conducting research data requirements surveys. These surveys may address both past and future data needs.

2. RDM Planning: utilising resources like the UK Digital Curation Center's DMPOnline tool or the California Digital Library's DMPTool, staff members in faculty Doctoral Training Centres collaborate to provide post-graduates, research staff, and principal investigators with advocacy and guidance on efficient data management planning. Additionally, there is a chance to participate in institutional annual planning rounds by posing insightful queries that delve into the needs for storage, security and sensitivity concerns, access, and future data infrastructure demands.

3. RDM Informatics: providing technical expertise for structured data description, including use of metadata standards and schema, data formats, ontologies appropriate to particular disciplines and domains. This is an opportunity to promote disciplinary norms and to work towards consensus.

4. RDM Citation: providing instructions and connections to other services, like DataCite, to facilitate the assignment of persistent identifiers to datasets in order to facilitate reuse, reference, and discovery.

5. RDM Training: Postgraduates, research personnel, and principal investigators can get data management training programmes and modules from faculty Doctoral Training Centres. A growing collection of repurposable resources from JISC projects (MANTRA, CAIRO, DATUM, DataTrain, DMTpsych) and data training materials (DCC 101 Lite) have been established by the DCC.

6. RDM Licensing: directing questions on data licencing to knowledgeable resources (such as the DCC Guide How to Licence Research Data). The legal and ethical concerns related to datasets may also be covered by this professional advice. Participating in university research ethics committees can be a useful way to spread information and facilitate communication.

7. RDM Appraisal: offering direction to help with decisions over which data to retain. A useful guide on How to Appraise and Select Research Data has been provided by the DCC.

8. RDM Storage: working in tandem with IT Services to guarantee that infrastructure provision and local data storage policies are both relevant and clear. Proactive cooperation with disciplinary, national, and worldwide data centres is also necessary, as is knowledge of funder-policy requirements (such those of ESRC) for data deposit in these archives.

9. RDM Access: providing guidance for the creation of practical data release policies and embargoes that respect the intellectual property of the researcher, the institution, and any collaborating industrial partners while also supporting open science agendas and FOI (the Research360 project has a particular focus in this area). ensuring that papers in institutional repositories have the proper links to underlying and additional data.

10. RDM Impact: collaborating with Research Support Offices to gather data on the effects of research datasets and their repurposing in order to provide RIM/CRIS systems with relevant impact evidence. A number of newly developed impact tracking platforms, like total.impact.org, make it easier to keep an eye on collections of research products, including datasets. Libraries have the power to encourage their use and support scholars in maximising their "network impact" on the Internet.

3.6 Stakeholders of Research Data Management

Stakeholders in research data management (RDM) include various individuals, groups, and entities with interests or responsibilities related to the collection, storage, sharing, and usage of research data. Here's a breakdown of some key stakeholders:

- **Researchers**: They are primary stakeholders as they generate and use research data. Researchers need efficient data management to ensure the quality, integrity, and accessibility of their data throughout the research lifecycle.
- **Funders**: Funding agencies and organizations have a vested interest in ensuring that research data they support is managed effectively. They may require data management plans (DMPs) as part of grant applications and expect compliance with their data sharing policies.
- **Institutions**: Universities, research institutes, and other organizations hosting research activities have a responsibility to support researchers in managing their data effectively. They may provide infrastructure, resources, policies, and training related to RDM.
- **Librarians and Data Managers**: Librarians and dedicated data managers often play a crucial role in supporting researchers with data management. They provide guidance on best practices, assist with data curation, metadata creation, and help ensure compliance with institutional and funder requirements.
- **Ethics Committees and Institutional Review Boards (IRBs)**: These bodies oversee research ethics and may have responsibilities related to data management, especially concerning sensitive or personal data. They ensure that data handling practices adhere to ethical guidelines and legal requirements.
- **Data Repositories and Archives**: These organizations provide infrastructure and services for storing, sharing, and preserving research data. They often work closely with researchers and institutions to ensure data is curated, described, and made accessible in accordance with community standards.

- **IT and Technology Providers**: IT departments within research institutions, as well as external technology providers, play a crucial role in providing the infrastructure, tools, and services needed for effective data management, including storage solutions, data analysis software, and security measures.
- **Publishers and Journals**: Publishers increasingly require authors to share data supporting their research publications. Journals may have their own data policies and work with authors to ensure data underlying published findings are accessible and properly managed.
- **Government Agencies and Regulatory Bodies**: Government agencies may have oversight roles related to research data management, especially concerning compliance with data protection regulations, intellectual property laws, and national research policies.
- **Collaborators and Partners**: In collaborative research projects, partners and collaborators may have interests in data management practices to ensure effective collaboration, data sharing, and compliance with any agreements or contracts governing the project.
- **Public and Society**: In cases where research has public implications or is publicly funded, the general public and society at large can be considered stakeholders. They may have interests in data transparency, access to research findings, and ethical handling of data, especially when it pertains to public health or environmental issues.

Effective research data management involves collaboration and coordination among these stakeholders to ensure that research data is effectively managed, shared responsibly, and used to advance knowledge and innovation while adhering to legal, ethical, and disciplinary norms.

3.7 Challenges and training requirements for RDM

Research Data Management (RDM) involves the organization, storage, preservation, and sharing of research data. Implementing effective RDM practices can pose various challenges, and meeting these challenges often requires specific training. Here are some challenges and training requirements associated with Research Data Management:

3.7.1 Challenges:

- **Data Quality and Integrity:** Ensuring the accuracy, reliability, and consistency of research data. Researchers need training in data validation, documentation, and metadata standards.
- **Data Security and Privacy:** Protecting sensitive and confidential data from unauthorized access. Understanding data security protocols, encryption methods, and compliance with data protection regulations.
- **Data Storage and Infrastructure:** Managing large volumes of data and choosing appropriate storage solutions. Familiarity with storage technologies, cloud services, and data transfer protocols.
- **Data Sharing and Collaboration:** Promoting collaboration while respecting data ownership and intellectual property rights. Training in collaborative tools, data sharing platforms, and understanding licensing agreements.
- **Metadata and Documentation:** Creating comprehensive metadata and documentation to enhance data discoverability and understanding. Educating researchers on metadata standards, documentation best practices, and the importance of clear descriptions.
- **Compliance and Ethics:** Navigating legal and ethical considerations related to data collection and sharing. Training on ethical research practices, legal compliance, and institutional policies.
- **Long-Term Preservation:** Ensuring the preservation and accessibility of research data over the long term. Understanding preservation strategies, data archiving principles, and using appropriate repositories.
- **Data Lifecycle Management:** Managing data throughout its lifecycle, from creation to disposal. Training on data lifecycle management practices, version control, and data archiving.

3.7.2 Training Requirements:

- **RDM Workshops and Courses:**
    1. Researchers should attend workshops and courses covering RDM principles, practices, and tools.
- **Data Management Plans (DMPs):**
    1. Training on creating effective Data Management Plans, which outline how data will be handled throughout the research project.
- **Metadata Standards and Documentation:**
    1. Education on using standardized metadata and documenting data in a consistent and comprehensive manner.
- **Data Security Training:**
    1. Training on data security protocols, encryption methods, and compliance with relevant data protection regulations.
- **Collaborative Tools and Platforms:**
    1. Familiarity with tools and platforms that facilitate collaboration and data sharing among research teams.
- **Legal and Ethical Training:**
    1. Training on legal and ethical considerations related to data collection, sharing, and ownership.
- **Preservation Strategies:**
    1. Understanding preservation strategies and training on using data repositories for long-term data storage.
- **Institutional Support:**

1. Leveraging institutional resources and support, including RDM experts and services.

- **Continuous Education:**

1. Encouraging ongoing education to stay updated on evolving RDM practices, tools, and policies.

By addressing these challenges through appropriate training, researchers can enhance the overall quality, integrity, and impact of their research data.

3.8 Open access research data repositories

1. Zenodo

Zenodo is a general-purpose open research data repository run by CERN and created as part of the European OpenAIRE initiative. Researchers can deposit reports, data sets, research software, articles, and other digital artefacts linked to their work. Each submission from Zenodo comes with persistent digital object identification (DOI), which makes the saved materials easily citable. Any researcher's work that is uploaded is kept safe in CERN's data centre for an extended period of time. Additionally, the researcher can use Zenodo's access restrictions to limit access to particular groups or share the research publicly.

2. Open Science Framework

Developed by the Centre for Open Science (COS), the Open Science Framework (OSF) is an open-source platform that facilitates scientific collaboration, documentation, and transparency. It is a free, non-profit organisation whose mission is to improve scientific research's reproducibility, integrity, and transparency. Throughout the whole study life cycle, researchers may plan, gather, analyse, and share their findings. It gives researchers a centralised area to manage files, data, code, and protocols. This facilitates private or public collaboration and automates processes like version control, preregistration, and preprint sharing. Additionally, it has integrated project management features that let users publish their work for wider distribution and organise, store, and exchange documents, datasets, and other types of

information. The OSF permits users to access their research after leaving their institution and encourages collaboration with others whether or not they are associated with the same institution. It facilitates a seamless workflow by integrating with a variety of data analysis tools and enables users to monitor how their research is accessible and used.

3. Microsoft Dataverse

Microsoft Dataverse is a potent data platform that enables businesses to handle and store data safely. It offers a centralised area for organising files, data, code, and protocols throughout the research lifecycle and is made to work with any kind of data and any kind of app. Data is arranged in rows and columns in tables, which resemble spreadsheets. A particular sort of data, such as text, numbers, or dates, is stored in each column. With its ability to manage huge datasets and its backing by Microsoft's infrastructure, Dataverse guarantees data security and uptime. Dataverse is a secure data storage platform that allows users to restrict access to particular user roles. In order to facilitate management and upkeep, the platform also comes with a number of tools for data modelling, data validation, and data integration.

4. Figshare

Users can make all of their research products discoverable, shareable, and citable by using Figshare as a repository. A wide range of research outputs, including tabular data, pictures, videos, presentations, posters, code, book chapters, and more, can be stored, shared, and cited using it. Because Figshare is made to interact with researchers' workflows, transferring data for review, curation, and publication is simple. In addition, it offers, for a one-time Data Publishing Charge (DPC), safe and redundant cloud storage for ten years or more for datasets and materials supporting a particular publication or project. Scholars can submit and exchange a vast array of research results (data sets, figures, photos, code, videos, and posters) using Figshare. A Digital Object Identifier (DOI) is assigned to each upload. Additionally, Figshare connects with other services, like GitHub and ORCID, to facilitate the sharing and cross-platform linking of your research outputs.

5. The Dataverse Project

The Dataverse Project is an open-source web application that enables academic institutions and researchers to create their own Dataverse repositories in addition to sharing, preserving, citing, exploring, and analysing research data. It functions as a community-driven platform that makes data more accessible to other users. The Dataverse Project is organised around hosting several Dataverse collections, each of which consists of datasets or other collections together with data files and descriptive metadata, including code and documentation to go along with the data. It is an adaptable platform that facilitates research data sharing and preservation, allowing users to efficiently explore, cite, and analyse data. By making data more discoverable and accessible, the Dataverse Project plays a crucial role in advancing open science practices and eventually advances research across a variety of disciplines.

6. Dryad Data Repository

Dryad is a global open-access research data repository, particularly for data supporting papers in science and medicine. Data is made discoverable, freely reusable, and citable through this carefully curated general-purpose repository. The goal of Dryad is to facilitate and encourage the reuse of academic research data, thereby aiding in the verification of published results, investigation of novel analytic techniques, and repurposing of data for unexpected research inquiries. Tables, spreadsheets, flat files, and other published data that might not have their own dedicated repositories can all be found in the repository. Every data file in Dryad is linked to an article that has been published and is released for reuse with a Creative Commons Zero waiver. The repository offers free data access and reuse, but there are fees associated with submitting or uploading research data. By assigning a distinct Digital Object Identifier (DOI) to every dataset for convenient access, the repository helps publishers, societies, journals, and authors to streamline data archiving at the time of publication.

7. Mendeley Data

Researchers can increase publication citations and funder mandate compliance by making their data publicly available through the Mendeley Data repository. It provides users with one-click access to datasets by connecting them with related articles. A DOI is assigned to datasets that are

uploaded to Mendeley Data, allowing other researchers to independently cite them. It spares readers from having to download bulky files by enabling them to preview data files right within the browser. Mendeley Data allows authors to immediately contribute data, guaranteeing full acknowledgment and credit for their work. Verification is done on datasets uploaded to Mendeley Data to ensure that they adhere to their guidelines and publication ethics. Mendeley Data improves the exposure and findability of research data linkages by sending metadata, including links to related publications, to DataCite. Mendeley Data presents a variety of usage indicators for each dataset, such as views, downloads, data citations, and altmetrics that track mentions and attention on social media. The maximum storage size for each dataset on Mendeley Data is 10 GB, with an additional 100 GB accessible for institutional subscriptions. The service is free to use.

8. The Harvard Dataverse

The Harvard Dataverse is an free online data repository that enables researchers from any discipline, both inside and outside of the Harvard community, to share, archive, cite, access, and explore research data. With approximately 2,000 dataverses, 75,000 datasets, and more than 350,000 files accessible for investigation, the Harvard Dataverse offers access to a wide variety of datasets to facilitate research. The open-source web programme Dataverse, upon which it is based, allows researchers to exchange, store, cite, examine, and evaluate research data. Through the Harvard Dataverse platform, scholars, journals, data authors, publishers, distributors, and linked institutions can all gain academic credit and web prominence. Every dataset in the Harvard Dataverse is assigned a DOI, which increases the data's visibility and permits independent reference by other researchers.

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CHAPTER 4

RDM AT NATIONAL AND INTERNATIONAL LEVEL

4.0 Introduction

This section deals with the status of Research Data Management at the national and international level. Various studies are conducted at the international level, many researchers have come together to investigate the status of RDM along with its preparedness, roles, practices and so on. As compared to international level vey less research has been conducted at the national level.

4.1 National Level

In the Indian context (Patel, 2016) discussed the necessity of obtaining and repurposing research data in the Indian setting. The project produced a conceptual framework for RDM at the institutional level as well as instructions on how to operate and process a prototype for a National Repository of Open Research Data (NRORD). The author counselled the University Grants Commission and the Government of India to develop a national RDM policy and underlined the significance of an institutional data sharing plan. A study was conducted by (Tripathi et al., 2017) to demonstrate how RDM is extended to academics, the researchers examined major university libraries in India and compared them to the top 20 university libraries worldwide. Moreover, it has proposed a model that the nation's university libraries should adhere to while implementing RDM services. The significance of research data and the ways in which university libraries support researchers with RDM services have been the focus of this study. The major universities in India are in the very initial stage of implementing RDM services, while the libraries of the top twenty universities in the world have already put them into place and are significantly assisting their academics' needs for research data. (Anilkumar, 2018) conducted a pilot study n order to access the knowledge of data archiving regulations, infrastructure needs, technologies employed, data curation, etc. 15 national research and academic institutes in India made up the survey sample. The study demonstrated that India's libraries were still in the very early stages of developing their position in academic institutions regarding Research Data Management. Another researcher (Bhardwaj, 2019) examined the opportunities provided by Indian research data repositories and found that things are rapidly changing in India. Though they were still in the early phases, institutions began creating research data repositories when the National Data Sharing and Accessibility Policy (NDSAP) was put into effect. It was discovered

that the bulk of the repositories were domain-specific, with the Life Sciences accounting for the majority of them. Two researchers

(Bunkar & Bhatt, 2020) from parul university conducted a research to understand the researchers' and academicians' perceptions of the role of the library and the research data management system at Parul University. According to the study, most respondents agreed that research data should be shared and should be freely accessible for browsing and reuse. Scholars express strong interest in and agreement about the library's role in organising and maintaining research data. Concerns over intellectual property rights are greater among academics and researchers when releasing data in the public domain. (Borkakoti & Singh, n.d.) conducted a survey of LIS specialists at Central Universities and Institutes of National Importance in north-eastern India to find out if RDM was being used in these establishments. Through the study it has been discovered that professional perceptions are evolving and moving in the right direction.. A group of researchers (Singh et al., 2022) conducted a study to evaluate how well RDS or RDM services are currently being adapted in Indian academic libraries (which comprise 186 establishments in total, including all 54 Central Universities and 132 Institutes of National Importance). The study found that the absence of RDM policy, institutional support, and technological problems have prevented academic libraries in India from implementing RDM services at the same rate as those in industrialised nations, according to the statistics. The report also offers recommendations to policymakers, higher authorities in academic institutions, and the government for the creation of robust RDM policies that specify the functions and responsibilities of libraries in RDM at the institutional and national levels.

A recent study was conducted by (Sinha et al., 2023) to comprehend the services that academic libraries in South and Southeast Asian nations provide for research data management (RDM). The purpose of the study was also to assess the RDM abilities needed by library and information science workers as well as the difficulties in delivering RDM services.the researchers found that the key RDM service categories offered in the South and Southeast Asian regions were data repositories, training in data management, upkeep of Web resources, data analysis and study, and raising awareness of reusable data sources. The provision of consulting services for data mining, analysis, and visualisation as well as for facilitating repeatability and workflow transparency received little attention. The findings showed that the majority of respondents felt that planning

skills for data management and metadata standards were necessary for RDM services in South and Southeast Asia.

4.2 International Level

4.2.1 Studies conducted in various regions of African continent

As per the research conducted by (Chiware & Mathe, 2016) A few research councils, academic libraries, and research councils in South Africa have implemented initiatives aimed at implementing RDM services inside their respective organisations. The UCT eResearch Centre, for instance, was founded by the University of Cape Town (UCT) to collaborate with researchers in identifying suitable IT solutions for their research endeavours. The University of South Africa (UNISA) conducted an examination into RDM procedures at UNISA as part of a project to build data management services. The universities of Pretoria, Stellenbosch, and Witwatersrand (Wits) are all at various phases of planning and implementation. The establishment of technical infrastructures and services for data, processing, and connectivity—which are necessary to facilitate data exchange, collaborative work, and remote access—is being carried out by the Council for Scientific and Industrial Research (CSIR), the Data Intensive Research Initiative of South Africa (DIRISA), and the National Integrated Cyber Infrastructure System (NICIS). The foundation for the expansion and development of RDM services in South African research and academic institutions will be provided by the IT infrastructures and digitization initiatives that are currently present in many South African universities, as well as national initiatives and communities of practice such as the Network of Data and Information Curation Communities (NeDICC). The research of the RDM landscape in South Africa reveals that while awareness of RDM is high in universities, the most pressing challenges are those related to leadership, policy, and skills.

(Chigwada et al., 2017) investigated RDM practices in Zimbabwean higher education institutions and discovered that there were generally non-existent RDM policies and guidelines, scarce financial and human resources, a dearth of reliable and secure technical infrastructure, and a general lack of support for RDM from the institution's management. To promote excellent data practices among academics, they suggested creating trustworthy data repositories. Another

research conducted by (Nhendodzashe & Pasipamire, n.d.) to check the readiness of providing RDM services in the University of Zimbabwe academic library. According to the study the researchers concluded that RDM is a service that researchers need from the library, the UZ library is only partially prepared to provide it. The UZ library lacks the necessary RDM expertise and legal duties to engage in RDM activities. It is essential that the library adopt enabling policies for access, control, data protection, and ownership of data since researchers are concerned about copyright concerns with their data and how those data will be accessed. If the project is to succeed, staff development is still another crucial issue that must be addressed.

(Chiware & Becker, n.d.) carried out a survey to find out whether Southern African HEIs were prepared to take the lead and take part in institutional RDM growth. They discovered that a variety of infrastructure, resource, and human capacity limitations prevented the majority of institutions from being completely prepared to handle RDM within their walls. The development of RDM guidelines and policies varies throughout nations, with the majority of institutions lacking any policies at all. Furthermore, the potential of institutional repositories to handle datasets and their metadata was not completely realised. Although there was a skills gap, certain institutions are making an effort to close it. In order to bring the current library research services into compliance with RDM, they advise organisational reorganisation and librarian training. (Avuglah, 2019) conducted a research to assess Research Data Management (RDM) capabilities at the University of Ghana (UG). The study's findings demonstrate that although RDM at UG is still in its infancy, it has enormous growth potential. RDM is seen as a crucial issue for maintaining research integrity even though there isn't a formal infrastructure in place for it. In general, it was discovered that capabilities were few, disorganised, and not formally established. The study suggests that in order to communicate management's commitment to RDM and to clarify RDM ambitions, a thorough and unambiguous policy framework should be constructed. Additionally, it suggests that research support personnel receive training to increase their ability to promote and assist RDM. In order to recommend appropriate data management strategies, the authors (Chawinga & Zinn, 2020a) looked into the research data management practices at a public university in Malawi. They discovered that since research data is increasingly regarded as a crucial raw material for both present and future scientific discoveries, many research stakeholders have banded together to create mechanisms for preserving it. Even while Africa produces a wealth of research data, it falls behind in managing that data, which means that most

of this important material may be lost. The authors came to the conclusion that there are four main issues that RDM efforts face: a lack of incentives, a lack of policies, a lack of skills, and a lack of cooperation among researchers. and in light of the results, the authors recommended that the university take into account developing a strong campus-wide data storage infrastructure, holding training sessions to give researchers and librarians the essential RDM skills, and setting aside funds specifically for the formal training of librarians at institutions like UCT. Librarians should take the initiative to visit and advertise RDM services to researchers and other university research stakeholders in the comfort of their offices in order to improve collaboration between researchers and librarians.

(Abduldayan et al., 2021) conducted a research at the federal universities of technology in Nigeria. The purpose of the study was to understand the research data management practices of chemistry researchers. The researchers of this study found that researchers studying chemistry have seen numerous instances of data loss that is irreversible due to inadequate data security systems, backup procedures, and storage media selection. Despite the fact that libraries are the best places to store data for a long time, trust issues and the risk of data ownership being lost to uninvited parties still exist. They don't employ a proper data management plan when doing their scientific research. The authors concluded that chemistry researchers at Nigeria's Federal Universities of Technology have little knowledge of or experience with RDM and suggested that chemical researchers require more training and continuous education regarding the significance and advantages of using proper research data management techniques. In order to support and boost researchers' confidence during the study process, the library should also implement research data management programmes.

A group of researchers (Machimbidza et al., 2022) conducted a research in which the researcher applied an adapted Technology, Economic, Legal, Organisational, and Schedule (TELOS) model to explore the feasibility of Research Data Management (RDM) at the Zimbabwe School of Mines (ZSM). The researchers came to the conclusion that, when viewed through the lenses of technology, the legal environment, and the abilities and knowledge necessary for the execution of RDM, ZSM does not now meet the TELOS framework feasibility test. In order to facilitate the generation, collecting, description, archiving, preservation, access, discovery, analysis, reuse, and transformation of data, ZSM lacks a strong technological infrastructure. ZSM has not yet

established a legislative framework that would allow RDM to be introduced. It lacks rules and guidelines to address, among other things, concerns with intellectual property, copyright, data licencing, ethics, data protection, freedom of information, and confidentiality. The researchers also come to the conclusion that although ZSM librarians are computer and IT literate, they are not skilled in RDM.

A new research by (Mosha & Ngulube, 2023) looked into offering research data management (RDM) courses in Tanzanian higher education institutions (HLIs) to enable postgraduate students in handling their research data. Survey questionnaires were used to gather information on postgraduate students' needs and opinions regarding the RDM courses taught in HLIs. In-depth interviews with key informants—academicians, ICT specialists, and library employees—were used to learn more about their backgrounds and expertise in instructing RDM courses. According to the study's findings, the researchers suggested that HLIs must begin instructing students in RDM courses; as a result, RDM courses will be taken into consideration for curriculum inclusion. The researchers also emphasized that RDM will be necessary to enable students at HLIs to preserve their data in data repositories for later use and to share their data with researchers globally. The researchers also concluded with their findings that the key informants showed a deficiency in abilities and comprehension related to instructing RDM courses. According to the researcher even when individuals finish their education, research data literacy abilities remain crucial, for which the researchers affirmed that teaching RDM in HLIs will be seen as a crucial component of academic instruction, encompassing workshops, online resources, and in-person lectures. The researchers also suggested that when teaching RDM courses in HLIs, instructional strategies that combine theoretical and practical sessions must be taken into consideration. Furthermore, because blended learning incorporates both traditional classroom instruction (in person and virtually) and online courses, it is a suitable structure for delivering RDM courses. The researchers also affirmed that other HLIs will build comparable courses for their employees, researchers, and students based on their study.

4.2.2 Studies conducted in Jordan

(Hamad et al., 2021) conducted a study to find out how Jordanian academic library staff views research data management and services, the conditions needed to set up RDM services at these

institutions, and the opportunities, challenges, and roles that RDS plays in Jordanian academic libraries. To conduct the study the authors chose 8 out of 10 Jordan public universities and 13 out of 20 private universities in Jordan. The findings show a high level of perception and knowledge on RDM. Staff perceptions at Jordanian academic libraries have identified roles, responsibilities, requirements, and obstacles. For example, the staff acknowledged that a data repository was a crucial component of the infrastructure that libraries needed to have in order to support researchers; yet, the findings of this study suggested that libraries placed a higher value on the guidance and training of researchers. The primary barrier to the introduction of RDM services in academic libraries in Jordan seemed to be a lack of funding for the provision of research data, insufficient knowledge and expertise with RDM services. The authors also concluded saying that the employees are persuaded that their role is rather informational and not technical. As a result, the study confirmed the necessity of educating library employees in RDM technical abilities and working with researchers to create RDM policy.

Another researcher (Al-Jaradat, 2021) undertook an investigation to find out the current position of Jordan's public university libraries, including the policies, practices, problems, and concerns of librarians about the gathering, processing, and preservation of research data. The researcher selected 10 public universities in Jordan and their staff to conduct the research. Upon investigation it is discovered that JPUL's (Jordan Public University Library) RDM initiatives are still in their early stages, and libraries have only lately begun to consider and engage in this field. The appropriate execution of RDM programmes in libraries is hampered by the staff members' incompetence and lack of skills in carrying out RDM activities as well as the absence of institutional RDM planning and policies. The researcher also pointed out, although none of the examined libraries mentioned the existence of any type of RDM services but with the help of current tools and techniques widely used in libraries, certain librarians are offering scientists and researchers certain restricted services related to research data. The researcher also found out that libraries have not taken any initiative to establish and develop a data repository. The researcher further suggested that in order to provide effective RDM services the JPUL should focus upon creation of specialised courses on data archiving, data cataloguing, data sharing, policy formulation, infrastructure development, and data repository design, all while preserving intellectual property rights.

4.2.3 Studies conducted in various regions of Asian continent

(Mohammed & Ibrahim, 2019) conducted a survey by selecting 5 universities in Iraq to investigate challenges and practices of RDM. Based on the study it is evident that RDM is still a relatively new concept in Iraqi institutions compared to other universities in developed nations. Based on the study conducted it is clear that when it comes to gathering and organising research data, Iraqi universities lag behind those in the developed world. Based on the study's findings, researchers felt that it is imperative that Iraq universities create their own research data repositories or make use of those that are already in place in order to guarantee that RDM standards are followed when conducting research. Additionally, to ensure that there is order throughout the research lifecycle, it is necessary to involve all stakeholders in data management, including researchers, universities, data repositories, users, funders, and publishers, from the outset of the project in order to address the primary RDM challenges faced by Iraqi universities. The researchers suggested, for the purpose of implementing RDM in a way that is both professional and effective, Iraqi institutions must establish partnerships with foreign universities as well as international data organisations like Research Data Alliance and DataCite.

(Aydinoglu et al., 2017) conducted the survey in 25 universities in Turkey to investigate rdm practices and understand the perception of rdm. According to the study RDM does not exist in terms of institutions. The primary funding organisation in Turkey, TUBITAK, does not have an RDM policy or strategy does nor does it request an RDM plan from the scientists it usually supports or funds. The universities lack a well-established system to assist their employees with RDM tasks, including staff, software, hardware, guidelines, policies, and training. There are no incentives or sanctions involved. The people in charge of governing/ regulating science do not see the advantages of RDM, the resources that RDM requires, or the future of research data, despite the fact that research is increasingly being performed using data. Based on the study conducted it bos also undertood that a vast majority of Turkish academics are devoid of the technical know-how and abilities necessary for efficient RDM. There is a dearth of basic knowledge about things like gathering and organising data in accordance with metadata standards or formats for data storage. On the other hand, despite their lack of technical expertise, academics are aware of the advantages of data sharing, including how it promotes multidisciplinary research and collaboration and aids in result verification. They said that while

they are willing to share in some situations, they are unable to do so for a variety of reasons. To address these problems the researchers have suggested that, TUBITAK ought to compile a research data strategy/policy document incorporating feedback from all parties involved. It would be unlikely for individual efforts to have any effect without a plan. Because foreign programmes need RDMs, Turkish research organisations and researchers must embrace improved RDM methods. (Piracha & Ameen, 2019) conducted a study to evaluate the planning and policy framework for research data management (RDM) in Pakistani university libraries. Using a mixed method explanatory sequential design, the researchers gathered data from 30 university libraries ranked highly by the Higher Education Commission. The study discovered lack of preparation and understanding when it comes to creating an RDM policy. It seemed that the topic was too recent to discuss at Pakistani university libraries. The findings show that there was no RDM policy in place at any university library. Some libraries, on the other hand, were only in the planning stages and were working on creating a policy statement, which might take a year. The researchers also indicated that their study could raise awareness regarding the RDM topic among the library professionals in their country.

On April 2, 2018, a nationwide research data management (RDM) policy titled "Measures for Managing Scientific Data" was formally announced by the State Council of China. (Huang et al., 2021) conducted a research to investigate the state of RDM at Chinese universities, and to explore Research Data Management policy and practice in Chinese university libraries. After considering the results, it is clear that RDM is still in its infancy in Chinese universities. First, the fact that only one university has an RDM policy that is available to the public, derived from Oxford University's policy, and hasn't even been updated since the Chinese national policy was released, serves as evidence of this. The study also points out that, Chinese institutions provide low level services in every instance. The low response rate indicates that there is a lack of awareness about RDM among the library professionals of China. A latest study was conducted by (Amanullah & Abrizah, 2023) to investigate the RDM services provided by academic libraries in Malaysia and the status of implementation based on the roles and practices of the librarians. Three sequential methods of data collection were used in this study: an online survey measuring the academic libraries' RDM implementation progress; a website analysis of 20 academic libraries regarding RDM services, training, and policies; and semi-structured interviews with three academic librarians to assess their roles and practices in RDM services.

The study found that Academic libraries in Malaysia offer research data management (RDM) services that are based on their core competencies, which include institutional repositories, bibliographic management tools, and the accessibility of research data. These services are offered instead of impacted RDM support services, like data analysis, data citation, data mining, or data visualisation. The practice and implementation of RDM services have not yet reached a point where they fully support the primary RDM aspects, despite the librarians' awareness of RDM and their involvement in research data services.

4.2.4 Studies conducted in UK, US and Australia

A group of researchers (Cox et al., 2017) conducted an international study on research data management (RDM) activities, services, and capabilities in higher education libraries which invited Australia, Canada, Germany, Ireland, the Netherlands, New Zealand, and the UK to participate. To evaluate trends and relative maturity levels, the results are compared with those of earlier research. The variety of RDM activities examined in this study are positioned on a "landscape maturity model," which represents planned and existing research data services and practices in university libraries. This model serves as both a baseline for future research and a "snapshot" of current advances. The findings show that libraries have taken the lead in RDM, especially when it comes to policy creation and advocacy especially in UK and Australia. Australia had an almost twofold increase in academic libraries with RDM policies from 29% to 56% between 2013 and 2016, while the UK saw a more than twofold increase from 17% to 42% during the same period. There is still a dearth of services, with a concentration on advisory and consultancy services (like training on data management and planning help) as opposed to technical services (like maintaining an active data curation database and providing a data catalogue). Libraries are working to increase staff members' skills in data curation, although concerns persist about the lack of consistency in skills and capacities. Obtaining "buy in" from researchers and senior management, collaborating with other support services, and resource allocation are other significant obstacles. (Tang & Hu, 2019) conducted a research on an international level with participants from North America, Europe, Africa, South America and Asia. Through this study the researchers wanted to understand the preparedness, challenges, roles, and training requirement to provide RDM services across continents. The study findings not only showed a

variety of regional and organisational variations in the RDM services and tools offered, but also how the degree of development and readiness of RDM positions affected the kinds of RDM services offered with majority of the respondents expressed worries about a lack of bandwidth or capacity in this area, they also acknowledged the value of RDM and wished to receive additional training. Ultimately, it was evident that institutional commitment to resources and training opportunities is essential for providing RDM services. (Gowen & Meier, 2020) conducted a longitudinal study to evaluate the staffing and research data management services provided by Association of American Universities (AAU) libraries over the course of the five years (2014-2019) and compared them to the libraries' goals for Research Data Management (RDM) outlined in each library's strategic plan. The findings of the study shows, although the number of libraries providing data services has increased, majority of these gains have come from libraries that did not prioritise RDM in 2014. Remarkably, a few of the libraries that listed RDM as a top priority in 2014 have seen a reduction in the number of data librarian posts. Now, more than half of the libraries that researchers included in the survey offer or assist with a data repository. The researchers were stunned at RDM being explicitly listed as a priority in many library strategic plans five years ago, no longer included it in the plan.

A group of researchers (Liu et al., 2020) conducted a research to identify the existing RDM policies and compare and differentiate it in three developed nations (USA, UK and Australia) to ascertain how the policies vary. The study reveals that access, retention, sharing, storage, and ownership are among the areas where the universities' shared underlying rules can be found. Among the other topics of concern were archiving, budget, privacy, and intellectual property. The management of research data is a fundamental principle shared by all universities, and many of them offer RDM services. The funders' policies often take precedence over university policies in most cases. The study also shows that the DMPs of the nations under consideration barely differ from one another. Regarding DMP, the United States mostly concentrates on adhering to funder policies without mandating that research be carried out in the absence of outside financing. Research data is either scheduled or kept for as long as necessary; there is no set length of time for its retention. The study also recommended that Policymakers and stakeholders should concentrate on data access, sharing, retention, security, storage, records, ownership, responsibility, and intellectual property, as well as use and reuse, DMPs, and preservation. Prioritising these fundamental ideas will help any university with a research data strategy to

provide high-calibre outcomes provided compliance is maintained. According to (Tripathi et al., 2017) The John Hopkins University Library offers help and instruction on managing research data through an online training course. Research Data Management is governed by explicit policies in the libraries of University College London, Imperial College London, and Oxford University. The research data management policy of the ETH Zurich library is outlined in the guidelines pertaining to research integrity. The researchers can use the instructions provided by the other libraries to write research data management plans, save them, and share them. Links to the research data policies of foreign publishers, NSF, and NIH have been made available by libraries. Additionally, they have given information about software repositories like Github, bitbucket, and others, as well as generic and subject-specific data repositories like Dryad, Figshare, Gen bank, Qualitative Data Repository, and Zenedo where researchers can upload their datasets. Additionally, libraries offer workshops, in-person interactions, user education, and training courses tailored to the needs of individual scholars.

4.2.5 Studies conducted in Spain and France

(Schöpfel et al., 2018) conducted a research to understand opinion and behaviour of French scientists (senior management level) in the French National Research Center (CNRS) regarding research data management (RDM). The researchers concluded that CNRS had started to establish a nationwide RDM policy. Yet the study found that The CNRS, being a sizable, multidisciplinary organisation that conducts research, must deal with a complex RDM landscape that includes significant variations in the values and practices (or "culture"), instruments, and skills between laboratories and institutes, as well as a wide range of stakeholders, including industry, funders, scientists, citizens, politicians, technical staff, librarians, and others, all of whom have sometimes conflicting interests. With committed personnel, software, protocols, funding, and collaboration, many labs and research teams have more or less experience with RDM; others are just getting started. Furthermore, the landscape is dynamic, with global collaborations, national and international funding agencies, technology advancements, and research policies introducing a powerful force for RDM. Another study was undertaken by (Martin-Melon et al., 2023) which dealt with identifying types and number of RDS services

deployed along with providing an overview of the research data services offered by Spanish public universities' academic libraries. The findings demonstrate that libraries are implementing new RDM services in spite of the absence of institutional policies pertaining to research data, but inequitably with regard to the quantity and kind of help offered. The majority of services are those connected to creating a data management plan (DMP) and preserving data in repositories. In contrast, a significantly smaller percentage of libraries compared to those that have created some of the services have a policy supporting research data. As a result, while the great majority of universities have open access policies in place, very few have created a special policy for open research data or amended their existing policies to incorporate the idea of open research data.

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CHAPTER 5

DATA ANALYSIS AND INTERPRETATION

5.0 Introduction

This chapter contains the data collected from the library professionals of the professional colleges of Goa. The data is analysed descriptively and statistically in this chapter. It is done in order to analyse the objectives of the research project. The survey results will be presented in the form of tables, charts, and figures along with a thorough analysis and interpretation of the information. The study's findings will provide insight on the current status of RDM and its implementation in the professional college libraries of Goa.

5.1 Data Analysis and Interpretation

5.1.1 Designation of the respondents

Designation of the respondents	No. of respondents	Percentage of respondents
Librarian	25	66%
Assistant Librarian	5	13%
Librarian - Grade l	3	8%
Library Assistant	2	5%
Library In-Charge	2	5%
Library Trainee	1	3%

Table 5.1.1 Designation of the respondents

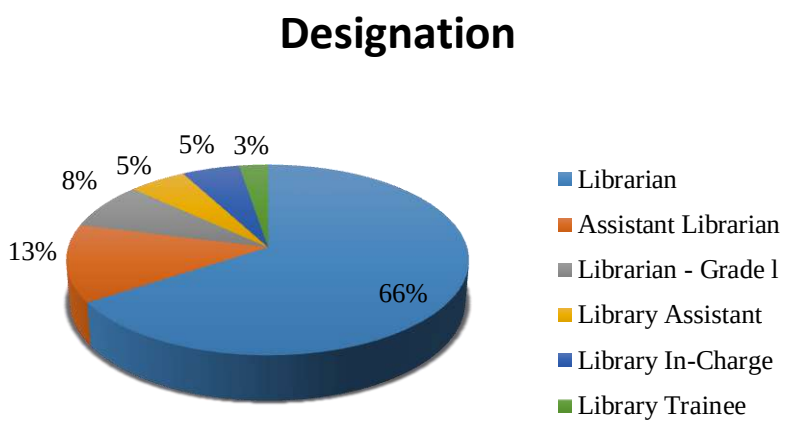

Figure 5.1.1 Designation of the respondents

The above pie chart represents that 66% of the respondents are Librarian, 13% of the respondents are Assistant Librarian, 8% of the respondents are Librarian - Grade I, 5% of the respondents are Library Assistant, 5% of the respondents are Library In – Charge and 3% of the respondents are Library Trainee.

5.1.2 Gender of the respondents

Gender of the respondents	No. of respondents	Percentage of respondents
Female	24	63%
Male	14	37%

Table 5.1.2 Gender of the respondents

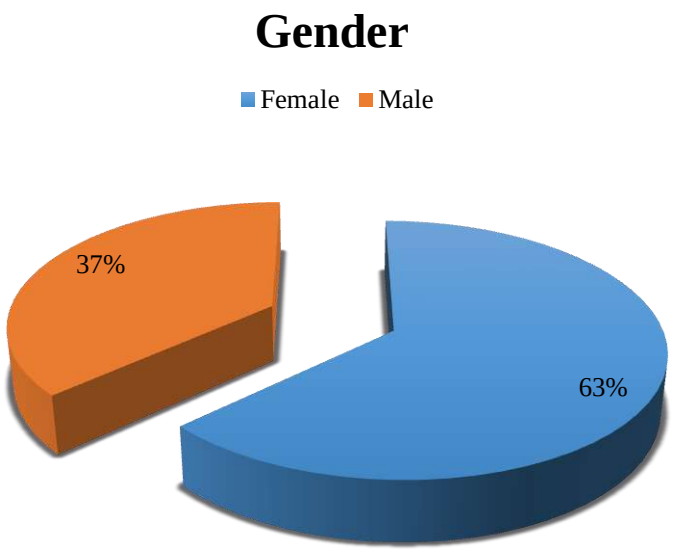

Figure 5.1.2 Gender of the respondents

The above pie chart represents that the professional college Libraries of Goa are dominated by Female population by 63%, while the male population is 37%.

5.1.3 RDM Policy

Q. Is there a formal RDM policy in place at your institution?

Responses	No. of respondents	Percentage of respondents
Yes	0	0%
No, but we will have a policy within 12 months	4	11%
Do not know	5	13%
No, we are not planning policy but it may take more than a year	7	18%
No, we do not have a policy and we are not planning one	22	58%

Table 5.1.3 RDM Policy

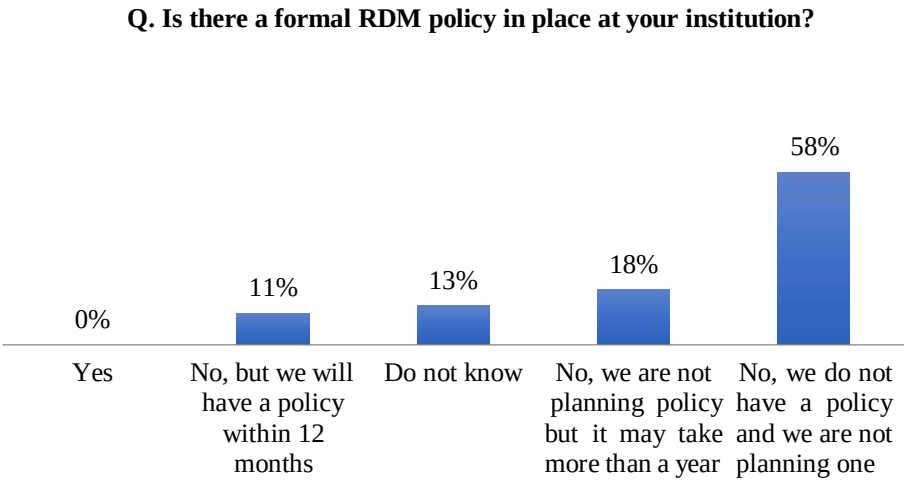

Figure 5.1.3 RDM Policy

A formal RDM policy would include guidelines of dealing with the research data and also provides path in providing RDM services. When asked if there is any formal RDM policy in place at their

respective institutions, 22 respondents (58%) responded saying there is no RDM policy as of yet and neither they are planning one. 7 respondents (18%) responded saying that it may take them more than a year to establish a formal RDM policy, while 4 respondents (11%) assured with establishing a formal RDM policy within 12 months. The remaining 5 respondents (13%) are not sure of when a formal RDM policy will be established in their institution.

5.1.4 Research data repository

Q. Do you have a dedicated data repository to store and manage the research data?

Responses	No. of respondents	Percentage of respondents
No	38	100%

Table 5.1.4 Research data repository

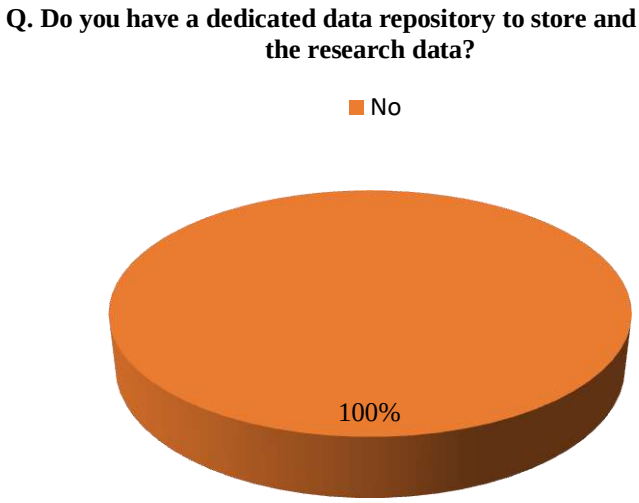

Figure 5.1.4 Research data repository

When asked if there is any dedicated data repository to store and manage the research data, all of the 38 respondents (100%) responded with NO (having no such dedicated data repository to store and manage research data).

5.1.5 Evaluation of institution's research data

Q. Do you conduct any audit, survey or evaluation of institution's research data?

Responses	No. of respondents	percentage
Yes, with the library as participant	1	3%
Yes, with the subject expert	2	5%
Maybe	8	21%
No, but we are planning or planned to conduct	9	24%
No, and we are not planning to conduct in near future	18	47%

Table 5.1.5 Evaluation of institute's research data

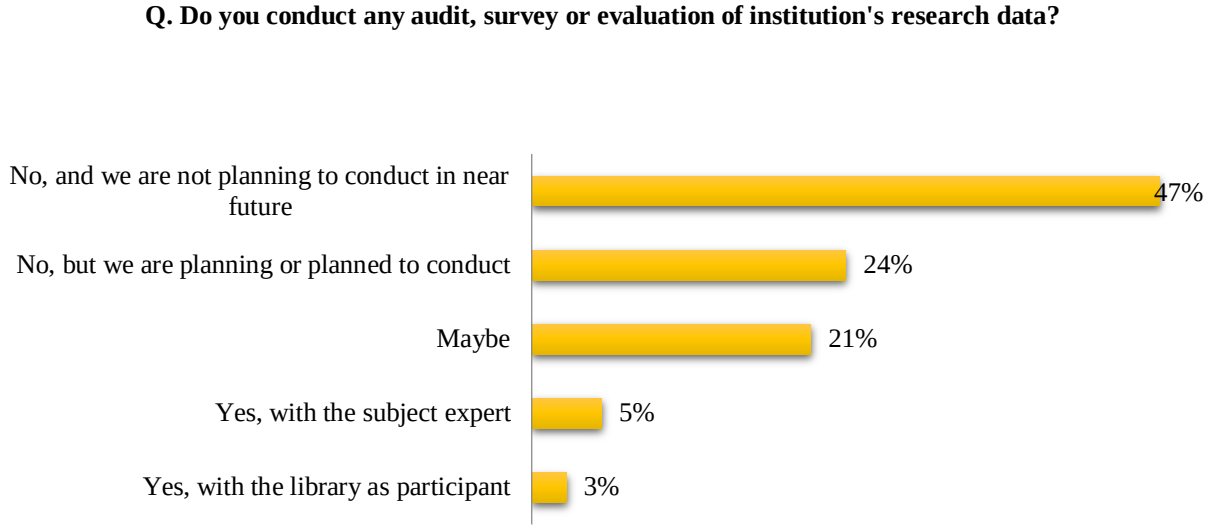

Figure 5.1.5 Evaluation of institution's research data

Evaluating the research data is very essential as it helps in ensuring that research was conducted fairly and the data gathered during the research work was neither fabricated nor falsified while presenting the research data. In this study it is found that majority of respondents i.e. 18 respondents

(47%) responded saying that they do not conduct any audit, survey or evaluation of institutions research data and they not planning to conduct in near future, while 9 respondents (24%) are planning to have planned to conduct the audit. 8 respondents (21%) are not sure whether they are conducting the audit or no. 2 respondents (5%) are sure about conducting the audit of the research data with the subject expert while the remaining 1 respondent (3%) confirmed conducting audit of the research data with the library as participant.

5.1.6 Partnership with the external organization

Q. Partnership with the external organization/institution/commercial providers to provide RDM services?

Responses	No. of respondents	Percentage
Yes	0	0%
No	33	89%
No, but planned or planning to do	1	3%
Nor planned neither planning to do	3	8%
RDM service infrastructure is established or developed	0	0%

Table 5.1.6 Partnership with the external organization

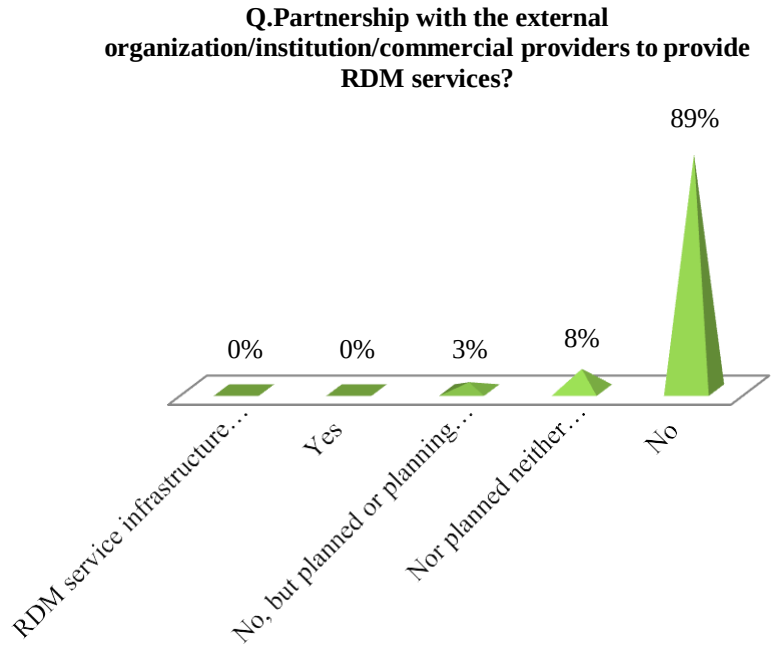

Figure 5.1.6 Partnership with the external organization

In this study we found out that 33 respondents (89%) have not partnered with any external organization to provide to provide RDM services, 3 respondents (8%) are assured that they have planned nor planning to partner up with any external organization to provide RDM services, 1 respondent (3%) is planning to partner up with an external organization while none of the institution has have confirmed partnering up with an external organization neither established or developed RDM service infrastructure.

5.1.7 Basic requirements to provide RDM services

Q. In your opinion, what skills/knowledge or abilities are required to provide RDM services?

Responses	No. of respondents	Percentage
Data curation skills	2	5%
Technical and ICT skills (e.g. data storage, infrastructure, architecture, etc.)	7	18%
Subject and or Disciplinary knowledge	2	5%
Knowledge of a variety of research methods and research lifecycle (e.g. data analysis, data visualization)	2	5%
Legal, policy and advisory skills (e.g. intellectual property, ethics, licensing, etc.)	3	8%
Understanding of research integrity, reproducibility and transparency principles	4	11%
All of the above	26	68%
Do not know	4	11%

Table no. 5.1.7 Basic requirements to provide RDM services

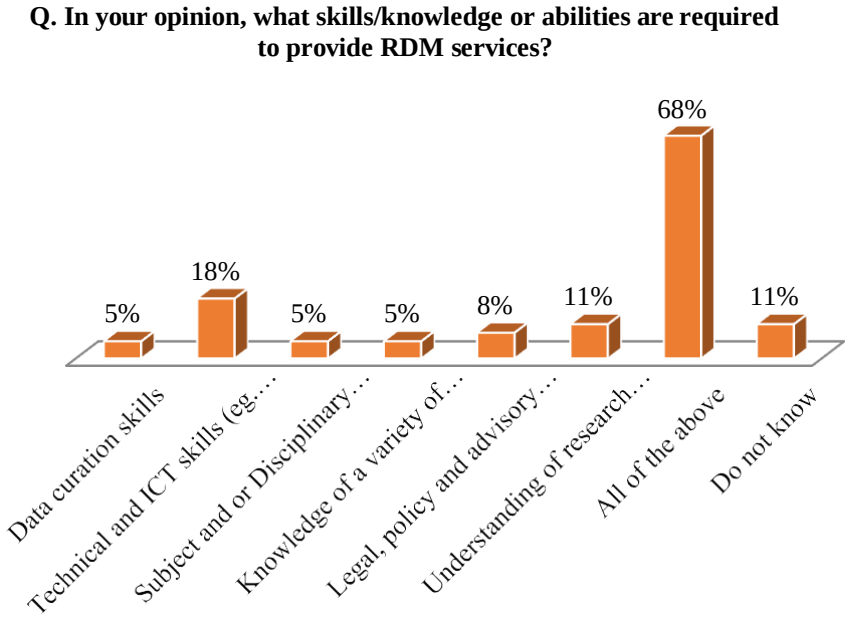

Figure 5.1.7 Basic requirements to provide RDM services

The respondents were given the option to select all the options that were applicable. Majority of the respondents i.e. 26 respondents (68%) felt that all of the options that were provided were applicable, while 7 respondents (18%) felt that Technical and ICT skills (e.g. data storage, infrastructure, architecture, etc.) are required to provide RDM services. 4 respondents (11%) felt that Understanding of research integrity, reproducibility and transparency principles are required to provide RDM services, while the other 4 respondents (11%) had no clear idea about what skills/knowledge or abilities are required to provide RDM services. Moreover 3 respondents (8%) believed that Legal, policy and advisory skills (e.g. intellectual property, ethics, licensing, etc.) are skills/knowledge or abilities are required to provide RDM services. Furthermore 2 respondents (5%) felt Data curation skills are required to provide RDM services, while the other 2 respondents (5%) believed Subject and or Disciplinary knowledge are required to provide RDM services and the remaining 2 respondents (5%) felt Knowledge of a variety of research methods and research lifecycle (eg. data analysis, data visualization) are required to provide RDM services

5.1.8 Staff support in acquiring skills in RDM

Q. How is your library supporting the staff in acquiring necessary skills in RDM services?

Responses	No. of respondents	Percentage
Encouraging online tutorials on RDM	2	5%
In-house staff workshops on RDM	3	8%
Organizing Webinars/ workshops/ conferences on RDM	4	11%
Support for staff to attend training sessions on RDM	6	16%
None	29	76%

Table 5.1.8 staff support in acquiring skills in RDM

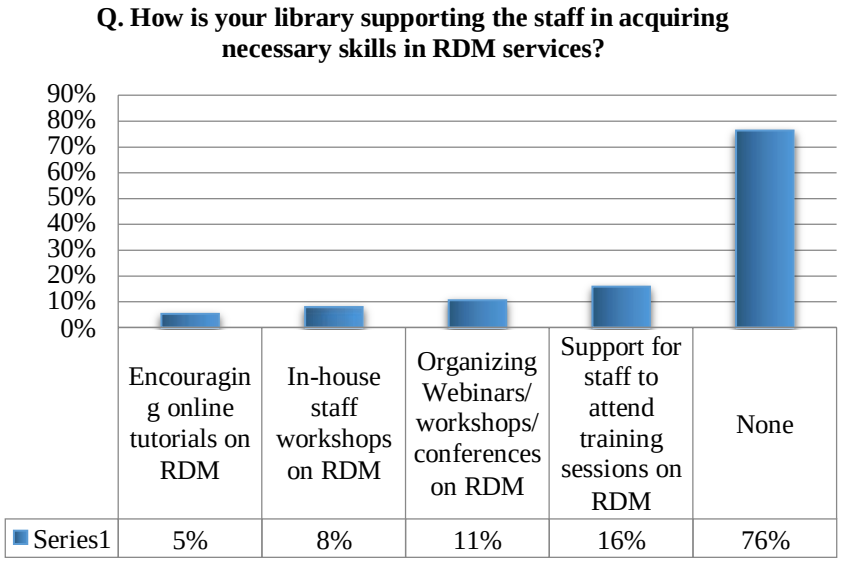

Figure 5.1.8 staff support in acquiring skills in RDM

The respondents were given the option to select all the options that were applicable. Majority of the respondents i.e. 29 respondents (76%) said that the library do not support the staff in acquiring necessary skills in RDM services, while 6 respondents (16%) said that the library supports staff to attend training sessions on RDM. Moreover 4 respondents (11%) said that the library organizes webinars/ workshops/ conferences on RDM, while 3 respondents (8%) said that the library provides In-house staff workshops on RDM. The remaining 2 respondents (5%) said the library encourages online tutorials on RDM for acquiring skills in providing RDM services.

5.1.9 Librarian's preference

Q. According to you, what should we call a research data manager?

Responses	No. of respondents	Percentage
Data Librarian	11	29%
Data Manager	25	66%
Other: Data Research Manager	1	3%
Other: Do not know	1	3%

Table 5.1.9 Librarian's preference

Figure 5.1.9 Librarian's preference

The above graph represents what the respondents wishes to call a research data manager. The majority of the respondents i.e 25 respondents (66%) prefer calling a research data manager as Data Manager, while 11 respondents (29%) prefer calling Data Librarian. 1 respondent (3%) suggested that a research data manager should be addressed as Research Data Manager, while the remaining 1 respondent (3%) have no idea what so ever.

5.1.10 Managing research data

Q. According to you, who should manage research data in an institution?

Responses	No. of respondents	Percentage
Libraries taking help from other relevant units such as (research unit, IT Department, etc)	19	50%
Subject Expert	9	24%
Library	5	13%
Do not know	4	11%
Other: R&D cell along with Librarian	1	3%

Table 5.1.10 Managing research data

Figure 5.1.10 Managing research data

In the above graph majority of the respondents i.e. 19 respondents (50%) mentioned that Libraries should manage research data in an institution by taking help from other relevant units such as (research unit, IT Department, etc.), while 9 respondents (24%) believed subject expert should manage the research data in an institution. Moreover 5 respondents (13%) felt that Library should manage research data in an institution, while 1 respondent (3%) suggested that R&D cell along with Librarian should manage research data in an institution. The remaining 4 respondents (11%) have no idea about what so ever

5.1.11 Dedicated RDM staff

Q. Do you have a dedicated staff for RDM?

Responses	No. of respondents	Percentage
No	38	100%

Table 5.1.11 Dedicated RDM staff

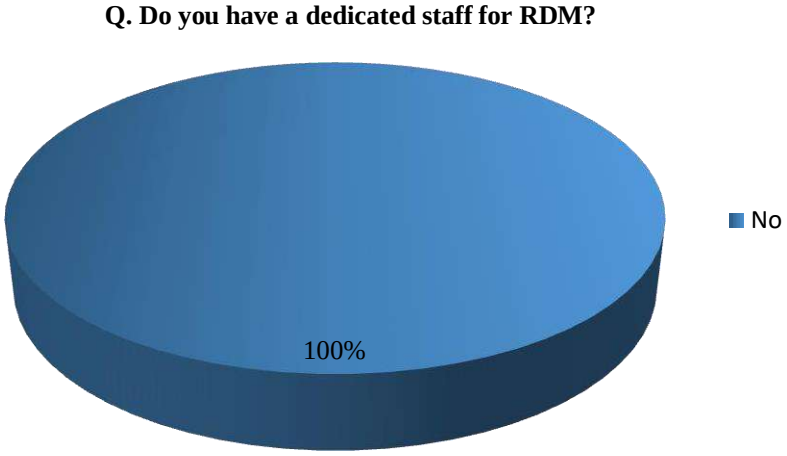

Figure 5.1.11 Dedicated RDM staff

Dedicated staffs are essential in providing RDM services; it will enable the staff in standardization/ reformatting, creation of secondary/derived data or creation of metadata for the individual's research data. When asked about having a dedicated staff for RDM almost all the 38 respondents (100%) answered that they do not have a dedicated staff for RDM

5.1.12 RDM services

Q. Which of the RDM services do you provide in the library?

Responses	No. of respondents	Percentage
RDM planning	1	3%
Data visualization	1	3%
Data discovery and access	2	5%
Research data organization and curation	2	5%
Protocol documentation	2	5%
Research metadata	3	8%
Research data sharing and dissemination	5	13%
Research data preservation	5	13%
None	32	84%

Table 5.1.12 RDM services

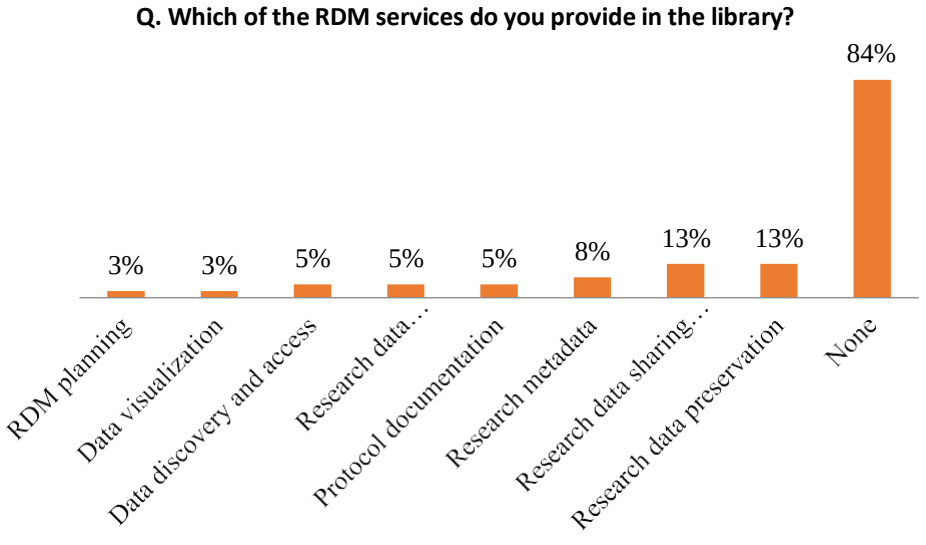

Figure 5.1.12 RDM services

The respondents were given the option to select all the options that were applicable. When asked about which of the RDM services are being provided by the respondents in their library, the majority of the respondents i.e. 32 respondents (84%) replied saying none of the mentioned services are being provided in the library. Furthermore 5 respondents (13%) said that they provide Research data sharing and dissemination service to the users, while the other 5 respondents (13%) said that they provide Research data preservation service to the users in their library. 3 respondents (8%) replied saying they provide research metadata service to the users in their library. Moreover 2 respondents (5%) said they provide data discovery and access service, while the other 2 respondent (5%) said they provide Research data organization and curation service and the remaining 2 respondents (5%) said they provide protocol documentation service to the users in the library. Additionally 1 respondent (3%) said that they provide RDM planning service while the other 1 respondent (3%) replied saying they provide data visualization service to the users in the library.

5.1.13 RDM storage tools

Q. What RDM storage tools do you provide to users/researchers in your library to facilitate RDM use?

Responses	No. of respondents	percentage
Office computers	8	21%
External hard drives	4	11%
Open source repositories	5	13%
Freely available software or services	6	16%
Cloud based platforms	2	5%
None	27	71%

Table 5.1.13 RDM storage tools

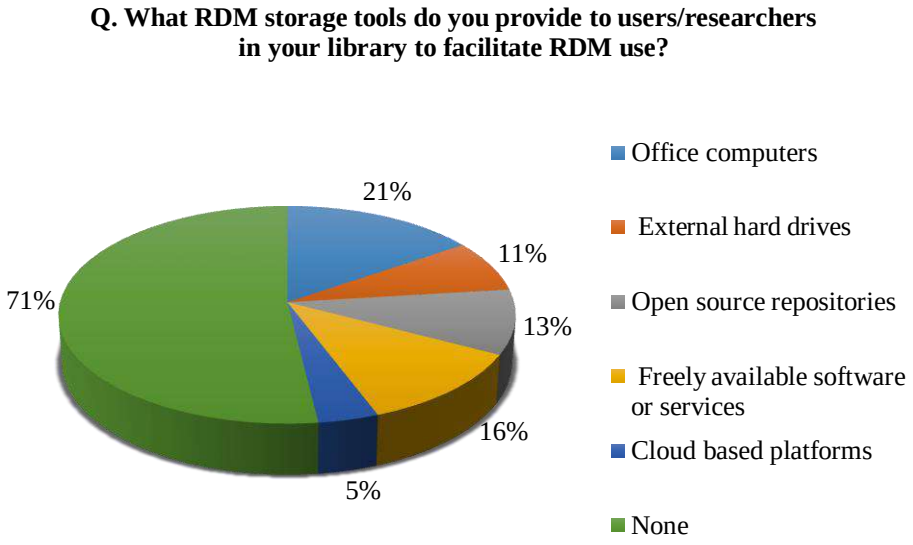

Figure 5.1.13 RDM storage tools

The respondents were given the option to select all the options that were applicable. The above pie chart depicts the types of RDM storage tools provided to the users/ researchers in the library to facilitate RDM use. The majority of the respondents i.e. 27 respondents (71%) said that they not provide any storage tools to facilitate RDM use to the users, while 8 respondents (21%) said that they provide office computers as RDM storage tools to facilitate RDM use to the users. Furthermore 6 respondents (16%) said they provide freely available software, while 5 respondents (13%) said they provide access to open source repositories as RDM storage tools to facilitate RDM use to users. Moreover 4 respondents (11%) said that they provide external hard drives as RDM storage tools while remaining 2 respondents (5%) said that they provide cloud based platforms as RDM storage tools to facilitate the use of RDM to the users.

5.1.14 Software to collect, process and share research data

Q. Which kind of application/software/platform do you have for the research data collection, processing and sharing?

Responses	No. of respondents	Percentage
Microsoft Dataverse	0	0%
The dataverse project (Harvard dataverse)	0	0%
Spreadsheet	7	18%
None	30	79%
Other: Do Not Know	1	3%

Table 5.1.14 Software to collect process and share research data

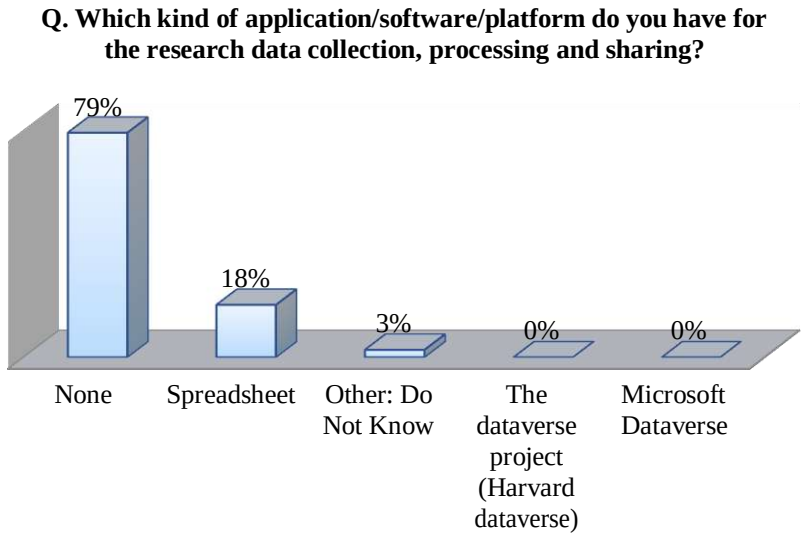

Figure 5.1.14 Software to collect, process and share research data

In this study it was asked which kind of application/software/platform respondents use for the research data collection, processing and sharing. While the majority of the respondents i.e. 30 respondents (79%) replied saying that do not use any kind of application/software/platform for

the research data collection, processing and sharing, 7 respondents (18%) said they use spread sheet for research data collection, processing and sharing and the remaining 1 respondent (3%) had no idea what so ever.

5.1.15 Collection of raw data

Q. In which of the following formats do you collect the raw/original research data?

Responses	No. of respondents	Percentage
Codes	0	0%
Ppt	2	5%
Audio	2	5%
Graphs	4	11%
.xls	4	11%
.Docx	5	13%
Pdf	10	26%
Other: Hardcopy of Theses/ case reports are collected	1	3%
Other: Hardcopy of Theses	3	8%
Do not collect	25	66%

Table 5.1.15 Collection of raw data

Q. In which of the following formats do you collect the raw/original research data?

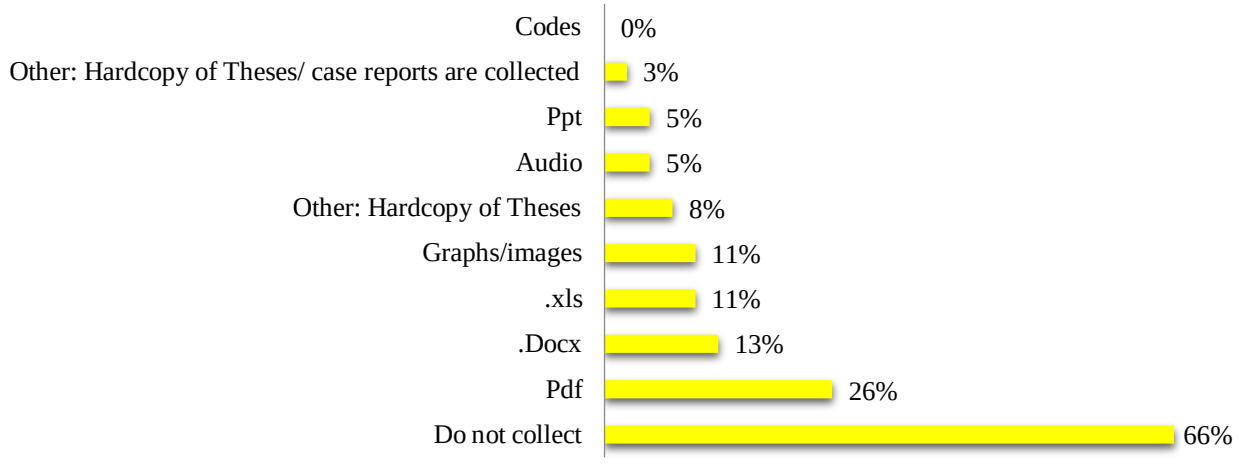

Figure 5.1.15 Collection of raw data

The respondents were given the option to select all the options that were applicable. When asked about the different format in which the raw/original data is collected, majority of the respondents i.e. 25 respondents (66%) replied saying that they do not collect raw/ original data. Moreover 10 respondents (26%) collect the raw/original data in pdf format, while 5 respondents (13%) collect the raw/ original data in .Docx format. 4 respondents (11%) said that they collect raw/original data in .xls format while the other 4 respondents (11%) replied that they collect raw/original data in graphs/images form. 3 respondents (8%) collect war/original data in the form of hardcopy (Theses). Furthermore 2 respondents (5%) said they collect raw/original data in the form of audio, while the other 2 respondents (5%) said they collect raw/original data in ppt format. The remaining 1 respondent replied saying that they collect raw/original data in the form of hardcopy (theses/ case reports), while none of the respondents collect raw/original data in the form of codes.

5.1.16 Factors affecting RDM

Q. According to you what are the factors affecting the implementation of RDM?

Responses	No. of respondents	Percentage
Lack of support from the Institution	14	37%
Lack of institutional policy	22	58%
Lack of curation tools and software	13	34%
Lack of curation skills and training (creation of metadata)	13	34%
Lack of funds	12	32%
Lack of awareness	20	53%
Lack of skilled staff	20	53%
Lack of storage and network infrastructure	17	45%
obsolescence of technologies	4	11%
Do not know	5	13%

Table 5.1.16 Factors affecting RDM

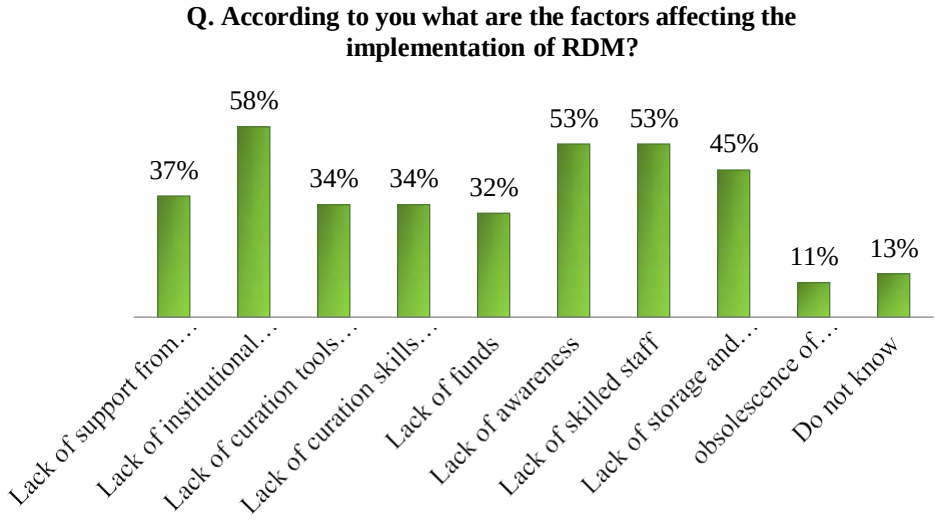

Figure 5.1.16 Factors affecting RDM

In this study the respondents were given the option to select all the options that were applicable. When asked about the factors affecting the implementation of RDM. Majority of the respondents i.e. 22 respondents (58%) felt that Lack of institutional policy is affecting the implementation of RDM. 20 respondents (53%) felt lack of awareness on RDM could be the factor affecting the implementation of RDM, while the other 20 respondents (53%) felt lack skilled staff could be affecting the implementation of RDM. 17 respondents (45%) reasoned that lack of storage and network infrastructure is affecting the implementation of RDM, while 14 respondents (37%) felt that Lack of support from the Institution is affecting the implementation of RDM Furthermore 13 respondents (34%) felt that Lack of curation tools and software could be the factor affecting the implementation of RDM, while the other 13 respondents (34%) believed that software Lack of curation skills and training (creation of metadata are the factors affecting the implementation of RDM). Moreover 12 respondents (32%) agreed that lack of funds can be the factor affecting the implementation of RDM, while 4 respondents (13%) felt obsolescence of technologies could be the factor affecting the implementation of RDM. Remaining 5 respondents (13%) have no idea about what so ever

5.1.17 Drivers of RDM

Q. According to you what are the major drivers of RDM services?

Responses	No. of respondents	Percentage
Demand for open access	17	45%
Library role - skilled staff	15	39%
Publishers	3	8%
Impact of research in RDM field	12	32%
Institutional Policy	19	50%
Consortia	6	16%
Do not know	9	24%

Table 5.1.17 Drivers of RDM

Q. According to you what are the major drivers of RDM services?

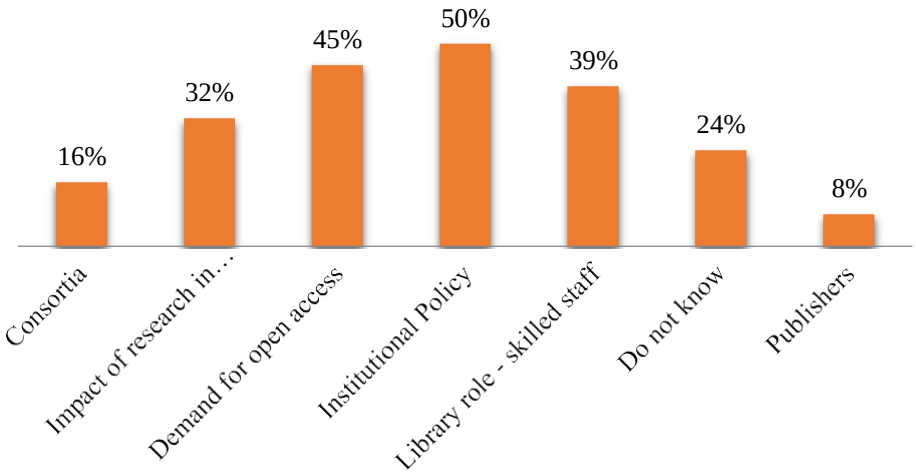

Figure 5.1.17 Drivers of RDM

In this study the respondents were given the option to select all the options that were applicable. When asked about what could be the major drivers of RDM services. Majority of the respondents i.e. 19 respondents (50%) agreed that institutional policy could be a major driver of RDM

services. Furthermore 17 respondents (45%) felt that demand for open access can be a major driver of RDM services, while 15 respondents (39%) felt library role - skilled staff can be a major driver of RDM services. Moreover 12 respondents (32%) believed that impact of research in the field of RDM could be a major driver of RDM services, while 6 respondents (16%) felt consortia could be a major driver of RDM services, the other 3 respondents (8%) felt that the role of the publishers could be a major driver of RDM services. the remaining 9 respondents (24%) had no idea about what so ever.

5.1.18 Respondents' opinion on RDM policy

Q. In your opinion, do you think there is a need for a Research Data Management (RDM) policy?

Responses	No. of respondents	Percentage
Yes	26	68%
Maybe	9	24%
No	3	8%

Table 5.1.18 Respondents' opinion on RDM policy

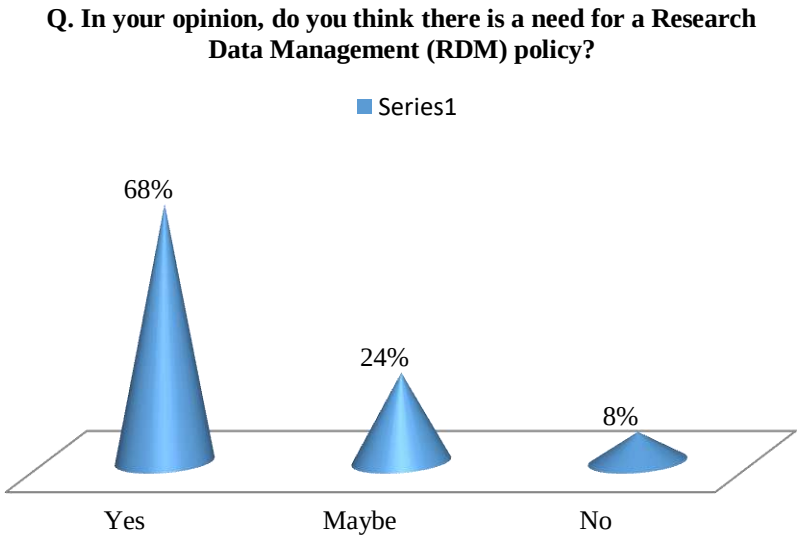

Figure 5.1.18 Respondents' opinion on RDM policy

When asked about if there is a need for a Research Data Management (RDM) policy, majority of the respondents i.e. 26 respondents (68%) replied with a YES, 9 respondents (24%) were not sure about RDM policy, while the remaining 3 respondents (8%) did not feel the requirement of RDM policy.

5.1.19 Respondents' opinion on RDM service

Q. Do you see RDM as an essential service a library should facilitate?

Responses	No. of respondents	Percentage
Yes	28	74%
No	2	5%
Maybe	8	21%

Table 5.1.19 Respondents' opinion on RDM service

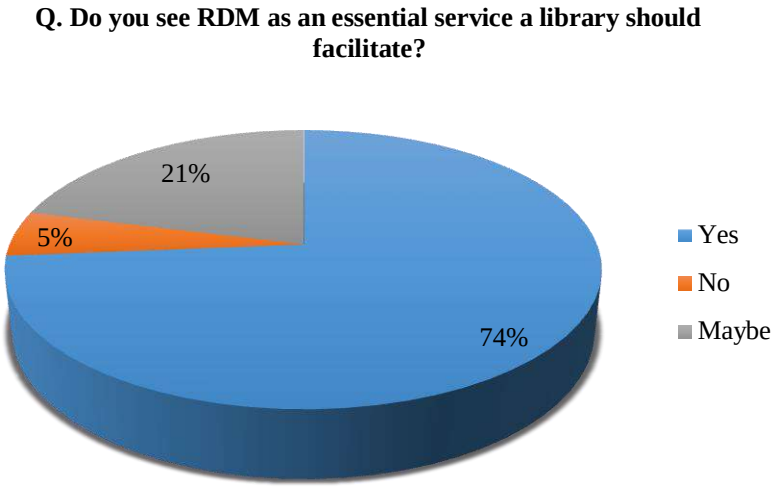

Figure 5.1.19 Respondents' opinion on RDM service

When asked about if the respondents see RDM as an essential service a library should facilitate, the majority of the respondents i.e. 28 respondents (74%) agreed on seeing RDM as an essential service a library should facilitate, 8 respondents (21%) partially agreed on seeing RDM as an essential service a library should facilitate, while the remaining 2 respondents (5%) did not agree on seeing RDM as an essential service a library should facilitate.

5.1.20 Funding to manage the research data

Q. Do you receive funding to manage the research data?

Responses	No. of respondents	Percentage
Yes	2	5%
No	36	95%

Table 5.1.20 funding to manage the research data

Q. Do you receive funding to manage the research data?

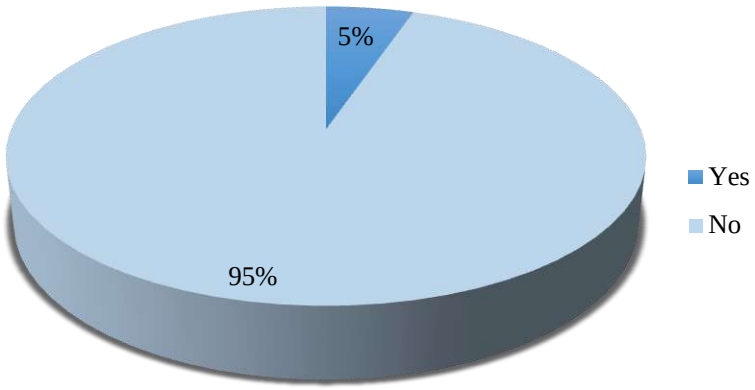

Figure 5.1.20 funding to manage the research data

When asked if the respondents receive any funding for the library to manage the research the majority of the respondents i.e. 36 respondents (95%) replied saying NO, they do not receive any funding to manage research data while the remaining 2 respondents (5%) replied saying they do receive funding to manage the research data.

5.1.21 Respondents' opinion

The following are the opinions from the respondents based on the below mentioned question.

Q. In your opinion, how can we change current scenario: from no RDM services to well-developed RDM services in academic libraries of India?

1. A respondent said, by providing training and awareness on RDM practices.

2. B respondent said, creating awareness on the advantages and by convincing authors to share the data.

3. C respondent said, by creating awareness

4. D respondent said, an important part of the mission of libraries has been to act for the public good, so that people who need information are not prevented from obtaining by its cost.

5. E respondent said, firstly it should be finalised who ia going to manage all this data for all researchers on different topics for this expertise, subject knowledge, time, interest all factor need to in to consideration.

6. F respondent said, firstly by bringing awareness about importance of RMS services. By conducting workshops for skill development.

7. G respondent said, need more awareness at the institutional level with workshop on tools used for RDM.

8. H respondent said, in every Institution there is need to focus on research work, if there is no research work, there won't be any demand for RDM services. Users of library demand for RDM services. Library staff needs knowledge of the RDM service.

9. I respondent said, By creating awareness and conveying the importance about the concept

10. J respondent said, There is need of awareness programme about this.

11. K respondent said, Awareness and training should be given on the importance of RDM

12. L respondent said, Yes it may be change but taken some time, at the time of information need. RDM proposal is very helpful for research & scientific library.

13. M respondent said, Needs to conduct Orientation and Awareness Programs and to frame Institutional Policy.

14. N respondent said, Awareness first and then policy

15. O respondent said, Creating RDM policy

5.1.22 Respondents' opinion

The following are the opinions from the respondents based on the below mentioned question.

Q. What do you think could be the reason for not having an RDM policy at the central level or institutional level?

1. A respondent said, Lack of awareness

2. B respondent said, lack of awareness and expertise

3. C respondent said, Lack of institutional policy, lack of support from the institution, lack of awareness

4. D respondent said, Lack of awareness and interest

5. E respondent said, Lack of Awareness and expertise

6. F respondent said, it's depended on which institutions it is. Like for technical UG level research happens only for the final year project, which does not need much collection of data while developing any new software or app or machine. Whereas at UG level BA, BSc etc. like social science, history etc. for final year project needs to collect data for analysis. So overall it depends on type of institutions. So institutions having research based on huge data collection and analysis for them RDM policy must be there.

7. G respondent said, Lack of interest in research work developed in scholars, so no demand from user for RDM services. As there is not much demand for RDM services, there is not any central level policy.

8. H respondent said, Lack of awareness about the concept and its benefits, unwillingness to share the research data collected

9. I respondent said, not required as research area of one person is independent of others.

10. J respondent said, Lack of Curation skills & Awareness

11. K respondent said, Lack of support from the Institution and Lack of awareness as well as lack of fund

12. L respondent said, Lack of awareness on RDM Policy.

13. M respondent said, Lack of awareness

14. N respondent said, No interest among people

15. O respondent said, Lack of awareness

5.2 Testing of Hypotheses

1. Hypothesis I: There is no formal RDM Institutional Policy in place in the professional colleges of Goa.

   Figure 5.1.3 reveals that none of the surveyed professional colleges have a formal RDM institutional policy in place while 39% of the Librarians said at some point they will establish a formal RDM policy but majority i.e. 58% of the librarians said they neither have nor they are planning a formal RDM policy. Therefore, it can be stated that the hypothesis –There is no formal RDM Institutional Policy in place in the professional colleges of Goa" is proven to be correct.

2. Hypothesis II: There is no dedicated research data repository for storing and managing research data.

   Figure 5.1.4 reveals that all the professional colleges surveyed have responded saying they do not have a dedicated research data repository for storing and managing research data. Therefore, it can be stated that the hypothesis "There is no dedicated research data repository for storing and managing research data" is proven to be correct.

3. Hypothesis III: Research Data Management (RDM) practice or implementation is in the infancy stage in the academic libraries of professional colleges of Goa.

   Figure 5.1.12 shows that majority of the professional colleges i.e. 84% (32 libraries) do not provide any RDM services while a small proportion of libraries i.e. 16% (6 libraries) provide at least 1 RDM service. Hence, the hypothesis –Research Data Management (RDM) practice or implementation is in the infancy stage in the academic libraries of professional colleges" is proven to be correct.

CHAPTER 6

MAJOR FINDINGS, SUGGESTIONSAND CONCLUSION

6.0 Introduction

This chapter deals with the major findings based on the analysed data and also provides some suggestions based on the findings and conclusion.

6.1 Findings

1. The study shows that almost all the professional libraries in Goa do not have a formal RDM policy at place, with majority (58%) indicating that the libraries are not even planning one.

2. This study confirmed the fact that almost all the professional colleges of Goa do not have a dedicated data repository.

3. The study found out that nearly half a proportion (47%) of the respondents (librarians) do not conduct any audit, survey or evaluation of institutions research data and they not planning to conduct in near future while the minority proportion (8%) indicating participation of subject expert and library staff in conducting the audits of the research data.

4. The findings show that none of the professional libraries of Goa have developed or established RDM service infrastructure and even majority portion (89%) of libraries have not even partnered with external organization to provide RDM services.

5. The study found that 68% of the librarians feel data curation skills, technical and ICT skills, subject and or disciplinary knowledge, knowledge of a variety of research methods and research lifecycle, legal, policy and advisory skills, understanding of research integrity, reproducibility and transparency principles all of these skills/knowledge or abilities are required to provide RDM services. While the remaining 32% of the librarians felt that at least 1 of the above mentioned skills are required to provide RDM services.

6. The study has found that 76% of the libraries do not support the staff in acquiring necessary skills in RDM services.

7. The study suggests that Libraries should manage research data in an institution by taking help from other relevant units such as (research unit, IT Department, etc), on which 50% of the respondents agreed upon, while a small proportion (13%) suggested library should manage research data in an institution.

8. This study also indicates that there are no dedicated staffs for providing RDM services in all of the professional college libraries of Goa.

9. The study shows that majority (84%) of the libraries (32 libraries) do not provide any RDM services in the professional colleges of Goa. While the remaining 6 libraries provide at least 1 RDM service.

10. The study implies that nearly 71% of the professional college libraries do not provide any RDM storage tools to users/researchers in the library to facilitate RDM use. While the remaining proportion of the population implied providing office computers, external hard drives, open source repositories, freely available software or services and cloud based platforms.

11. The study shows 79% of the professional college libraries in Goa provide no application/software/platform for the research data collection, processing and sharing.

12. The study indicates that majority portion (66%) of the overall population do not collect any raw/ research data which is an essential element in providing RDM services.

13. The study shows that majority (58%) of the respondents felt that lack of institutional policy is the major factor along with lack of support from the institution, lack of curation tools and software, lack of curation skills and training, lack of funds, lack of awareness,

lack of skilled staff, lack of storage and network infrastructure, obsolescence of technologies in the implementation of RDM.

14. The finding shows that 68% of the population feel there is a requirement for RDM policy to provide fully effective RDM services.

15. The study also found that 74% of the population agreed that RDM is an essential service the libraries should provide

6.2 Suggestions

1. The libraries should develop or establish an online data repository to securely manage and store the research data of the researchers provided open access to all which would help in research transparency

2. The libraries should start collecting raw/ primary/ original research data from the researchers and evaluate it with library staff or subject expert's help, and further assign metadata and description to the collected research data for easy retrieval.

3. Library professionals should take up RDM as a topic to conduct research to spread awareness among the researchers as many library professionals are still unaware about RDM

4. The library professionals and stakeholders should collaborate to formulate an institutional research data management policy and also draft a proposal to the UGC requesting them to establish a central policy on Research Data Management (RDM) listing out the guidelines to provide RDM services.

5. Library professionals need to improve their skills to provide RDM services. The creation of data management plans, data curation tools and software, the assigning

metadata and unique identifiers, copyright and ethical concerns, and other topics should all be included in training programmes.

6. Library and Information Science curriculum should include RDM and related topics/ subjects. As a result, the young professionals would have the necessary abilities to offer RDM services.

7. Libraries must conduct conferences and seminars on topics such as RDM or RDM related topics in order to discuss current case studies of different libraries and to serve as an inspiration to other libraries.

8. In research programmes where data-intensive research is the norm, a basic understanding of RDM should also be taught.

6.3 Conclusion

Immense research has produced an extensive amount of research data. Advancement of information technology has made quite possible to store research data and can be reused by other researchers. It saves the time of researchers and money of the funding agency. In many countries funding agencies have made mandatory to submit and deposit the research data in repository. A system that manages, preserving, sharing and retrieving research data is known as the Research Data Management System. Many Universities of the world have started RDM in their institutes and libraries are also taking the initiative to provide RDM Services to their educational communities. A library provides guidance, encourage and support their users towards RDM. This present research was undertaken to investigate what type of RDM services are being provided to the students/ researchers in the professional college libraries of Goa. While based on the research it is evident that RDM implementation is still in its infancy and currently very few of the RDM services are being provided that too in a handful of colleges. According to the study it is found that there is lack of support from institutions to provide rdm services, technological, lack of skilled staff, lack of curation tools software, lack of funds, lack of storage and network infrastructure. Moreover there is no RDM institutional policy established in any of the professional colleges. It is also noted that there is an absence of research data repositories in these colleges. It is also vital that the librarians should develop skills by encouraging themselves in online seminars and workshops related to RDM. Promoting the adoption and implementation of RDM services in the academic libraries should be a major responsibility of the government, institutions, and library professionals working in the libraries. RDM is an important facility or a service that should be provided in the professional colleges as the college student are unaware about how to manage and store their research data after the research is completed. There are various data repositories freely available and can be set up in the respective colleges to collect, store and manage the researchers research data. As research is being made mandatory for bachelors, master's programme RDM should be made available to the researchers from the start till the completion of their research work, because just as much as research is important in finding a solution to problem or finding an alternate approach to solve a problem, preserving the research data is equally important along with permitting the data to be accessed or reused by the future researchers. Based on the research conducted, this study suggests creating RDM policies

at the institutional and national levels that would require RDM services to be offered in the academic libraries as necessary services, along with this library professionals should up skill themselves and grasp knowledge based on research data management (RDM).

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QUESTIONNAIRE

Research data refers to all different kinds of data which are collected/generated/gathered by the researcher during the course of his/her research work. These research data are valuable resources gathered by the earlier researchers at the expense of much time and money and if properly stored these resources can be accessed, referred, re-evaluated for academic and research purposes in future. Most often, the current research activities in a discipline are based on the data of the earlier research in that area; therefore research data management (RDM) has become very significant in the advancement of scholarly pursuit.

RDM supports the entire research lifecycle, including data management preparation, electronic curation, development and creation of metadata and more. This helps to ensure that findings are checked accurately and enables new and innovative works based on existing data. Research data management explains how the data has been collected and how the same data is structured, stored, maintained and exchanged in a research project. At the global level, many academic colleges/institutions in different countries have started implementing and providing RDM services, along with having a dedicated data repository and policy framework.

1. Is there a formal RDM policy in place at your institution? *

- ◯ Yes
- ◯ No, we do not have a policy and we are not planning one
- ◯ No, we are not planning policy but it may take more than a year
- ◯ No, but we will have a policy within 12 months
- ◯ Do not know

2. Do you have a dedicated data repository to store and manage the research data? *

- ◯ Yes
- ◯ No

2b. If Yes, then mention the data repository _____

3. Do you conduct any audit, survey or evaluation of institution's research data? *

- ◯ Yes, with the subject expert
- ◯ Yes, with the library as participant
- ◯ No, and we are not planning to conduct in near future
- ◯ No, but we are planning or planned to conduct
- ◯ Maybe

4. Partnership with the external organization/institution/commercial providers to provide RDM services? *

- ( ) Yes
- ( ) No
- ( ) Nor planned neither planning to do
- ( ) No, but planned or planning to do
- ( ) RDM services infrastructure is established or developed

4b. If Yes, then click the below options to justify the nature of the collaboration.

Tick all that apply.

- [ ] Advice on the Data Management Plan (DMP)
- [ ] Advice on awareness and retrieval of reusable sources
- [ ] Citation and data publication advices
- [ ] Data analysis, mining, visualization advice
- [ ] Advice on copyright and IPR
- [ ] Run a data repository
- [ ] Metadata creation, active data curation, and Preservation advice

5. In your opinion, what skills/knowledge or abilities are required to provide RDM services?

Tick all that apply

- [ ] Data curation skills
- [ ] Technical and ICT skills (eg. data storage, infrastructure, architecture, etc)
- [ ] Subject and or Disciplinary knowledge
- [ ] Knowledge of a variety of research methods and research lifecycle (eg. data analysis, data visualization)
- [ ] Legal, policy and advisory skills (eg. intellectual property, ethics, licensing, etc.)
- [ ] Understanding of research integrity, reproducibility and transparency principles
- [ ] All of the above
- [ ] Do not know

6. How is your library supporting the staff in acquiring necessary skills in RDM services? *

Tick all that apply.

- [ ] Organizing Webinars/ workshops/ conferences on RDM
- [ ] Encouraging online tutorials on RDM
- [ ] Support for staff to attend training sessions on RDM
- [ ] In-house staff workshops on RDM
- [ ] None

☐ Other: _____

7. According to you, what should we call a research data manager? *

◯ Data Librarian

◯ Data Manager

◯ Other: _____

8. According to you, who should manage research data in an institution? *

◯ Library

◯ Libraries taking help from other relevant units such as (research unit, IT Department, etc)

◯ Subject Expert

◯ Do not know

◯ Other: _____

9. Do you have a dedicated staff for RDM? *

◯ Yes

◯ No

10. If Yes, then which part of RDM is done by the special staff?

Tick all that apply.

☐ Database integration

☐ Reformatting/standardization

☐ Creation of secondary/ derived data

☐ Creation of metadata

☐ Other: _____

11. Which of the RDM services do you provide in the library? *

Tick all that apply.

☐ RDM planning

☐ Research data sharing and dissemination

☐ Research data preservation

☐ Data discovery and access

☐ Research metadata

☐ Data visualization

☐ Research data organization and curation

- [ ] Protocol documentation
- [ ] None
- [ ] Other: _____

12. What RDM storage tools do you provide to users/researchers in your library to facilitate RDM use? *

Tick all that apply.

- [ ] Office computers
- [ ] External hard drives
- [ ] Open source repositories
- [ ] Freely available software or services
- [ ] Cloud based platforms
- [ ] None
- [ ] Other: _____

13. Which kind of application/software/platform do you have for the research data collection, processing and sharing? *

- ( ) Zenodo
- ( ) Microsoft Dataverse
- ( ) The dataverse project (Harvard dataverse) Spreadsheet
- ( ) None
- ( ) Other:

14. In which of the following formats do you collect the raw/original research data? *

Tick all that apply.

- [ ] Pdf
- [ ] .Docx
- [ ] .xls
- [ ] Graphs/images
- [ ] Ppt
- [ ] Audio
- [ ] Codes
- [ ] Do not collect
- [ ] Other: _____

15. According to you what are the factors affecting the implementation of RDM? *

Tick all that apply.

- [ ] Lack of support from the Institution
- [ ] Lack of institutional policy
- [ ] Lack of curation tools and software
- [ ] Lack of curation skills and training (creation of metadata)
- [ ] Lack of funds
- [ ] Lack of awareness
- [ ] Lack of skilled staff
- [ ] Lack of storage and network infrastructure
- [ ] obsolescence of technologies
- [ ] Do not know

16. According to you what are the major drivers of RDM services? *

Tick all that apply.

- [ ] Demand for open access
- [ ] Library role - skilled staff
- [ ] Publishers
- [ ] Impact of research in RDM field
- [ ] Institutional Policy
- [ ] Consortia
- [ ] Do not know

17. In your opinion, do you think there is a need for a Research Data Management (RDM) policy? *

- ◯ Yes
- ◯ No
- ◯ Maybe

18. Do you see RDM as an essential service a library should facilitate? *

- ◯ Yes
- ◯ No
- ◯ Maybe

19. Do you receive funding to manage the research data? *

- ◯ Yes
- ◯ No

20. In your opinion, how can we change current scenario: from no RDM services to well-developed RDM services in academic libraries of India?

21. What do you think could be the reason for not having an RDM policy at the central level or institutional level?