7-19-2023

Research Data Management Practices and Challenges in Academic Libraries: A Comprehensive Review

Subaveerapandiyan A
DMI-St.Eugene University, subaveerapandiyan@gmail.com

Research Data Management Practices and Challenges in Academic Libraries: A Comprehensive Review

Subaveerapandiyan A

Former Chief Librarian

Department of Library and Information Science

DMI-St. Eugene University, Lusaka, Zambia

Email: subaveerapandiyan@gmail.com

ORCiD: https://orcid.org/0000-0002-2149-9897

Abstract

This comprehensive review article delves into the current landscape of research data management (RDM) practices and challenges faced by academic libraries across various regions. Utilizing a wide range of studies and data collected from different countries, this article aims to provide a comprehensive overview of the state of RDM services, the role of librarians, and the advancements in technology within academic libraries. The review explores the importance of RDM in supporting open science, data sharing, and reproducibility, while also shedding light on areas that require further development and improvement.

Introduction

The exponential growth in research data and the increasing emphasis on data sharing, transparency, and reproducibility have necessitated a reevaluation of research data management practices in academic libraries. This lengthy article seeks to provide an in-depth understanding of the evolving role of academic libraries in RDM, the challenges faced, and the potential solutions to advance research data management services.

Methodology

This extensive analysis employs a systematic and comprehensive approach to gather and synthesize data from a vast range of sources. It includes a meticulous search and review of academic journals, conference papers, case studies, and reports related to RDM practices in academic libraries. The methodology ensures that diverse perspectives and experiences from different continents are considered to provide a global outlook on the subject matter.

Literature Review

Fitzgerald et al. (2007) present an executive summary of their report that examines the legal framework surrounding the generation, management, dissemination, and use of research data. The report explores the operation of copyright law, contract and confidentiality laws, and other relevant legislation impacting research data, such as privacy and freedom of information laws. It emphasises the importance of developing proper legal frameworks to enable open access and sharing of research data among the research community. The report provides practical guidance on implementing legal protocols and recommends further work on data access policies, frameworks, and strategies. It also proposes the development of data management policies, data management plans, data management toolkits, and template agreements to support effective data management and access.

Delserone (2008) discusses the University of Minnesota Libraries' research data management and stewardship initiatives. They highlight the hiring of science librarians, a study on scientific researchers' needs, the implementation of the University Digital Conservancy, and involvement in the Research Cyberinfrastructure Alliance. The article emphasises the importance of data management and stewardship in academia, presenting the Libraries' efforts as a potential model for other institutions. It provides valuable insights into the evolving landscape of research data management.

Fitzgerald et al. (2008) present a comprehensive guide on data management from a legal and policy perspective. The article addresses researchers' challenges in data-intensive projects and emphasises proper data management systems and legal frameworks. It discusses critical legal aspects such as copyright, moral rights, confidentiality, contracts, privacy, and patents. The guide introduces the concept of data management policies, data management plans, and data management toolkits as essential components for effective data management. Practical examples and recommendations are provided to assist researchers and database managers in understanding and navigate the legal complexities surrounding research data.

Giffels et al. (2010) provide an overview of responsible data management, emphasising the importance of standards, transparency, and communication within the research community. The authors discuss various aspects of data management, including research design, data collection, analysis, interpretation, and sharing. They highlight the significance of data integrity, as accurate and reliable data are crucial for scientific advancement, public policy decisions, and professional reputations. The paper explores ethical considerations, intellectual

property issues, and the evolving landscape of data management practices in response to technological advancements and regulatory developments. The authors suggest that clear communication, adherence to best practices, and collaboration among researchers, institutions, and publishers are essential for promoting responsible data management. The paper also references a special issue of Science and Engineering Ethics dedicated to responsible data management, which includes papers discussing image manipulation, research design, research oversight, data sharing, intellectual property, and training in relevant policies. The authors conclude that investing in effective data management processes and practices is crucial for maintaining research integrity and supporting the research enterprise.

Ningning (2010) discusses the application of data warehouse and data mining techniques in higher education teaching management. The author highlights higher education institutions' challenges in the 21st century and emphasises the need for modern information technologies to support teaching, research, and management processes. The paper presents the concepts of data warehouse and data mining as crucial technologies for improving educational management. A data warehouse is a subject-oriented, integrated, time-varying, and non-volatile data collection used to support decision-making processes. The author explains the data extraction, transformation, and loading (ETL) process in building a data warehouse and the various steps involved. Data mining is extracting implicit, potentially helpful information and knowledge from large amounts of complex data. The paper highlights using neural networks and rough set theory in data analysis and mining. Integrating data warehouses and mining technologies can significantly enhance information organisation, utilisation, and decision-making in educational institutions. A case study focusing on student escalation and course repetition illustrates the application of data warehouse and data mining techniques. The paper concludes by emphasising the importance of leveraging these technologies in the context of higher education to meet the demands of a globalised and technologically advanced education system.

Ahmad et al. (2011) discuss the importance of data management in scientific computing and its applications in various scientific disciplines. The paper focuses on the Institute for Data Intensive Engineering and Science (IDIES) at Johns Hopkins University, which aims to foster the interdisciplinary development of tools and methods for deriving knowledge from massive datasets generated by instruments, experiments, and simulations. The authors describe the research and academic model of IDIES, which includes faculty members from diverse

disciplines. They highlight the benefits of establishing a data-intensive computing centre, such as providing a centralised resource for big data problems and facilitating collaboration with academia, industry, and government agencies. The paper also presents several ongoing projects at IDIES, including the Sloan Digital Sky Survey, turbulence simulations, wireless sensor networks for environmental monitoring, data centre energy consumption analysis, and data preservation. The authors discuss the challenges and advancements in scientific data management, such as building large databases, developing mathematical models for stream processing, and designing data-intensive architectures. They emphasise the need for collaborative research and integrating data management expertise with scientific domain knowledge to address complex scientific problems. The paper encourages students and researchers interested in data-intensive challenges to explore opportunities at IDIES and engage in collaborative research in scientific data management.

Zikos and Mantas (2011) discuss the strategies employed in successfully managing the RN4CAST study, one of the most significant multi-country research projects in nursing. The paper focuses on core research strategies rather than administrative management activities, highlighting the importance of collaborative teamwork, efficient coordination, and standard data collection tools and protocols. The authors emphasise the need for active participation from all partners and engagement with communities, interest groups, policymakers, and stakeholders. They underline the link between research strategies and successful management, emphasising the significance of achievements in scientific research management. The paper explores general management practices applicable to research management, such as empowering partners, effective communication with stakeholders, resource mobilisation, international collaboration, knowledge management, and coordination. The authors then present the strategies employed in managing the RN4CAST study, including establishing standard study protocols, addressing variations in data sources and definitions, data collection, analysis, and dissemination of results. The paper concludes by discussing the challenges faced in managing large-scale research projects and their impact on the validity and scientific quality of survey results.

In their paper, Yun and Jingxin (2011) address the challenges faced in implementing Intelligent Transportation Systems (ITS) Data Management Systems. They propose a framework that emphasises user requirements and the development of data processing tools. The authors highlight the limited usage and wastage of data in existing systems and stress the importance

4

of continuous evolution to meet changing user needs. The research provides valuable insights into improving the effectiveness of ITS data management systems.

The article by Johnson et al. (2012) discusses the development and implementation of e-science and research support services in the Health Sciences Libraries at the University of Minnesota. It highlights the needs and opportunities University Libraries face in building knowledge and capacity for supporting e-research. The authors explore the broader e-science initiatives and the role of libraries in the research landscape. The article emphasises the growing e-research needs in health sciences and outlines plans to enhance library resources and support for e-science. It provides insights into the evolving role of libraries in facilitating research in the digital age.

Borgman (2012) conducted a literature review on the problem of sharing research data. The article discusses the challenges and complexities of data sharing in various fields, emphasising the increasing volume of data produced and the inconsistent sharing practices across disciplines. Borgman explores four rationales for sharing data: reproducing or verifying research, making publicly funded research results available, enabling new questions from existing data, and advancing research and innovation. The article addresses the motivations, incentives, and beneficiaries of data sharing and highlights the need for clear policies and practices. Borgman concludes by stressing the importance of understanding the complexities of data sharing to inform data policy and practice.

The literature review titled "Library research support in Queensland: a survey" by Richardson et al. (2012) focuses on the evolving role of university libraries in supporting research activities. Based on a survey conducted among member libraries of the Queensland University Libraries Office of Cooperation (QULOC), the study examines trends in research support. It presents findings specific to support researchers and the research agenda. The survey reveals variations in eResearch support and research data management across libraries, highlighting areas for potential growth and development. The authors discuss library structures, roles, consultation with researchers, liaison with research divisions, tracking research impact, support for ERA/HERDC initiatives, institutional repositories, publication support, bibliographic management, HDR student support, research skills training, eResearch, data management, collaborative tools, web services, research collection development, and assistance with

grants/funding applications. The study concludes by emphasising the need for continued collaboration among libraries to adapt effectively to the changing research landscape.

In their chapter on "Research data management and the role of libraries," Schlembach and Brach (2012) highlight the increasing significance of data management in academic research libraries. They discuss how libraries have taken leadership roles in institutional repositories, data description standards, and digital publishing support. The authors emphasise the importance of data sharing and the challenges libraries face in facilitating data curation. They showcase several significant players in the field, including Johns Hopkins University, Massachusetts Institute of Technology (MIT), Purdue University, University of Virginia, University of North Carolina, University of Illinois at Urbana-Champaign, and the e-Science Portal for New England Librarians. Collaboration between libraries and researchers is emphasised as essential for successful data management. The authors conclude by underscoring the need for libraries to stay abreast of developments in data management and actively engage with researchers to ensure effective data use.

Shahi et al. (2012) studied construction research data management and sharing. They highlight the necessity of sharing research data within a research network and the increasing requirements from funding agencies, such as the National Science Foundation (NSF), for data-sharing plans. The authors note that existing data management models for construction research data are underdeveloped and propose electronic product and process management systems (EPPMS) as a solution. They describe EPPMS as a web-based system that utilises workflows to automate the collection, authorisation, and dissemination of construction research data. A comparative analysis with other web-based systems suggests that EPPMS offers a more suitable approach for construction research data management. The authors discuss the advantages of research data sharing, such as collaboration, problem-solving, and transparency, but also address challenges, including technical issues, lack of incentives, and perceived competition. They conclude by presenting the structure and functionalities of the proposed EPPMS model, highlighting its potential benefits for construction research data management and sharing.

The paper by Shahi et al. (2012) highlights the underdeveloped state of construction research data management and the need for effective systems to manage and share research data. The proposed solution uses electronic product and process management systems (EPPMS) as a

web-based approach that automates data collection, authorisation, and dissemination. The study also explores the current state of research data services in academic libraries. Findings indicate that only a tiny minority of libraries currently offer these services, but a significant number plan to do so in the next two years. Creating web guides and providing reference support are the most common services offered. Larger institutions and those receiving NSF funding are more likely to offer a broader range of services. The study concludes that academic libraries have an opportunity to play a vital role in research data services and contribute to the knowledge creation process.

The executive summary of the report by Ruusalepp and Dobreva (2012) provides an overview of the state of digital preservation services. The report analyses 190 tools and services for digital preservation and identifies areas where bridging gaps between e-Infrastructures and preservation services are needed. The study focuses on various functions within a preservation system, including pre-ingest and transfer, ingest, storage, digital object analysis, preservation planning, access, and reuse. The analysis reveals that certain functional entities offer better than others, with digital object analysis and metadata extraction tools being the most popular. The report highlights the need for more widely accepted comparison metrics, sustainable services, and user support in the digital preservation market. It proposes the development of a roadmap for digital preservation as an infrastructure service and suggests future developments that may influence the preservation landscape.

Dickmann et al. (2012) discuss the importance of research data management (RDM) in the biomedical field to address the issue of "bit rot," which refers to the decay or obsolescence of digital data. RDM aims to ensure reliable access to digital data for research groups, both locally and distributed. Metadata plays a crucial role in understanding data, and the study examines its use in the context of genome data and biomedical image data. The results highlight the benefits of metadata for research and its potential impact on improving research efficiency. The study also acknowledges that RDM still needs to be fully integrated for all biomedical data, and it still needs to be a suitable approach for clinical trial data management. The study emphasises the need for standards and further development in RDM and metadata practices.

Hassanzadeh et al. (2012) provide an overview of data management issues in the Semantic Web, highlighting research opportunities for the data management community. The study emphasises the adoption of RDF and SPARQL in addressing data management challenges such

as storage, query optimisation, and integration. It acknowledges the increasing amount of data on the web and the transformative impact of Web 2.0 applications. The Semantic Web aims to enhance data understanding and exploitation through metadata enrichment. The study emphasises the need for representation models, communication mechanisms, and query engines for semantic-aware data management systems. It also explores the incorporation of semantics into traditional data management approaches, recognising the benefits of ontologies and semantic models. The paper aims to bridge the gap between the Semantic Web and data management communities, highlighting the research potential and opportunities for collaboration.

Snyder et al. (2012) present a model called the Research Management Team (RMT) for providing institutional support in clinical and translational research data management and informatics. The model addresses the challenges researchers face in collecting and managing data, particularly when they need more expertise and resources. The RMT combines the Research Electronic Data Capture (REDCap) tool with a team of trained staff to offer cost-effective support for researchers. The RMT assists researchers in configuring data entry systems, ensures data security and compliance, and provides expertise in data management and project coordination. The model has been well received, with high satisfaction rates among users. The RMT has experienced significant growth and has been shared with other institutions, contributing to developing best practices in research data management.

Halbert et al. (2012) describe the DataRes research project, which aims to investigate data management in research institutions in response to federal requirements for data management plans. The project focuses on understanding stakeholder expectations and emerging data management policies to inform the educational needs of information professionals in managing research data. The project involves conducting surveys, focus groups, and interviews with key stakeholders such as researchers, university administrators, librarians, funding agency officials, and research equipment vendors. The research questions explore trends in data management plan policies, stakeholder expectations, and the skills and preparation required for professionals involved in data management. The project aims to provide insights into the emerging landscape of research data management and guide curriculum development and training opportunities in information science. The project activities include surveys, focus groups, interviews, database analysis of institutional policies, publication of research findings, symposium, and a comprehensive white paper.

Charbonneau (2013) discusses strategies for data management engagement, particularly in the context of health sciences librarians. The article acknowledges the growing volume of research data, often called the "data deluge," and the need for libraries to adapt and support data-intensive research. Graduate Library and Information Science (LIS) schools are enhancing curricula to prepare information professionals for e-science, e-research, and data management challenges.

Schneider (2013) presents a pragmatic approach to teaching research data literacy, focusing on creating, managing, and reusing research data. The paper defines research data literacy as a sub-discipline of information literacy and explores its parallels and connections to information literacy. The author proposes a fusion of core skills and a two-dimensional matrix to develop a flexible curriculum for research data literacy. The matrix considers different student populations and offers various teaching modules. The paper emphasises the curriculum's need for flexibility and scalability to accommodate the diverse topics and stakeholders involved in research data management. The author aligns core skills from information literacy and data curation and then connects them to teaching units based on the target audience. The proposed curriculum addresses the education and training needs of students, scientists, data managers, and information specialists in research data management.

Cox and Pinfield (2014) surveyed UK universities in 2012 to examine the involvement of libraries in research data management (RDM) and the strategic priority of developing RDM services. The study revealed that libraries offered limited RDM services, with more activity observed in large research-intensive institutions. The research identified skills gaps, resource allocation, and cultural change challenges. Libraries were actively engaged in developing institutional RDM policies and services, recognising the importance of RDM in their future role. Priorities such as providing advisory and training services for RDM were emerging. The study compared its findings with previous research and utilised an innovation hype-cycle framework and Abbott's theory of professions to understand potential future directions. The paper emphasises the growing focus on RDM at the institutional level and the need for collaboration among various professional services, including libraries, to support RDM. The research provides insights into the current landscape of library involvement in RDM and discusses factors influencing future developments.

Herzmann et al. (2014) present a data management approach employed by the Sustainable Corn project, a multidisciplinary agricultural research endeavour. The study emphasises the need for collaborative data sharing and highlights barriers like time constraints and limited funding. The approach involved creating a virtual environment using cloud-based tools to facilitate centralised data collection and collaboration among team members across different locations. Standardised sampling protocols and familiar tools like spreadsheets in the cloud were utilised to ensure data consistency and ease of use. The phased implementation approach and the use of dashboards for tracking data inflow were effective in managing the data collection process. The study underscores the importance of skilled personnel, ongoing communication, and detailed metadata in facilitating successful data management in multidisciplinary research projects.

The case study by Johnston and Jeffryes (2014) examines the data management skills required by structural engineering students at the University of Minnesota. The researchers interviewed graduate student research teams and a faculty advisor to identify gaps in their data management knowledge. The study highlights the importance of addressing these gaps to ensure that engineers can handle the challenges of e-science and big data in their research. The findings reveal that the students needed more formal training in data management, which could hinder their future research positions. The students demonstrated inconsistencies in data storage, file naming, backup practices, and security measures.
Additionally, they needed a greater understanding of documentation, metadata, data analysis, data sharing, and preservation. The study emphasises the need for collaboration between engineering disciplines and academic research libraries to provide training and support in data management skills. The research underscores the significance of data management education for engineering students in the digital age.

Davidson et al. (2014) present a comprehensive overview of the emerging best practices in managing research data and information within UK universities. The paper highlights the importance of efficient research information systems and a collaborative research ecosystem in enabling data-intensive research. It discusses various initiatives undertaken by the Digital Curation Centre (DCC) to assist institutions in meeting funding body mandates and improving their research data management practices. The authors emphasise the role of stakeholders such as researchers, librarians, administrators, and IT professionals in ensuring the availability and usability of research data in the long term. The paper also covers data management planning,

training programs, and assessing the costs and benefits of research data management. It provides valuable insights into effective research data management and sharing strategies, benefiting institutions worldwide.

Ball (2014) provides an overview of the resources the Digital Curation Centre (DCC) offers for research data management. The DCC, a collaboration between several universities in the UK, has been compiling best practices and developing tools to support digital curation for over a decade. The paper highlights the increasing importance of research data management, driven by funder requirements and the need for institutions to take data management seriously. The DCC offers various resources, including briefing papers, tools like the Data Asset Framework (DAF) and the CARDIO assessment tool, policy development guidance, data management planning support through DMPonline, and training programs for librarians and researchers. The paper emphasises the comprehensive range of resources from the DCC to assist institutions in effectively managing and curating research data.

Verbaan and Cox (2014) conducted a study to explore the perceptions and roles of librarians, IT staff, and research administrators in developing RDM services. The study draws on theoretical frameworks such as occupational sub-culture, jurisdictional struggle, and Third Space to understand the perspectives of these professional groups. The findings indicate that IT professionals primarily focus on short-term data storage and information security, research administrators prioritise compliance and research quality, and librarians emphasise preservation, advocacy, and open access. The study reveals differences in how these professional services view RDM, with the Library claiming a new jurisdiction in RDM compared to other departments. There is no evidence of a significant struggle over jurisdiction among the departments studied, as the shared concern for the organisation's greater good and accommodation of its needs play a role in mitigating conflicts. This study contributes to understanding early responses to the RDM agenda and highlights the potential for reconfiguring professional services with RDM. Further research is needed to explore the evolving roles and relationships between libraries, IT services, and other professional services in different institutional contexts and the emergence of hybrid roles in the Third Space theory.

Pinfield et al. (2014) conducted a qualitative study on the involvement of academic libraries in research data management (RDM). The findings showed that while libraries play a significant role in RDM, there is variability in their relationships with other stakeholders. Current RDM

programs focus on policy and guideline development, with some attention on technology infrastructure and support services. Major drivers for RDM include storage, security, quality, compliance, preservation, and sharing. The study identified influencing factors such as acceptance, culture, demand, incentives, roles, governance, politics, resources, projects, skills, communications, and context. The research highlights the complexities of RDM and the need for ongoing investigation to inform the development of effective RDM initiatives involving multiple stakeholders.

Tammaro and Casarosa (2014) investigated research data management (RDM) education and training programs, focusing on the role of information professionals and data scientists in the research lifecycle. The study utilised workshops and events to discuss concerns related to digital libraries and digital curation, aiming to identify competencies and skills required for data curators. The investigation revealed a list of technical and operational competencies, including knowledge and understanding of digital curation, intellectual guidance and support skills, and practical project management and organisation skills. Competency gaps were identified in organisational and policy aspects and issues related to the data. The study highlighted the interdisciplinary nature of RDM and the need for a flexible educational framework to accommodate the diverse needs of information professionals. The convergence of education in libraries, archives, and museums was also emphasised, along with the evolving role of memory institutions in the research process.

Zhao (2014) discusses the importance of scholarly publishing literacy in the context of the increasing popularity of open-access journals and the challenges researchers face in selecting appropriate outlets for their research. The author argues that academic libraries and librarians, with their knowledge of scholarly publishing, access to resources and tools, and expertise in information literacy, are well-positioned to support researchers in developing scholarly publishing literacy. The paper highlights the need for a broader research support framework incorporating scholarly publishing literacy as an extension of information literacy. The author emphasises the role of librarians in raising awareness of open access developments, assisting researchers with understanding funders' policies and copyright, administering institutional repositories, and using bibliometrics and quality indicators for due diligence checking. The paper also addresses the need for a common understanding of scholarly publishing literacy among librarians and the challenges in addressing researchers' publishing behaviours. It

concludes by advocating for ongoing professional discourse and consistency in research support roles and services among academic libraries.

In their case studies, Clements and McCutcheon (2014) discuss how the University of St Andrews and the University of Glasgow have developed their institutional research management systems to meet the evolving needs of funders, policymakers, managers, and researchers. They emphasise the importance of open science and the challenges of supporting researchers in implementing research data management processes that align with their workflows. The universities have employed integrated models, utilising standards and fostering an ongoing stakeholder dialogue. They have integrated research information systems with open access repositories, ensuring data is entered once and reused, enabling access to authorised individuals. The case studies highlight the benefits of these systems in improving research information quality and supporting compliance reporting. The universities have collaborated on projects involving CERIF, grant information, and research data management, working towards common understanding and standards for dataset metadata. They acknowledge the complexities of managing heterogeneous research data and emphasise the need for early engagement with researchers and the promotion of subject-specific repositories.

In their article, Cox et al. (2014) discuss the rising importance of research data management (RDM) in UK academic libraries. A survey revealed that many libraries plan to prioritise RDM, with areas such as policy development, advisory services, researcher awareness, training, and data repositories identified as key focus areas. The authors highlight the need for collaboration between library teams, research administrators, IT, metadata specialists, and researchers to implement RDM services effectively. They acknowledge the challenges in understanding diverse data practices across disciplines and the need to build an infrastructure for RDM. While librarians possess relevant skills and knowledge, creating awareness and demand for RDM services among researchers is crucial. The authors suggest utilising professional networks and available resources such as the Digital Curation Centre website, the book "Delivering research data management services," and the RDMRose project, which offers learning materials tailored for information professionals. They emphasise the need for librarians to actively engage in professional development and adapt their existing competencies to support RDM effectively.

In their study, Shahi et al. (2014) address the need for effective data management and sharing systems in construction research. They highlight the importance of sharing research data for

collaboration within research networks and compliance with funding agency requirements. The authors propose using electronic product and process management systems (EPPMS) as a construction research data management solution. EPPMS, such as the Coreworx system, offer web-based platforms that utilise workflows to automate research data collection, authorisation, and dissemination. The authors compare EPPMS with existing web-based cloud and SharePoint systems and argue that EPPMS provide a more suitable solution for construction research data management. They emphasise the advantages of EPPMS, including its ability to manage information and knowledge, customisation options, collaborative features, and support for process-based information. The developed EPPMS includes components such as a project portal, document management system (DMS), viewer, and workflow engine. Workflows are crucial in automating processes, ensuring data control, facilitating collaboration, and maintaining data quality. The authors present several implemented workflows, highlighting the benefits of the developed EPPMS for construction research data management. They conclude that the EPPMS model offers a reliable and efficient solution for managing and sharing construction research data, promoting collaboration, accessibility, content quality, and technical simplicity. Future work involves further development of metadata representation, scalability testing, and expanding the system's capabilities.

In their 2014 article, Doty et al. discuss their experiences participating in a working group focused on learning and applying the Interuniversity Consortium for Political and Social Research (ICPSR) processes and tools for curating research data. The group consisted of data specialists from various institutions who engaged in discussions and hands-on work using ICPSR workflows. The participants shared their perspectives and lessons learned from curating different datasets. Duke University's experience involved processing data on political donors, encountering challenges such as incomplete and mismatched data and addressing confidentiality concerns. Emory University highlighted gaps in coded data on homeschooling practices, emphasising the need for pre-planning and documentation for long-term archiving. UCLA's Social Sciences Data Archive focused on improving its workflow and understanding the work required for open archiving. The participants recognised the resource demands and the value of librarians' data management and preservation consultation. The article underscores the importance of collaboration, institution-wide policies, and a trained workforce in data curation efforts.

In their 2014 article, Henderson et al. discuss strategies for implementing research data management (RDM) services in academic libraries with limited resources. The article highlights experiences from three institutions: Virginia Commonwealth University (VCU), James Madison University (JMU), and a collaboration of seven New England libraries. The common theme across these institutions is utilising existing resources and tools and collaboration to overcome resource constraints. VCU focused on building a web presence and communication plan, conducting an environmental scan, and supporting NSF data management plans. JMU leveraged existing tools like the DMPTool and engaged in cross-campus collaborations to identify researcher needs and advocate for additional resources. The New England Collaborative developed the New England Collaborative Data Management Curriculum (NECDMC) to teach RDM best practices to students and researchers. The article emphasises the importance of understanding the research data landscape, leveraging existing resources, and collaborating to create new tools and services. Despite resource limitations, these institutions demonstrate that meaningful progress can be made in research data management with careful planning and strategic approaches.

Johnston (2014) discusses the importance of data curation services in academic libraries, particularly in response to the White House Office of Science and Technology Policy's mandate to improve access to federally funded research. The University of Minnesota Libraries conducted a data curation pilot project to curate research data for public access and reuse. The pilot involved selecting five research datasets, analysing them with the help of library professionals and subject experts, and creating a workflow model for data curation. The pilot demonstrated the feasibility of providing data curation services and received positive feedback from faculty. The pilot's success highlighted the need to develop a data curation service that aligns with researchers' workflows and expands existing capacities. The article emphasises the role of libraries in ensuring the responsible curation, archiving, and preservation of research data to facilitate its accessibility and long-term usability.

Wiley (2014) discusses the use of metadata in research data management, highlighting the role of academic institutions and librarians in data initiatives. The University of Illinois formed an e-research implementation group to promote data management and updated its data management website to provide education and resources. The website covers data documentation, metadata, data sharing, and preservation. Librarians play a crucial role in supporting researchers and helping them make their data accessible. The website has been well-

received, and plans include assessing its usage and making further improvements. The importance of metadata is emphasised as it enables data discovery, evaluation, and collaboration while protecting the organisation's investment in data. The website educates students, faculty, and the broader community about data management and the significance of metadata and documentation.

In 2014, Akmon presented an update on the National Science Foundation (NSF) DataNet project at the Research Data Access and Preservation Summit. The project aimed to combine data research infrastructure organisations to support digital preservation, access, integration, and analysis. Five project partners were funded to pursue group goals, including DataONE, SEAD, Terra Populus, and the DataNet Federation Consortium. DataONE focused on data preservation, metadata, usability, and educational outreach, while SEAD built a cyberinfrastructure for sustainability science. Terra Populus developed tools for combining data from different sources, and the DataNet Federation Consortium aimed to create a national data infrastructure. The partners aimed to support diverse scientific studies and address data sharing and preservation challenges.

In their study, Zilinski et al. (2015) examined the landscape of research data policies and library data services at major U.S. research universities. Their analysis of 206 institutions found that about half of the surveyed libraries offered data services beyond resource guides, while approximately 40% had librarians dedicated to data management support. They also discovered that institutions more engaged in research and with higher research spending were more likely to have specific data policies. The study highlighted concerns regarding data ownership and legal issues. The authors emphasised the need for further development of policies, best practices, and education in library data services, with librarians taking a leading role in policy and service development. The research indicated a growing emphasis on data services in libraries.

In their 2015 article, Rolando et al. discuss the role of data management plans (DMPs) as a research tool and how academic and research libraries can use them to inform the development of research data management (RDM) services. With the increasing recognition and demand for formal DMPs, libraries are expanding their roles to include RDM services such as training, consultation, and support for data management components. The authors collaborated to develop an analytic rubric for assessing DMPs required by the National Science Foundation

(NSF). Analysing DMPs provides insights into faculty and graduate students' knowledge, capabilities, and needs in data management. The rubric is a research tool for librarians to understand local RDM practices better and tailor services accordingly. By reviewing DMPs, libraries can allocate resources effectively and provide targeted support for data-driven research. The authors expect their rubric to fill the need for evaluating DMPs and contribute to the collective knowledge base of academic librarianship in research data services.

Brown et al. (2015) discuss the development of new skills for research support librarians in the context of engaging with the research community and the increasing importance of research data. The article focuses on the challenges a traditional academic librarian faces transitioning into a data librarian role. It highlights the need for a skills development program, mentorship, and a support network of specialists to facilitate this transition. The authors outline strategies for successful role transitions, including investing in training and staff development activities, leveraging existing librarian capabilities, and understanding the researcher's perspective. The article emphasises the importance of formal and informal training, mentoring, and support networks for research support librarians. It concludes by highlighting the role of national organisations in supporting librarians as they acquire new skills and adapt to the evolving research landscape.

Hiom et al. (2015) present a case study of developing research data management services at the University of Bristol, focusing on transitioning from a Jisc-funded project to a sustainable research data service. The paper highlights the services and activities implemented during the project and pilot phases, particularly emphasising sustainability planning to integrate research data management as a core university service. The authors provide practical advice and insights into the challenges and experiences of valuing and supporting university research data management. The case study emphasises the need for funding models, benchmarking with other institutions, and analysing future service demand. It also discusses the importance of training, discipline-specific support, and addressing data management challenges. The paper highlights the significance of ongoing investment in research data management to secure grant funding and partnership opportunities and the continuous development of the Research Data Service to meet the evolving needs of researchers at the University of Bristol.

Makani (2015) proposes a conceptual framework for an institutional research data management support system (RDMSS) that integrates knowledge management, research data management,

and university scholarship. The framework has three layers: a user-friendly Graphical User Interface (GUI), data application mechanisms for reflective practice and action research, and a knowledge-sharing and data management layer. The RDMSS aims to enhance data discovery, use, and reuse while addressing disciplinary divides in research data management. The paper offers criteria for the framework and suggests it can guide the design of institutional RDM infrastructure and knowledge discovery services. Further empirical research is needed to validate the framework's applicability.

Searle et al. (2015) describe the development of research data services at Griffith University, focusing on the role of librarians. The university's organisational structure and partnerships have facilitated service development, supported by policies, best practice guidelines, and well-supported infrastructure. Training programs, repository support, and data planning services are still evolving. The authors emphasise the importance of building data literacy skills for researchers and providing professional development opportunities for librarians. The case study offers examples of library-led activities and highlights areas for improvement. The paper provides insights for other libraries and contributes to advancing research data capability and capacity in the library profession.

Higman and Pinfield (2015) explore the relationship between research data management (RDM) and data sharing in the formulation of RDM policies and practices in higher education institutions (HEIs). The study consists of a content analysis of 37 RDM policies from UK HEIs and two detailed case studies of institutions with different approaches to RDM based on interviews with staff involved in policy development. The analysis is interpreted using Actor-Network Theory (ANT). The findings suggest that RDM policies and services involve complex networks of professionals with varying priorities. Data sharing is considered necessary in HEI policies, but its prominence is mainly due to the positions adopted by major research funders. The case studies reveal different approaches to RDM policy formation, with one institution emphasising the role of research funders. At the same time, the other focuses on internal drivers such as research governance and preservation. The study highlights the limited attention given to the relationship between data sharing and RDM policy in the existing literature. The research provides insights into developing RDM policy and practice in HEIs and funding organisations. The paper contributes to the RDM literature by examining the connection between RDM policy, services, and openness, a topic that has received little attention previously.

Awre et al. (2015) examine the concept of research data management (RDM) as a "wicked problem." They argue that managing research data has become increasingly challenging due to the quantity and complexity of digital data. Despite the growing importance of RDM in international and national policies and funder mandates, research institutions, particularly in the UK, need to be faster to allocate resources for advanced research data services. The authors suggest viewing RDM as a wicked problem, drawing on the concept Rittel and Webber (1973) introduced to describe complex and intractable societal problems. Multiple perspectives characterise wicked problems, lack of comprehensive solutions, complex interventions, value conflicts, resistance to change, and other challenging features. The authors assembled practitioners from various professional backgrounds involved in supporting RDM to explore the concept of wicked problems in-depth. Their analysis found that many features of wicked problems were relevant to RDM, including ideological and economic constraints, multiple intervention points, the absence of definitive solutions, resistance to change, and more. Some participants also noted that RDM might only partially align with all the characteristics of wicked problems, as it shares similarities with other challenges in scholarly communication and open access. Nevertheless, the concept of wicked problems stimulated thoughtful discussions and helped clarify the specific character of RDM challenges. The authors conclude that the concept of wicked problems, even if not a perfect fit for RDM, can help stimulate fruitful discussions and shift perceptions about addressing complex problems.

Surkis and Read (2015) introduce research data management (RDM) as a growing area of interest for libraries. They emphasise the need for librarians to provide services in this field, including teaching data management, assisting researchers, creating subject guides, and supporting data requirements. The authors define data as facts and statistics collected for analysis and highlight its diverse forms. They discuss the data lifecycle and the importance of data management in organising, documenting, preserving, and providing access to research data. The paper underscores researchers' increasing obligations to manage and share data due to funding and publishing policies. Lastly, they suggest ways for librarians to engage in RDM, such as familiarising themselves with data management practices and understanding researchers' needs.

Wissik and Ďurčo (2015) present an institutional research data workflow model that covers the entire data lifecycle and showcase its implementation in the Austrian Centre for Digital Humanities. The model aims to harmonise existing processes and systems to achieve a clear

division of roles and a sustainable workflow for research data management. The authors discuss different research data lifecycle models, including linear models like the USGS Science Data Lifecycle Model, organization-based models like the University of Oxford Research Data Management Chart, and community-based models like the DCC Curation Lifecycle Model. They emphasise the importance of adapting these models to specific institutional contexts and the evolving nature of data-dependent research practices. The paper highlights the need for institutional workflow models to guide researchers and ensure effective data management.

Keller (2015) provides an outsider's view on the ongoing changes in Australian university libraries to support research. The study examines the reasons for the intense focus on research support and discusses adjustments made to libraries' service portfolios and the changing roles of subject or liaison librarians. Comparisons are drawn to European developments, particularly in the UK, Switzerland, and Germany. The study identifies and discusses five essential research support services: institutional repositories, open access, bibliometrics, support for research students, and research data management. It explores how these services are resourced and integrated into library operations. The study highlights measures taken by senior management to build and sustain efficient research support services, including rationalising student services, focusing on research support activities, and creating new positions dedicated to research support. The author also raises questions about the influence of government and university policies on Australian libraries' priorities. The study emphasises the role of Australian libraries as partners in research and their commitment to contributing to research excellence.

Henderson and Knott (2015) discuss implementing a research data management program at Virginia Commonwealth University (VCU) Libraries. The program addressed the growing need for data services to support the institution's research mission. The authors highlight the importance of standardised data storage and management as computer-intensive research methodologies become more prevalent. They describe the collaborative nature of data services involving various institutional resources such as the VCU Center for Clinical and Translational Research and VCU Technology Services. The authors emphasise the role of library administration support and the establishment of strategic partnerships with researchers and faculty in building the program. They conclude that libraries, with their expertise in organising information and tradition of outreach and education, are well-suited to provide research data management services. They suggest starting with small steps and leveraging existing skills to implement data services effectively.

Wilkinson (2016) presents the FAIR Guiding Principles for scientific data management and stewardship. These principles were developed by a diverse group of stakeholders from academia, industry, funding agencies, and scholarly publishers to improve the infrastructure supporting the reuse of scholarly data. The FAIR Principles emphasise the need for data to be Findable, Accessible, Interoperable, and Reusable, focusing on enabling machine-driven discovery and use of data. The principles aim to guide data producers and publishers in enhancing the reusability of their data holdings, supporting knowledge discovery, integration, and reuse by the scientific community. The article highlights the importance of good data management and stewardship in facilitating data discovery, evaluation, and reuse. It emphasises that all scholarly digital research objects, including data, algorithms, tools, and workflows, should adhere to the FAIR Principles. The FAIR Principles have the potential to benefit researchers, data publishers, funding agencies, and the data science community by promoting transparency, reproducibility, and the advancement of discovery through effective data management and stewardship.

Zhang and Chen (2016) studied data management and curation practices using DSpace as a case study. Their research addressed the need for common standards and best practices in this emerging field. The study analysed 171 data repositories from 164 institutions across 95 countries. The findings showed that data management and curation are global issues, with academic institutions and government agencies leading. The repositories served various purposes, including institutional, learning resources, and subject repositories. The study also identified the most commonly adopted system functions. The research highlights the need for standardised data management and curation practices and provides valuable insights for institutions creating their repositories.

Koopman and De Jager (2016) discuss the state of digital data archiving and research data management in South Africa, focusing on a case study conducted among biological sciences researchers at a South African university. The study aimed to explore the readiness of researchers to engage with data management and archiving through repositories. The findings revealed that while some researchers were already involved in digital data archiving, there needed to be more systematic research data management among researchers and the university. The article emphasises the increasing importance of data archiving and management, mainly due to recommendations by the National Research Foundation. It highlights the challenges in

data ownership, intellectual property, and copyright and issues related to data storage, backup routines, and data migration. The survey also indicates the need for data management education and research support. The authors emphasise the importance of institutional commitment, policies, and collaboration to ensure long-term security and accessibility of research data in South Africa.

Wilms et al. (2016) discuss the importance of research data management (RDM) in international research collaborations and the role of cloud technology, using Sciebo ("science box") as an example. They compare RDM requirements of funding institutions such as NSF, DFG, and ARC. Sciebo supports data sharing, storage duration, data security, and external access but lacks features like internal data relations and collaborative tools. The authors highlight the need for standardised RDM guidelines and the challenges in adoption among researchers. They conclude that Sciebo has potential as an RDM tool, but improvements are needed to meet all requirements. RDM is crucial for research credibility and reproducibility, and cloud services can significantly support RDM processes.

Fransson et al. (2016) discuss the development of research data management (RDM) support for doctoral students at Malmö University. The university library conducted a web survey to understand researchers' attitudes and practices related to RDM. Based on the survey results, specific seminars and workshops were organised to promote conscious RDM practices among doctoral students. The support offered considered both general aspects of RDM and discipline-specific practices. The aim was to develop integrated RDM support that aligns with the research practices of doctoral students. The survey revealed diverse research practices and a need for more knowledge and support in open research data, data management plans, and data organisation. The authors highlight the importance of addressing disciplinary differences and providing tailored support to meet the specific needs of researchers. The library's role in RDM support involves collaboration with other support functions and ongoing efforts to enhance knowledge and practices related to RDM.

Wright (2016) discusses the importance of data management plans (DMPs) in research and the availability of electronic resources to assist in developing data management skills and creating DMPs. The author highlights that grant institutions increasingly require formal DMPs for research planning, leading medical and academic libraries to support and assist researchers in this area. Several tools are mentioned, including Data Research MANTRA, an online course

that provides modules on various aspects of data management, and DMPTool and DMPonline, which offer step-by-step guides for creating DMP documents according to best practices and specific funder or institutional requirements. These resources help researchers and librarians make informed decisions about managing research data and ensure its availability and usefulness in the long term. The article emphasises the growing importance of data management practices and the role of libraries in supporting researchers in this area.

Wu and Chen (2016) surveyed to understand the needs of researchers in chemistry disciplines regarding research data management and sharing. The survey covered five perspectives: data generation and collection, data recording and processing, data preservation and backup, data management and sharing, and the need for data-sharing services. The survey included 119 researchers and graduate students from the Chinese Academy of Sciences. The results provided insights into the attitudes and needs of researchers in chemistry disciplines regarding data management and sharing. The authors suggest that the survey findings can help design library services that cater to researchers' needs, particularly in promotion, consulting, and training for research data management and sharing. The study emphasises the importance of addressing researchers' concerns and providing support in effectively managing and sharing research data.

The paper by Patel (2016) presents a conceptual framework for research data management (RDM) at the institutional level. It highlights the importance of sharing research data and discusses copyright, licensing, security, and privacy challenges. The framework proposes guidelines for data management, including developing institutional data-sharing policies, changing researchers' mindsets towards data sharing, and collecting datasets along with research documentation. It also suggests the establishment of a National Repository of Open Research Data (NRORD) to store and share open data, addressing data privacy and copyright issues. The framework aims to help institutions manage research data effectively, promote data sharing, and ensure proper data handling throughout the research data lifecycle.

De Waard (2016) discusses the importance of research data management (RDM) and presents a framework for managing research data at Elsevier. The framework focuses on supporting the needs of researchers throughout the data lifecycle. It emphasises the creation of an exemplary data ecosystem that enables data sharing, preservation, accessibility, discoverability, citation, comprehensibility, review, reproducibility, and reusability. The paper highlights ongoing efforts to develop collaborative partnerships between researchers, librarians, institutions,

government offices, funders, and publishers to establish effective data management practices. Additionally, it addresses the challenges of data privacy, data security, copyright, and licensing. The framework promotes reproducibility, transparency, and open data, enhancing research integrity and efficiency.

Federer (2016) discusses the role of librarians and information professionals in research data management (RDM) in the age of big data. The article highlights the changing landscape of scientific research, with researchers increasingly relying on large digital datasets and facing new data sharing and management requirements. Librarians, with their expertise in knowledge management, are well-positioned to provide valuable support to research teams. The paper explores the opportunities for librarians to assist with various data management, analysis, and preservation aspects. It emphasises the importance of developing library-based research data services aligned with the research data life cycle, including data management planning, reuse, visualisation, and sharing. As funders and journals emphasise data sharing, librarians can be crucial in assisting researchers and expanding their services to meet the research community's evolving needs.

Helbig (2016) explores the experiences of a pilot workshop on research data management (RDM) tailored explicitly for geographers. Given the increasing collection and availability of digital data, the article highlights the growing importance of responsible handling and documentation of research data in geography—the workshop aimed to provide discipline-specific training and support for researchers and students in managing their data effectively. The article discusses the challenges and benefits of RDM for geographers, including the need for early data documentation, legal issues, and the advantages of data sharing and reuse. It emphasises the role of universities in offering training and guidance for efficient research data management and the importance of communication and incentive structures to encourage researchers' engagement with RDM. The workshop covered research data definitions, data management plans, data backup and security, file structuring and version control, metadata schemas, research data repositories, and data citation. The article concludes with lessons learned from the pilot workshop, including the significance of timing, creating a welcoming atmosphere, and collaborating with discipline-specific repositories.

In their article, Sesartic and Töwe (2016) discuss the research data services provided by ETH-Bibliothek, the main library of ETH Zurich. They highlight the importance of effective data

management for sharing and long-term preservation throughout the data lifecycle. The library supports conceptual questions, training, data publication, and preservation. Close collaborations with researchers are established to promote mutual learning and address new challenges. The library focuses on its strengths in metadata management, content curation, and customer support. They also provide data management training through workshops and tailored courses. The authors emphasise the significance of the Data Management Plan (DMP) Checklist developed by ETH-Bibliothek, which aids researchers in managing their data effectively. The checklist covers various aspects of the data lifecycle and helps researchers with documentation, metadata, file formats, storage, and ethical considerations. ETH-Bibliothek is vital in facilitating research data management at ETH Zurich.

Myneni et al. (2016) present a collaborative effort between industry and academia to improve data management in an academic biomedical laboratory. The study addresses the challenges researchers face in managing heterogeneous and voluminous research data, which hinder research productivity. The collaboration spans four years and employs various data collection methods such as observations, interviews, surveys, progress reports, and discussions. Qualitative data analysis is conducted to identify specific problems, intervention areas, and collaboration characteristics for successfully implementing a new research information management system called Labmatrix. The results emphasise the importance of end-user perseverance, human-centric interoperability evaluation, and demonstrating the return on investment in terms of effort and time for laboratory members and industry personnel. The study highlights the need for informatics solutions that support human and cognitive interoperability and contribute to successful collaboration and scientific productivity in biomedical laboratories. The paper concludes with lessons learned, including the significance of customisation, system interoperability, and close collaboration between academia and industry in implementing information management systems in biomedical research.

Koltay (2017) discusses data literacy's importance for researchers and librarians. Data literacy is closely related to information literacy and plays a vital role in the data-intensive paradigm of scientific research. The paper explores the significance of data, researchers' behaviour regarding data sharing and management, research data management, the potential roles of academic libraries, data quality, data citation, and approaches to data literacy. The author emphasises the need for researchers to develop data management skills and highlights the role of libraries in providing data literacy education and support. The paper calls for further

investigation into phenomenography approaches to data literacy and its relationship to the digital humanities. Library and librarians must actively engage in data literacy to meet researchers' evolving needs and contribute to effectively managing research data.

The paper "Challenges of Research Data Management for High Performance Computing" discusses the difficulties of managing research data in the context of High-Performance Computing (HPC). The challenges include the large volume and diverse formats of HPC research data, inadequate data management concepts, and organisational issues. The paper proposes requirements for a feasible HPC research data management system to address these challenges, including scalable storage, effective metadata schemes, persistent identifiers, data security, and workflow integration. It also introduces the role of a Scientific Data Officer (SDO) responsible for data management. The paper emphasises the need for a comprehensive data life cycle beyond project completion. The paper highlights the importance of addressing technical, organisational, and administrative aspects of data management in HPC.

Wu et al. (2017) The poster titled "How do Chinese Researchers Use Research Information Management Systems?: An Exploratory Study" presents findings on the usage of research information management (RIM) systems by Chinese researchers. The study identifies Chinese researchers' RIM systems, including ResearchGate, Google Scholar, ORCID, and Baidu Academic. The findings reveal various activities in which Chinese researchers use RIM systems, such as finding literature, connecting with scholars from other countries, disseminating research, and curating their research information. Motivations for using specific RIM systems include obtaining English papers and connecting with international scholars, while language barriers and the Great Firewall of China act as deterrents. The study suggests addressing language barriers and providing translation services to enhance Chinese researchers' participation in RIM systems.

Chard et al. (2017) introduce Globus, a research data management platform that offers data transfer, sharing, user authentication, and data publication services. By adopting a software-as-a-service (SaaS) model, Globus simplifies research data management and reduces costs. The authors highlight the challenges faced in data management and emphasise the need for user authentication, efficient data transfer, and simplified data sharing. They discuss how Globus addresses these challenges through its cloud-hosted service, Globus Connect software, and the integration of Globus Auth for authentication and authorisation. Additionally, the paper

emphasises Globus' role as a platform for developing research services, enabling service providers to leverage its capabilities through REST APIs and software libraries. The widespread adoption and usage statistics presented demonstrate the effectiveness of Globus in facilitating research data management.

Cox et al. (2017) conducted an international study on research data management (RDM) activities in higher education libraries. The results showed that libraries have taken a leadership role in RDM, particularly in advocacy and policy development. The development of RDM services is still limited, focusing more on advisory and consultancy services rather than technical services. Challenges identified include resourcing, collaboration with other support services, and obtaining buy-in from researchers and senior managers. The study emphasises the need for libraries to enhance their skills and capabilities in data curation and address these challenges to support effective RDM.

Chan and Loizides (2017) conducted an inventory of research data management services in France, funded by the Ministry of Higher Education and Research. The study identified and analysed 60 services provided by 45 structures covering various research fields. The inventory aimed to understand the types of research data services available in France, help researchers and librarians identify appropriate support, and inform resource allocation. The results highlighted the heterogeneous and emergent nature of the services, with a mix of institutional and national scopes. Sustainability and utilisation were identified as critical challenges. Many services relied on short-term funding and struggled to ensure long-term preservation. Additionally, researchers had limited awareness of the services, indicating a need for increased promotion and integration of data management services in research practices.

Lee et al. (2017) studied the metadata practices used in the research information management (RIM) system ResearchGate. The study aimed to understand how researchers utilise metadata elements in ResearchGate and how this information can help institutional repositories align their metadata models with researchers' needs. The study identified three categories of RIM system users: community members, readers, and personal record managers. Preliminary findings showed that community members were more willing to share personal information and provide full texts of their works than readers and personal record managers. The analysis of ResearchGate's metadata elements revealed nine different categories representing academic-related activities. The study highlighted the importance of understanding researchers'

motivations and perceived values of metadata elements for future research and developing a value model for RIM metadata elements.

Koltay (2017) discusses the importance of Research Data Services (RDS) in academic libraries to support the evolving landscape of Research 2.0. Academic libraries play a crucial role in managing research data and aligning their services with the data-intensive nature of modern research. The paper emphasises the need for librarians to develop competencies in research data management, data curation, data literacy education, data governance, and data quality. It highlights best practices, such as collaborations with other university units and creating data champions communities. By providing effective research data services, academic libraries can support researchers in managing, preserving, and utilising data, ultimately contributing to the advancement of research.

Van Loon et al. (2017) conducted a study to evaluate the quality of data management plans (DMPs) at Wayne State University. They analysed 119 DMPs from National Science Foundation grant proposals submitted between 2012 and 2014. The results revealed that while researchers understood the importance of sharing data, many DMPs lacked adequate data descriptions, data management during the project, and data preservation and sharing after project completion. The study also identified variations in DMP content between academic units, suggesting the need for differentiated outreach services. The authors emphasise the importance of providing targeted education and consultation to improve the quality of DMPs and research data management practices.

Grant (2017) conducted a literature review to explore perspectives on the relationship between research data, recordkeeping, and research data management. The author examined literature from the archival and recordkeeping professions and other sources discussing the management and preservation of research data. The review highlighted that records professionals are increasingly engaging with research data management, and there is a growing recognition of the relevance of their skills in this area. The review also discussed the skills required for managing research data, which cut across disciplines such as librarianship, records management, and IT. Additionally, the application of records management approaches to research data management was explored, including using the records life-cycle or records continuum models. The review revealed that archives have accessed and preserved research datasets since the mid-20th century. The findings suggest the need for guidelines and

documentation to support records professionals in managing research data and raising their profile as data management experts.

Burgi et al. (2017) conducted a study on research data management in Switzerland, focusing on long-term preservation. The project aimed to provide national services for researchers' data management needs, including guidelines, active data management solutions, and long-term storage options. The study utilised document analysis and interviews with researchers, aiming to develop a data management framework and guidelines. The project consisted of five tracks: guidelines and policies, active research data, long-term preservation, consulting and training, and dissemination. The study emphasised the importance of rational data management and the need for collaboration and resource-sharing among institutions.

Chigwada et al. (2017) examined research data management (RDM) practices in Zimbabwean research institutions. The study highlighted the growing need for academic libraries to offer RDM services, such as assisting with data management plans and supporting data archiving and sharing. Many librarians lack experience in RDM and require targeted professional development. The article provided a comprehensive list of internet resources, including online communities, training materials, and tools, to help librarians educate themselves on RDM. These resources cover data management planning, data curation, and data sharing.

Latham (2017) discusses the role of academic libraries in research data management (RDM) and the challenges they face. The emergence of RDM as a topic of interest is largely driven by funding agencies' requirements for robust data management plans. Libraries have started re-evaluating their support for research and expanding into RDM services. They play a crucial role in assisting researchers in data management, creating data management plans, and offering expertise in policy formulation. Libraries prioritise certain RDM services, such as informational services like data locating and citing, over technical services like repository management. Challenges include limited resources, skill enhancement, and IT and research administration collaboration. Reconciling different perspectives and achieving common goals is essential. It is important to remember that RDM services should cater to the needs of all researchers, not just those applying for grants requiring data management plans.

A scoping review by Perrier et al. (2017) found a growing body of research on research data management (RDM) in academic institutions. The authors noted that there are still many gaps

in the literature, such as limited research on the impact of RDM interventions on research productivity and reproducibility. The authors concluded that future research should focus on these gaps to inform the development of RDM policies and practices in academic institutions.

Yoon and Schultz (2017) conducted a content analysis of 185 academic library websites in the United States to examine research data management services. The study revealed a need for libraries to advance their services, provide online information, and develop educational programs. While libraries offered basic services such as assistance and data deposit, there was variation in the extent of services provided. Libraries were found to cover various topics related to research data management on their websites, but some areas, such as data documentation and administration, were not adequately addressed. Approximately one-third of libraries offered educational programs, primarily focusing on data management. The study also highlighted internal and external links on library websites, connecting researchers to resources such as tools, data repositories, and government regulations. The findings suggest the importance of improving and expanding research data management services in academic libraries.

Morgan et al. conducted an RDM experience study in 2017. Libraries are increasingly collaborating with other units within academic institutions to support research data management (RDM) as a response to the complex nature of RDM tasks traditionally handled by researchers alone. The University of South Australia (UniSA), the University of Adelaide, and Flinders University in South Australia exemplify this collaborative trend. These institutions have adopted diverse approaches, such as workshops, web pages, library guides, and appointments, to offer RDM support. They have also developed specialised tools and software packages and acquired additional skills to meet the specific needs of researchers. Effective RDM services require collaboration and integration with university-wide systems. The libraries' involvement encompasses various aspects of data management, including planning, description, storage, curation, preservation, licensing, and open access. By actively engaging in RDM, libraries assert their relevance and strengthen their connections with the research community.

Haddow and Mamtora (2017) studied research support services in Australian academic libraries, focusing on aligning these services with national research evaluation exercises and the growing interest in research impact beyond traditional bibliometrics. The study used

quantitative and qualitative research methods to explore research support services' extent, management, and challenges. The findings revealed three key themes: services, staff and resourcing, and relationships. The study showed that research support services in Australian academic libraries assisted with grant applications, promotions, appointments, and publishing. Service models varied, ranging from structured bibliometric services to capacity-building initiatives. The study also found that while bibliometric services were well-established, altmetrics services were introduced in a more limited capacity. Staffing, skills, funding, and partnerships influenced research support services delivery. The study highlighted the need for academic libraries to develop staff skills, foster collaborations with research offices, and stay informed about the evolving research environment to provide research support services effectively.

Van Zeeland and Ringersma (2017) conducted a case study on developing a Research Data Management (RDM) policy at Wageningen University & Research in the Netherlands. The study aimed to create guidelines for the RDM policy by analysing existing frameworks and principles on data management and data management practices within the organisation. The researchers interviewed research groups to identify "best-practices" cases where data management met essential criteria. These best practices informed the development of the RDM policy. The study highlighted the increasing recognition of the value of research data and the growing emphasis on transparency, reuse, and verifiability. It also emphasised the role of university libraries in supporting data policies and the need for engagement with researchers to understand their data management practices and inform policy development. The findings demonstrated the importance of data storage, archiving, and registration criteria in developing an effective RDM policy. The study concluded that engaging with researchers and using best practices as examples can facilitate the adoption of data management guidelines and support the implementation of RDM policies.

Kvale and Stangeland (2017) focused on developing research data management (RDM) training courses at the University of Oslo Library. The study addressed the increasing requirements for data management and data sharing in research. The courses targeted researchers, PhD students, research support staff, master students, and librarians. The training program included collaboration with existing initiatives, such as software and data carpentry, to provide digital skills training and data management. The study emphasised the importance of sharing courses and materials with the broader community and organising events to raise

awareness. The researchers highlighted the need for further development and formalisation of the training program to meet evolving policy and research data requirements. The University Library was crucial in promoting good data management practices through training and support.

The article by Kaye et al. (2017) discusses the development of a shared research data service (RDSS) for UK universities. The authors emphasise the importance of research data management and sharing in maintaining research integrity and enabling new research and innovation. The RDSS aims to facilitate the deposition, publication, storage, archiving, and preservation of research data while supporting compliance with research policies and improving research reproducibility. The article outlines the process of requirements gathering, engagement with pilot institutions, and collaboration with suppliers to develop the RDSS. The authors highlight the need for interoperability, integration with existing systems, and adherence to metadata standards to meet the diverse needs of researchers from various disciplines. The RDSS project is in the alpha development phase, with plans for beta development and potential production service.

Thielen and Hess (2017) present a case study on incorporating research data management (RDM) instruction into a doctoral curriculum for education graduate students. They highlight the importance of RDM skills in the social sciences and the lack of such instruction in graduate programs. The authors discuss their collaboration as research data and education librarians, the design and implementation of targeted RDM support, and the assessment of student feedback. They provide practical suggestions for social science librarians to create similar workshops and emphasise the need to consider students' unique needs and motivations. The article concludes by discussing future directions, including longitudinal research on the impact of RDM instruction and lessons learned for implementing RDM in graduate curricula.

The study conducted by Matusiak and Sposito (2017) explores the various types of research data management (RDM) services offered by academic libraries and research centres internationally. These services aim to assist researchers in meeting funder requirements for data management planning and promoting open access to research data. The authors highlight the evolving nature of RDM services and the different program designs and strategies employed to address technological challenges and user needs. The research investigates organisational models for RDM services in Australia, Europe, and North America through a mixed-method

approach involving content analysis of job announcements, interviews with professionals, and analysis of supporting documents. The study identifies consultative and technical services as the two main types of RDM services, with academic libraries being the primary providers. Additionally, the study uncovers examples of embedded curation services, distributed networks of RDM expertise, and multi-purpose research data centres. The findings demonstrate the diversity of approaches to RDM services and highlight the importance of collaboration and adaptation to meet researchers' requirements in different contexts.

The article by Dunie (2017) emphasises the significance of research data management and the role of electronic laboratory notebooks (ELNs) in ensuring data integrity and availability. With the increasing volume of research data and the prevalence of research fraud and retractions, proper data management is crucial for maintaining the quality and reproducibility of research. ELNs offer features such as data integrity, revision history, time stamps, and compliance with regulations, providing a secure and accessible platform for managing research data. They facilitate collaboration, support institutional research policies, and enable data sharing and reproducibility. LabArchives, mentioned as a leading cloud-based ELN, exemplifies the benefits of using such tools in research data management. By transitioning from traditional paper notebooks to digital solutions, researchers can improve efficiency, protect their work, and enhance the searchability and organisation of their data. In today's era of advanced technology and global collaborative research, ELNs have become indispensable tools for researchers, helping them effectively manage and preserve their valuable research data.

The Arias-Coello et al. (2018) study focused on research data management (RDM) in three Spanish universities. The researchers administered an online survey to faculty members and doctoral students to assess their awareness and understanding of various aspects of RDM. The results indicated a growing demand for RDM skills among the academic staff and research students. The study revealed that commonly used file types included standard office documents, internet and web-based data, images, archived data, and structured scientific and statistical data. Most respondents used data volumes in the range of gigabytes and megabytes. Most stored their research data on personal devices or in the cloud, with a small percentage utilising central servers or external repositories. The survey also explored the participants' knowledge and usage of metadata, with many indicating the need for more training in this area. The findings emphasised the importance of formal training, including data management plans, metadata, consistent file naming, and data citation styles. The study concluded a growing need

for data management literacy skills among academic staff and research students, highlighting the importance of universities offering appropriate training tailored to researchers' needs in different disciplines.

Špiranec and Kos (2018) studied data literacy and research data management (RDM) in Croatia. The survey aimed to understand the practices of Croatian researchers and PhD students regarding the production, dissemination, storage, and description of research data, as well as institutional attitudes towards these issues. The study found that researchers mainly relied on their research projects and networks to obtain data. Data types used included standard office documents, images, web resources, and software applications. Most data was stored on researchers' devices, with a small percentage using cloud services or institutional repositories. While researchers recognised the importance of long-term storage and metadata, their practices varied. The study also revealed a willingness to share data, but only a small percentage was truly open. Researchers expressed concerns about misinterpretation and misuse of data. Institutional involvement and communication regarding RDM were perceived as lacking. The study highlighted the need for education and training in RDM to promote a systematic approach to data management.

The chapter by Kennan (2018) highlights the importance of managing research data and the need for effective data management planning throughout the data's life cycle. The chapter discusses the diverse forms and sources of research data and emphasises the significance of planning to ensure proper data management within research projects and programs. It explores the legal, ethical, and policy reasons for data management planning and the practical and pragmatic reasons. The role of researchers in the data management process is also addressed, along with the influence of organisations and associated actors. The chapter identifies ten essential components of a data management plan and provides a checklist for researchers in the early stages of constructing such a plan. Additionally, it offers references to valuable data management tools and resources. The chapter underscores the need for policies, infrastructures, staffing, and systems to support researchers in implementing data management plans. It highlights the heterogeneity of research data, requiring tailored management approaches based on specific research disciplines and data types.

Tripathi and Pandy (2018) present a conceptual framework for research data management in higher educational institutions. The framework outlines the data life cycle and addresses data

privacy, security, copyright, and licensing issues. It emphasises the importance of data sharing and proposes guidelines for data management, storage, and usage. The authors discuss copyright determination, licensing, data interpretation, and security challenges. They highlight the need for data classification, metadata, and an interoperability framework. The framework aims to help institutions manage research data effectively, comply with requirements, and improve research outcomes. It also mentions implementing open data policies and platforms nationally in India.

Perrier et al. (2018) conducted a meta-ethnographic analysis to explore the experiences of academic libraries with research data management (RDM). The study revealed three major themes: negotiating space, preparedness, and strategies for impact. Academic libraries faced challenges in defining their roles and relationships within RDM but were recognised as neutral and centralised spaces within institutions. Libraries often had reactive responses to emerging RDM requirements and experienced skill gaps in RDM among staff. Strategies for impact included providing guidance, creating awareness, and forming collaborations with other units. The study highlighted the importance of understanding the perspectives of academic libraries in addressing RDM obligations to plan and make informed decisions.

Wang and Liu (2018) discuss the development of scientific research management in the era of big data. They highlight the opportunities and challenges big data brings and propose innovative coping strategies. The paper emphasises the importance of efficient management of scientific research projects and achievements in the context of the big data era. It explores the characteristics of the big data era, including the large amount and variety of data, low-value density, and high processing speed requirements. Big data can lead the development of scientific research management by facilitating the acquisition of original data, promoting active engagement of researchers, and enabling automatic data collection for research management purposes. They also emphasise the need for a big data mindset and the utilisation of data mining techniques to unlock the intrinsic value of data. The article emphasises the significance of adapting scientific research management practices to leverage the potential of big data in universities.

Brown et al. (2018) discuss the evolution of research support services at The University of Queensland Library (UQ Library) and the role of the institutional repository in facilitating these services. The paper highlights the university's research-focused mission and the need to

respond to global and national drivers that shape institutional strategy. UQ Library has developed research support services aligning with these drivers, particularly in research dissemination, open access, and data management. Establishing functional teams with traditional liaison librarians has allowed UQ Library to deliver innovative and comprehensive research support services. The paper describes the "triangle" service model, where library staff at different levels provide varying research support. The functional teams, closely linked by the institutional repository (UQ eSpace), specialise in digitisation and digital curation, research data management, scholarly publishing, and digital scholarship. The core infrastructure of UQ eSpace supports the research lifecycle and ensures the integrity of research outputs and data. The authors emphasise the importance of collaboration and partnerships within the institution to deliver effective research support services. The case study illustrates how UQ Library has adapted its services to meet the research community's evolving needs and contribute to the university's research mission.

The paper by Baolong et al. (2018) explores data management maturity models. It applies them to Project S, which focuses on the academic careers of scientists with massive amounts of unstructured data. They propose a data management maturity framework based on the Data Capability Maturity Model (DCMM) and divide the project's maturity into five levels. The authors compare different models, including IBM's, DMM, DCAM, and DCMM. They highlight the importance of data management in the digital age and the need for comprehensive evaluation models. The paper concludes by discussing the current status of Project S and its impact on data management capabilities. The proposed framework aims to improve data management and can be applied to similar projects.

Bugaje and Chowdhury (2018) conducted a study to identify the design requirements of a user-centred research data management (RDM) system. The paper highlights the importance of user-centeredness in RDM systems and the lack of clearly-defined criteria for assessing usability or user-centeredness. The authors employed user-focused research methods such as questionnaire surveys, face-to-face interviews, and a systematic appraisal of existing services to understand user-centeredness in research data repositories. Based on their findings, they translated the requirements into design requirements for a user-centred RDM system. The paper emphasises the need for efficient data discovery, metadata creation, user-friendly interfaces, and features such as data visualisation and interaction. The proposed system aims to conform to UKRI guidelines and FAIR principles to enhance the usability and manageability of research data.

Singh et al. (2018) highlight the significance of research data management (RDM) and its benefits for institutions and researchers. They discuss critical issues related to RDM, including roles and responsibilities, cost and infrastructure, data-sharing policies, legal and ethical concerns, and more. The paper presents a framework for managing research data at the institutional level. It emphasises the importance of policies promoting data sharing, addressing copyright issues, ensuring data security, and adhering to research ethics. It also acknowledges challenges such as cost-effectiveness, developing data-sharing policies, and protecting against plagiarism. The authors suggest strategies for addressing these challenges and emphasise the need for institutions and researchers to prioritise RDM and develop effective policies and frameworks.

The article by Ng'eno and Mutula (2018) presents a literature review on Research Data Management (RDM) in agricultural research institutes. The authors emphasise the importance of RDM in strategically positioning the agricultural sector in the knowledge economy, reducing duplication of effort, promoting innovation, and ensuring compliance with funders' requirements. The review highlights that while RDM has been widely embraced in developed countries, African agricultural research institutes lag. Major challenges include the lack of a legal, policy, and regulatory framework, inadequate technical infrastructure, and limited human resources capacity. The article recommends the establishment of a legislative and policy framework for RDM, capacity-building programs, and improvement of technical infrastructure. The review showcases the advancements in RDM perspectives in countries such as the United Kingdom, the United States, Australia, Canada, South Africa, and Kenya, where initiatives and investments have been made to support data management practices in research institutes.

The study by Majid et al. (2018) explored research data management practices at Nanyang Technological University, Singapore. The survey of 241 respondents revealed that most research data produced were in MS Office format, images, and structured statistical data. While respondents showed a positive attitude towards collaboration and data sharing, they preferred sharing data within their teams. Concerns included legal and ethical issues, data misuse, and misinterpretation. The majority expressed interest in research data management training. The study highlighted the need for awareness campaigns, training sessions, and certification programs to promote effective data management. Increased knowledge and familiarity with

data management concepts and practices are necessary to improve research data management culture.

Shelly and Jackson (2018) studied how Australian universities support researchers in managing and making research data more accessible. The research aimed to determine if university libraries could play a bigger role in research data management (RDM). The findings showed no consistent approach to RDM across the 13 universities surveyed. While there was a general emphasis on securely storing research data, practical support in undertaking RDM activities was lacking. The study raised questions about library staff's experience, training, and professional development to expand their role in RDM effectively. The article highlighted the need for further research and emphasised the importance of libraries in providing training and support for RDM activities, particularly in promoting open access to research data.

Khan et al. (2018) conducted a study to examine how research data services (RDS) are organised in North American academic library websites and to what extent they support the research data lifecycle. Using an information architecture perspective, the researchers analysed 50 academic library websites. The study identified three provisions that makeup RDS: Information Access, Technical Support, and Personalized Consultation. Information Access includes data management guides, tutorials, funding agency requirements, and links to external RDS websites. Technical Support involves data repositories, tools for creating data management plans, and limited data analysis and visualisation support. Personalised Consultation refers to in-person assistance with data management. The study found that RDS strongly supports various stages of the research data lifecycle, such as planning, data curation, and data access. Technical support services were limited compared to information access services. The study highlights the importance of RDS in managing and providing access to research data but also suggests the need for further development and support in certain areas of the research data lifecycle.

Piracha and Ameen (2018) conducted a qualitative study to explore university faculty members' research data management (RDM) practices at the University of Punjab in Pakistan. The researchers conducted semi-structured, in-depth interviews with ten faculty members and analysed the data thematically. The study aimed to understand the factors related to RDM and curation practices, the amount and types of research data produced, the support needed for data curation, and the willingness to share data. The findings indicated a need for assistance in

storage, security, backup quality, and the establishment of a central repository. Faculty members expressed a positive attitude towards sharing data, albeit with certain conditions and concerns about misuse. They highlighted the requirement for data literacy training and the role of libraries in providing support. Challenges included a lack of skills, awareness, and designated personnel for data management. The study emphasises the importance of RDM services and highlights the need for policy implementation and repository development to facilitate effective research data management practices.

Brochu and Burns (2019) conducted a literature review to explore the role of librarians in research data management (RDM) and examine institutional research policies supporting librarian collaboration in the research team. The review aimed to identify the current level of publication on the librarian's involvement in RDM and provide valuable resources for library and information professionals. The authors discussed the emergence of RDM and the challenges and opportunities it presents for librarians. They emphasised the importance of understanding the research data lifecycle and highlighted the key components of data collection, processing, analysis, preservation, discovery, and re-use. The Digital Curation Center (DCC) was mentioned as a valuable resource for good research data practices and tools. The authors discussed the role of librarians as information professionals who collect, catalogue, store, preserve, and provide access to information. They argued that librarians play a crucial role in supporting researchers throughout the research data management plan (DMP) process and ensuring proper data management from the beginning of the research cycle. While the involvement of librarians in RDM planning varies across institutions, the authors noted that libraries are increasingly expected to provide information and guidance on research tools and research supports. The review concluded by recommending resources and tools for librarians interested in learning more about RDM and supporting researchers in the DMP process.

Latif et al. (2019) studied "A generic research data infrastructure for long tail research data management." The authors discussed the importance of digital research data in ensuring transparency, reproducibility, and innovation in scientific research. They emphasised the need for research data management practices that comply with scientific standards to make data discoverable, citable, and accessible for potential reuse. The authors introduced GeRDI (Generic Research Data Infrastructure), an initiative to connect research data infrastructures across domains and research practices. GeRDI provides generic and open software to support multidisciplinary research questions and address the challenges of managing long-tail research

data. The authors discussed the research data lifecycle, pilot research communities involved in GeRDI, requirements gathering techniques, metadata standardisation, architecture, and challenges faced in the project. They highlighted the importance of community engagement, flexibility in the architectural design, and monitoring of related initiatives to ensure the unique value proposition of GeRDI. The paper concludes by emphasising the role of infrastructure projects in enabling modern interdisciplinary research practices and providing services throughout the research data lifecycle.

Payal and Tripathi (2019) conducted a selective review of the literature on research data management in academic libraries. The authors emphasised the need for libraries to understand the emerging issues, trends, and challenges related to research data management to provide appropriate services for researchers. They discussed the importance of research data, its preservation, and the role of libraries in extending data management services. The authors highlighted the policies of publishers and funding bodies regarding data sharing and emphasised the role of libraries in supporting researchers in organising, documenting, preserving, and sharing their data. They also mentioned the need for capacity building among library professionals to provide effective research data management services. The paper concluded by advocating for library professionals to update their skills and knowledge to meet the new trends and to sensitise researchers about the importance of data sharing and accessibility.

Read (2019) presented a case study on developing, implementing, and evaluating a clinical research data management (CRDM) workshop offered by an academic library in a medical centre. The 1.5-hour workshop addressed the need for research data management (RDM) training in the clinical research community, focusing on core competencies such as data collection planning, instrument design, data standards utilisation, data quality maintenance, storage, transfer, and analysis best practices, and role management. The workshop received positive feedback, with 99% of attendees stating they would recommend it to others and 98% expressing their intention to apply the learned competencies in their work. The workshop's success led to the establishment of a collaborative training series and policy groups to address researcher challenges in CRDM and data management. This case study highlights the importance of tailored RDM education and the role of libraries in supporting researchers.

The article by Redkina (2019) discusses current trends in research data management (RDM) based on an analysis of policies, guidelines, and requirements set by governments, grantors, and publishers. The author highlights the importance of developing institutional and national RDM services to support effective research data management. The article emphasises the need for researchers to adopt RDM practices throughout the research process, including data acquisition, storage, organisation, and sharing. It also addresses the challenges and barriers to data openness, such as legal and ethical concerns, data misuse, and misinterpretation. The article highlights the growing global recognition of the FAIR principles (Findable, Accessible, Interoperable, and Reusable) for promoting data sharing and exchange. The article underscores the significance of RDM in advancing scientific research and calls for developing RDM training and support services for researchers.

Todorova et al. (2019) surveyed the University of Library Studies and Information Technologies (ULSIT) to assess data literacy and research data management practices among faculty and doctoral students. The study revealed gaps in understanding data management best practices and identified the need for data literacy training. Findings indicated that younger researchers use a wider range of data file types, while those with more experience handle larger volumes of information. The survey also highlighted concerns about copyright policies and rights protection when sharing research data. Recommendations included implementing an institutional data management policy, developing a research data repository, and organising training on data management topics. The study emphasises the importance of enhancing data literacy and research data management skills to ensure data quality, integrity, and reuse.

Steinerová and Ondrišová (2019) conducted a study on research data literacy perception and practices among Slovak researchers. They presented a typology of research data based on qualitative analysis and a concept map. The survey results showed that researchers positively perceived data management but expressed concerns about data misuse and misinterpretation. Most participants were willing to share their data and expressed interest in research data management training. The study highlighted the importance of developing and maintaining research data infrastructures in the information environment. The authors suggested implications for LIS education, including data analysis, visualisation courses, and establishing research data infrastructures.

The article "Expanding the research data management service portfolio at Bielefeld University according to the three-pillar principle towards data FAIRness" by Schirrwagen et al. (2019) discusses the expansion of research data management (RDM) services at Bielefeld University, focusing on data quality and reproducibility. The authors highlight the university's three-pillar approach, including policies, technical infrastructure, and support structures. They provide guidelines on research data handling and offer tools and services for data management planning, publication, and legal aspects. The Conquaire project addresses data quality with a Data Irreproducibility Analyzer (DIRA) and supports reproducible research. Reproducibility experiments were conducted to understand research workflows and identify issues. Bielefeld University plans to establish a Competence Center for Research Data Management to meet the growing demand for RDM. The authors emphasise the university's commitment to promoting openness and good research practices through RDM initiatives.

Tang and Hu (2019) conducted an international survey to explore the state of library research data management (RDM) services. The survey involved over 240 librarians who outlined their roles, preparedness, challenges, and training needs in providing RDM services. The findings revealed differences in RDM services and tools among locations and organisational types, influenced by the level of preparedness and RDM role development. Respondents recognised the importance of RDM and expressed a desire for more training, emphasising the need for institutional commitment to resources and training opportunities. The study advocates for nurturing and training data librarians as an emergent profession. It also highlights the importance of developing a global community of practice for data librarians to collaborate, exchange information, and advance RDM practices worldwide. The study underscores the evolving role of librarians in supporting researchers' RDM needs, promoting collaboration across campus, and integrating RDM into the research data lifecycle. Participants also highlighted the need to enhance data access, discovery, and integration into existing library systems, while acknowledging the impact of emerging technologies like artificial intelligence on RDM services.

Wiljes and Cimiano (2019) discuss their experience teaching a full semester course on research data management for students. They emphasise the importance of including research data management in academic education to develop sound skills in managing research data. The course follows a competency-based approach, using interactive exercises and practical applications tailored to students' disciplinary backgrounds. The curriculum covers essential

topics such as good scientific practice, data backup and archiving, organising data, sharing and publishing data, finding and reusing data, and open science. The authors evaluate the course through a survey among participants and find positive feedback, with students recognising the usefulness of the course and expressing interest in more advanced offerings. They conclude that research data management should be integrated into academic education as early as possible, and they encourage interdisciplinary collaboration to develop shared curricula and teaching materials.

Avuglah and Underwood (2019) conducted a study to assess the research data management (RDM) capabilities at the University of Ghana (UG). The study focused on four key elements: policy framework, technological infrastructure, skills and knowledge, and support services. Data was gathered through interviews and document analysis, and the CARDIO Matrix tool informed the assessment. The results showed that RDM at UG is currently underdeveloped but has growth potential. The university needs a formal RDM policy, and capabilities were found to be limited, uncoordinated, and not officially instituted. The study recommends the development of a comprehensive policy framework for RDM, capacity building for research support staff, and including data management planning in research practices. It also suggests establishing a working group to champion RDM and the need for curriculum development and proactive initiatives by academic and research libraries. The findings have implications for RDM development at UG and other institutions in Ghana and Africa, highlighting the importance of policy, capacity building, and specialised support services.

Frederick (2019) explores the evolving role of academic libraries in research data management (RDM) within Ghanaian university libraries. The paper provides a comprehensive overview of libraries, research data, RDM, and its constraints. As information communication technology and disruptive technologies continue to reshape higher education, libraries are adapting to support scholars in producing, storing, and disseminating digital data. The challenge lies in preserving this data for future generations as it is not typically stored in libraries. The paper highlights the importance of RDM for reliable verification of research results and outlines strategies for the effective adoption of RDM in tertiary institutions. Academic libraries play essential roles as data quality hubs, offering researchers RDM services, information support, and training.

Marlina and Purwandari (2019) conducted a systematic literature review to develop a strategy for research data management (RDM) services in Indonesia. The study identified strengths such as high research activities, national support, and the need for long-term data preservation. Weaknesses included a lack of skills, research data policies, infrastructure support, and incentives. Opportunities for RDM services were related to cultural changes in data sharing and technological advancements. Threats included data privacy, data security, and publisher policies. The proposed strategies involved implementing national policies, improving research data awareness, building e-research support, developing standards and privacy tools, offering online training, and advocating for research data publication. Experts in research management validated these strategies.

Goben and Griffin (2019) analysed research data management needs assessments in libraries. They identified 37 case studies in the United States and categorised them based on institution types and target populations assessed. Most studies focused on public, doctoral, and highest-research institutions, with faculty members being the most frequently assessed respondents. The studies primarily addressed data storage, sharing, and long-term access. Gaps were identified, including the need to assess the needs of students, staff, and non-faculty researchers and the lack of research on RDM needs in non-STEM disciplines. The authors recommended future research to target these gaps and promote consistent research instruments and data sharing to advance the field of research data management.

Wiley and Burnette (2019) conducted a study to assess the data management support needs of bioengineering and biomedical research faculty, focusing on researchers involved in National Institutes of Health (NIH) funded projects. The study aimed to explore the researchers' knowledge, attitudes, and practices regarding data management. Interviews with 16 researchers covered research projects, data types, data management plans, file storage, data sharing, and awareness of campus support services. The findings revealed that researchers had varying levels of awareness and adoption of best practices for data management. Challenges identified included dealing with legacy data, file organisation, and making data open and accessible. The study highlighted the need for instruction in data management strategies, file organisation, metadata standards, and data deposit options. It also emphasised the importance of understanding researchers' perspectives and challenges to develop effective library services for data management support.

Wilms et al. (2020) studied the factors influencing researchers' decision-making in research data management (RDM). The study extended the social exchange theory with elements from prospect theory to provide psychological insights into researchers' decision-making and evaluated the role of cost-benefit evaluations under uncertainty. A homogeneous group of German Information Systems researchers was presented with the data management policies of a principal funding agency. The results showed that many researchers see a high value in RDM but are still held back by uncertainty. Perceived fear of losing control over one's data emerged as a significant hindering factor, while the fear of losing one's unique value did not prevail. The study used a structural equation model based on partial least squares (PLS) to validate the research model. The sample consisted of 111 participants, of which 96 had good data points and did not indicate any significant influences from cultural factors such as age, gender, or job position. The results supported the hypothesis that perceived switching costs, status quo bias, perceived switching benefits, and reputation positively or negatively affect the perceived value of RDM, positively affecting the intention to comply with RDM guidelines. Fear of losing control and losing one's unique value was also found to negatively affect the purpose of complying with RDM guidelines and to negatively moderate the effect of the perceived value of RDM on the intention to comply.

Nwabugwu and Godwin (2020) highlight the importance of research data management (RDM) services in academic libraries in Nigeria. It outlines the various components of RDM services, including data management planning, digital curation, and metadata creation and conversion. The paper also identifies key skills and tools required for RDM services, including DMPonline, Data Asset framework, CARDIO, and Curation cost exchange. The paper highlights the challenges faced by academic libraries in providing RDM services, including lack of financial and human resources, technology obsolescence, and inadequate guidelines on best practices. The authors call on academic libraries to prioritise RDM services as they are essential in improving the institution's visibility, impacting its research activities, and aligning library services with the university research mission. The authors recommend partnering with international organisations like DataCite and Research Data Alliance to provide professional RDM services.

Bunkar and Bhatt's (2020) study investigated the perceptions and attitudes of researchers and faculty members of Parul University, Vadodara, India, towards research data management and sharing. The study aimed to identify the level of awareness and attitudes towards research data

sharing and the RDM system, how researchers preserve their data for long-term use, and examine the attitudes of researchers and faculty members towards sharing their research data. A web-based survey questionnaire was used to collect data from 88 out of 100 randomly selected research scholars and faculty members from various departments of Parul University. The study results showed that most respondents were aware of and agreed with research data sharing and free accessibility of research data. Researchers and faculty members were interested in the library's involvement in organising and preserving research data. The study concluded that there is a need for continued efforts to spread awareness about open access and for libraries to offer RDM services to their users.

The study titled "Academic library's leadership and stakeholder involvement in research data services" by Kim (2020) explores the leadership role of academic libraries in research data services and how collaboration with stakeholders can impact the maturity of the services offered. The study involves a secondary analysis of existing survey data collected by Cox, Kennan, and Lyon, which was undertaken to address the question of how academic libraries supported the management of research data in their institutions and how they planned to develop services in the future. The survey received 209 valid responses from directors of academic libraries in Australia, Canada, Germany, Ireland, Netherlands, New Zealand, the United Kingdom, and the United States. The survey was divided into advisory and technical services, each with several functional activities. The survey questions were used to analyse the library's role, internal stakeholders' involvement, external partner involvement, and the maturity of the research data services. The study found that libraries offer more mature services when they take the primary responsibility for developing them, and the involvement of internal stakeholders and external partners leads to more mature services. The data were analysed using SPSS software and descriptive analysis, and a non-parametric Mann-Whitney U test was used to test possible differences among the groups in the sample. The study provides evidence that libraries play a crucial role in the leadership of research data services, and collaboration with stakeholders and external partners can significantly impact the maturity of the services provided by the libraries.

The study "Data management and use through research practice partnerships: A literature review" (He et al., 2020) reviewed 86 articles published from 2013 to 2019 that explored research-practice partnerships (RPPs) in the field of education, with a focus on data management and use. The authors aimed to identify key strategies used by RPPs to support

data management and use and to engage in two-way problem-solving collaborations between researchers and practitioners. The authors found that data management and use engagement in RPPs involved an iterative process of data exploration, co-design, implementation, dissemination, and use. The review also revealed key strategies used by RPP stakeholders to address challenges in data management and use, including time management, cultural considerations, and mutual appropriation. The authors concluded by highlighting the need for more research on the equity of data management and use in RPPs and a deeper understanding of the inner workings of RPPs. The review has some limitations, such as geographical limitation (only focusing on RPPs in the United States), only including published studies, and search biases inherent in the review process.

Tupan and Kamaludin (2020) conducted a study on the publication of research data management in open-access journal analysis based on Scopus data. The study aimed to determine the number of open-access resources for research data management publications, top authors and institutions, and the most researched topics. The results showed that the number of open-access research data management publications has increased since 2014, with the highest number occurring in 2019 (49 publications). The top journal was the Data Science Journal (11 publications). The most productive authors were Cox, A.M. and Pinfield, S. The largest contributing institutions were the University of Toronto and New York University, with the United States and China being the top contributing countries. The most open-access research data management was in the form of articles (107 publications), and the top funding sponsors were the Deutsche Forschungsgemeinschaft and the National Science Foundation. The most researched topics were big data, research data management, information management, data management, medical research, software, information processing, and metadata.

Mozgova et al. (2020) present a research data management system for a large collaborative project, specifically the Collaborative Research Centre 1153 "Process chain for the production of hybrid high-performance components through tailored forming." The authors address several key questions about implementing research data management (RDM) in large collaborative projects, including creating awareness and a culture of data management, establishing requirements for data types, implementing RDM tools, developing a domain-specific vocabulary, and deriving new research questions from existing data. The authors propose an RDM infrastructure consisting of a Research Data Management System and a Knowledge Management System linked semantically through a tailored forming-specific

vocabulary. The authors use a combination of online surveys, workshops, and interviews to gather information and evaluate the proposed RDM system. The authors conclude that their approach ensures the quality of data management while reducing time and resource expenditure and improving the understanding and transparency of data and processes across the project.

Chawinga and Zinn (2020) conducted a study on research data management (RDM) status at a medical school in a developing African country. The study focused on four aspects of RDM: generation, preservation and backup, competencies, and challenges. Data was collected through a questionnaire administered to 84 health researchers and 16 librarians, as well as structured interviews with the Director of Research of the university. The study found that the current RDM status allows academic libraries to participate in research data management. The study argues that adopting RDM policies is essential to promote the popularisation and operationalisation of RDM activities within African universities. The study was motivated by the fact that African countries lag in RDM efforts compared to developed countries and aimed to inform the research community about best practices and interventions for improved storage, preservation, access, and reuse of research data. The study was conducted using a mixed methods design, with data collected from researchers, librarians, and the Director of Research.

Lefebvre et al. (2020) studied research data management planning (RDMP) practices in academia. The study aimed to shed light on the current challenges and practices of RDMP by exploring the process from both the perspective of funders and research data services. The study followed a case study approach, collecting data through ten semi-structured interviews with representatives of funding agencies and data management services in the Netherlands and one interview with the European Commission. The 98 data management sections were analysed in research proposals submitted to the Dutch National Science Foundation. The study concluded that RDMP faces many challenges, and evaluating its effectiveness in generating reusable data is complex. The study also identified recurring points of improvement and proposed actionable criteria to ensure proper addressing of data reusability in RDMP.

Adika and Kwanya (2020) focus on the research data management (RDM) skills required by lecturers and the levels of RDM literacy among lecturers at Strathmore University in Nairobi, Kenya. The study aims to identify the gaps in RDM skills among the lecturers and suggest ways to strengthen the RDM capacity at the university. The research design adopted was a case study, and a mixed methods approach was used to collect and analyse the data. The data was

collected through questionnaires and focus group discussions and was analysed using SPSS and thematic analysis, respectively. The study's findings indicate varying levels of RDM literacy among the lecturers at Strathmore University, with a good understanding of the need for RDM skills but gaps in areas such as sharing research data on open access journals, data legislation, and securing research data. The study has practical implications as it can be used to attract attention to RDM and to develop institutional policies on RDM. The study's results are limited because it was conducted in only one university in Kenya, but the findings are contextualised in the global landscape.

The authors, Töwe and Barillari, present an approach to Research Data Management (RDM) support for researchers at ETH Zurich in their publication "Who Does What? – Research Data Management at ETH Zurich" (2020). The ETH approach is based on three phases along the research data life-cycle: Data Management Planning, Active RDM, and Data Publication and Preservation. Two ETH units provide the services, the Scientific IT Services and the ETH Library, focusing on openBIS for quantitative scientific disciplines. The authors discuss the strengths and weaknesses of the current set-up and the challenges it faces, including the cost of storage and the evolving needs for RDM. The authors also mention the national collaboration between Higher Education Institutions in Switzerland, including openRDM.swiss and DLCM2, and SIS's recent proposal to expand RDM services to the European level.

The study by Choi and Lee (2020) aims to investigate the current status of research data management among government-funded science and technology research institutes in Korea. The authors surveyed 301 researchers from 23 institutes, covering research data creation, management, utilisation, and sharing. The survey results indicate that various types of research data are being created in nearly three-quarters of R&D projects. Still, they are mostly stored and managed at the personal or laboratory level, with only a small portion being openly shared. The survey also shows that most researchers have data management policies or guidelines. Still, data management is seen as an additional task, and institutional support for sharing and reusing data is lacking. The researchers reported that regulations, security concerns, and lack of incentives are the main barriers to data sharing, and they demanded incentives for data management and sharing activities, technological support for data management, procurement of research data quality, and awareness raising for open science. In conclusion, the study highlights the need for follow-up policies and infrastructure development to promote the sharing and reuse of research data in Korea. The findings suggest that research data

management is still in its early stages, and there is a gap between the demand for research data and the willingness to share it. To address this gap, the authors call for cultural change towards open science and proper recognition of research data management and sharing activities in the academic community.

The paper by Bishop et al. (2020) presents the development of a data management plan (DMP) scorecard, a tool designed to assess the completeness and quality of DMPs. The scorecard provides a quantitative measure to evaluate how data are planned to be shared and a first step toward shareable data. The scorecard is designed to align with the Digital Curation Exercise presented in the Belmont Forum Data Management Toolkit, presenting 14 criteria in 9 broad areas. The purpose and use of the scorecard are three-fold: as an evaluation tool to quantitatively assess full proposal DMP responses, as a training resource to be shared with potential proposers or with awardees, and as an evaluation tool employed by the Secretariat or thematic program office to access milestones and progress during mid- or end-term project review/valorisation. The scorecard encourages consistent interpretation of criteria and evaluation by providing users with information on how to score their responses for each area, and it contains a detailed rubric for each criterion. The paper highlights that an average score of 1 (all criteria addressed, even if incomplete) is a minimum for a DMP, and those scoring higher than an average of 1 provide more detail and those less than one should be revised as some required elements are likely missing and/or incomplete.

The article discusses the challenges of devising research data management strategies within a university, considering the five Vs for generated research data; Volume, Variety, Velocity, Veracity and Value, and the need for consistent and adequate research data management policies and guidelines. It also highlights the importance of FAIR data principles in embracing open data opportunities and the availability of new ICT options for institutions to make considered choices for their research data management. The Exemplar-driven Research Data Management and Analysis Strategy (ERDMAS) Conceptual Framework is presented, consisting of a bidirectional vertical and horizontal axis that accommodates both the researcher-driven perspective and the institutional, policy-driven perspective. The framework allows for an ongoing system-wide comparative review to occur in parallel, continually informing policy and guidelines refinement and enabling a responsive evolving RDM solution. ERDMAS has been successfully implemented in an institution, resulting in over 38 RSBs developed, representing a diverse range of research data management and analysis problems.

Schröder and Nickel (2020) conducted a study on Research Data Management (RDM) as an integral part of the research process of empirical disciplines, using landscape ecology as an example. The authors aimed to integrate RDM into the research design to complement the classic quality control and assurance in empirical research, which has been limited to data production. The study demonstrates that sharing and reuse of empirical data by scientists, as well as thorough peer reviews of knowledge produced by empirical research, require the documentation and archiving of the problem of the research in question, the operationalised definitions of the objects of investigation and their representative selection, and the methods of data production including indicators for data quality and all data collected and produced. The study also outlines the RDM in the environmental sciences using the example of the Chair of Landscape Ecology at the University of Vechta. The authors recommended developing, systematising, and expanding RDM activities across universities and strengthening the university's RDM culture through public relations measures to motivate and sensitise all stakeholders to RDM-related legal and administrative issues. They also suggested coordinating RDM activities centrally into an institutional structure with the involvement of external partners and using standardised RDM concepts to establish target group-specific training courses to build RDM skills and to draft institutional RDM rules to safeguard the RDM at the university level. The study provides insights into the importance of RDM in empirical research and suggests ways to improve RDM practices in universities.

The purpose of Chiware's (2020) study was to determine the current skills of librarians working in research data management services in academic and research libraries in South Africa, as well as to assess the relevance of courses and programs that are currently being offered by library and information studies programs in response to the needs of research data management services. The study identified 13 institutions as participants in an online survey, and a review of Web pages of existing library and information studies schools was carried out to establish courses that would support research data management services. The findings revealed an environment in a developmental stage, with limited skilled personnel to research data management services, an absence of specific data librarianship courses within existing library and information studies programs and minimal scope for the full range of data management courses within professional development programs. The paper provides information on approaches to develop further existing curricula to contribute to the data management needs

and support governments, funders, and publishers' requirements for the discoverability and re-use of research data across research domains.

Man et al. (2020) examine scientific data management in the era of big data and highlight the need for efficient management and circulation to enhance the value of scientific data resources. They provide a comprehensive review of the international experience in scientific data management, analyse the problems and challenges in China, and suggest future direction and suggestions for developing scientific data management. The authors identify two main problems scientific data management faces: insufficient data mining and reanalysis ability and inconsistent standardisation of scientific data. They suggest solutions such as continuously standardising scientific data resources, strengthening data mining capacity, and enhancing international cooperation to improve the efficiency of the national innovation system. The authors emphasise the importance of data as a strategic resource to support national economic construction and scientific research in the big data environment.

The article "Training Data Stewards in Italy: Reflection on the FAIR RDM Summer School" by Tammaro & Caselli (2020) reflects on the organisation and evaluation of the "Fair Research Data Management" Summer School in Parma, which aimed to bring together participants from different backgrounds and countries to address the skills gap for data stewards in Italy. The article presents the context of research data management (RDM) in Italy, highlighting the need for specialised training for data stewards and librarians, including core competencies such as cataloguing, evaluation and selection of resources, preservation, management of research data, technological skills, management skills, and organisational culture. The article discusses the selection of participants and the approach to training and evaluation, emphasising the importance of hands-on activities and collaborative learning. The article concludes that the Summer School successfully achieved its objectives and suggests further initiatives to enhance RDM skills in Italy.

Bishop et al. (2020) conducted a study to explore current data management training needs and practices for Belmont Forum member agencies and researchers to inform a toolkit. Fourteen Belmont Forum-affiliated individuals were interviewed using the Data Curation Profile (DCP) approach. The DCP approach was created to capture the step-by-step data lifecycle from scientists for digital curation. The interview findings highlight gaps in data management theory and practice knowledge that could impact data reuse. The results of these interviews were used

to populate a Toolkit of data management training and effective practice resources specifically developed to train Belmont Forum grant awardees. The following literature review provides more insight into previous DMP implementation, awareness, and training studies. The study used a qualitative, semi-structured interview approach,, the DCP approach. The sampling frame included any former or current Belmont Forum-affiliated researcher or agency representative. Ultimately, fourteen interviews across multiple projects with five researchers and nine agency representatives from six countries (four continents) occurred.

The paper "Open research data in African academic and research libraries: a literature analysis" by Chiware (2020) provides a literature review on research data management services in African academic and research libraries on the backdrop of advancing open science and open research data infrastructures. The review reports that open science in Africa is still in the developmental stages, with research infrastructures facing funding and technical challenges. Data management services are in the formative stages, with progress reported in a few countries. The paper highlights that the role of academic and research libraries in Africa remains important in higher education and the national research and innovation systems. The future of open research data management, its contribution to scientific and technological advancement on the continent, and the role of academic libraries will evolve slowly. The paper concludes that the African voice needs to be included in the open science discourse, and sound policy frameworks backed by guidelines and incentives for researchers are necessary.

Smits and Teperek (2020) conducted an exploratory study on 16 master's students in the Netherlands to understand their perceptions and attitudes towards research data management. The article presents the findings of the study, in which students were found to be confused about the meaning of data management, with many of them associating it with privacy aspects. The study found that few students had a clear data management plan, with many managing their data ad hoc. The study further reveals that the students had diverse approaches to data management education, with most classes being limited in scope. The students demonstrated awareness of the importance of good data management practices and were willing to learn more. The report provides recommendations for measures that can be taken to improve data management awareness and skills among master's students and highlights the steps taken by Delft University of Technology in this regard. The study is important as it provides insight into the perceptions and practices of master's students in research data management and highlights the need for accurate measures to improve data management awareness and skills among

master's students. The study employed semi-structured interviews to collect data from the participants.

Borda et al. (2020) conducted a scoping review on research data management practices in health and biomedical citizen science. They analysed five online platforms and found diverse approaches to data management but a lack of consistent practices. The platforms varied in data creation, analysis, distribution, retention, and transparency. The study emphasised the need for transparent and accessible research data management models to ensure the quality and reproducibility of citizen science research in the health and biomedical field. The authors called for the participatory development of standards and resources to improve data management in these initiatives.

Joo and Peters (2020) conducted a survey to assess the needs of researchers for data-related assistance and their research data management behaviour at a research university. The study found that researchers perceive a greater need for assistance in quantitative analysis and data visualisation. Health scientists showed the highest need for data-related assistance, while humanities researchers demonstrated the lowest need. The researchers also explored data formats, storage practices, documentation behaviour, and data-sharing intentions. Tabular/spreadsheet formats were widely used, and computers and external storage devices were the most common options. Standard file naming was the preferred method for data documentation. Researchers were willing to share their data personally or as supplementary materials to journal publications. The study highlights the importance of understanding researchers' needs and behaviour to develop user-centred research data services in academic libraries.

Blask and Förster (2020) propose the DIAMANT model, a reference framework for implementing research data management (RDM) infrastructures. The model addresses the lack of a comprehensive framework for the ideal conditions of RDM implementation in research institutions. It emphasises the integration of RDM with the research process itself and advocates for an organisational perspective that synchronises information processes and workflows. The DIAMANT model has three perspectives: functional, organisational, and governance. It outlines the ideal RDM process, identifies relevant organisational units, and defines their relationships. The model aims to optimise the RDM process, enhance research integrity and economy, and facilitate the incorporation of RDM into institutional landscapes.

It encourages the use of existing infrastructures and services and promotes the development of national and international research data infrastructures.

Kumari and Parmar (2021) surveyed to explore the perceptions and practices of research data management (RDM) among scholars in the universities of Gujarat. The study aimed to raise awareness about RDM and its impact on research ease. The survey collected responses from research scholars in 25 universities, focusing on areas that need improvement. The findings indicated that 94.40% of scholars were aware of RDM. Desktop/laptop computers (77.8%) and internet-based storage (44.4%) were commonly used for data storage and backup. Half of the universities had institutional repositories, highlighting the need for infrastructure improvements. The study revealed that 50% of researchers experienced data loss, emphasising the importance of effective strategies and systems. Only 22.2% of scholars used metadata standards for storing research data, suggesting a need for better practices to facilitate preservation, curation, and data sharing.

The study by Hamad et al. (2021) explored research data management (RDM) services in academic libraries in Jordan. The findings revealed a high perception and awareness among library staff regarding their roles and responsibilities in providing RDM services. The requirements for RDM services included the need for data repositories, research data management tools, and resources for data analysis. Budget constraints and staff experience with research data were identified as the main challenges faced by academic libraries. The study emphasised the importance of increasing awareness among library staff, enhancing their technical skills in RDM, and promoting collaboration between libraries and researchers. By addressing these factors, academic libraries in Jordan can effectively support the research community in managing and utilising research data.

The study "Research data management policy and practice in Chinese university libraries" by Huang et al. (2021) aims to explore the status of Research Data Management (RDM) in Chinese universities and how university libraries have been involved in supporting RDM at an institutional level. The study used a mixed-methods approach, including website analysis, a questionnaire for university librarians, and semi-structured interviews to collect data. The findings showed that RDM in Chinese universities and academic libraries is in its infancy, with a lack of local policy and limited activity in developing support services compared to data repositories. The study attributed the low level of RDM development to alternative data-sharing

infrastructures in some disciplines, low professionalisation of librarianship, and weaker cultural resonance of openness. The study offers insights into RDM development and recommends that libraries focus on understanding user needs and promoting advisory services to build an understanding of RDM in the research community.

The study conducted by Dogan et al. (2021) aimed to gather preliminary information for developing Aperta, a national data repository in Turkey. The study found that researchers in Turkey have low levels of awareness and experience in research data management (RDM). While approximately 83% of participants reported using research data, only 9% had prepared data management plans. The most common data types used and produced were experimental, text, survey, and graphical data. Local computers were the primary storage method for research data, with limited use of cloud storage or institutional repositories. The study emphasised the need for incentives, training, and support from institutions like TÜBİTAK to promote RDM practices and enhance data sharing in Turkey.

The article by Mushi (2021) discusses the emergence of research data management (RDM) and services, particularly in academic institutions and research organisations globally. While some developed countries have started offering RDM services, some academic libraries in developing countries are at the stage of planning or implementing the service. The article presents available open resources for different data practitioners, particularly researchers and librarians, to improve RDM knowledge and boost the confidence of academic and research libraries in establishing the service. The available resources include training materials and online courses, DMP tools, and open data repositories for researchers to archive their valuable data freely. The article highlights a case study conducted at the University of Dodoma, Tanzania, revealing a low RDM awareness level among researchers and librarians. The study findings suggest that the available open resources are essential to increase data literacy, which will eventually stimulate data management practices for the sustainable development of societies.

Fadlelmola et al. (2021) emphasise the importance of data management plans (DMPs) in modern biomedical research, as they facilitate data tracking, organisation, and maintenance. Developing effective DMPs is essential for complying with institutional and funder mandates, ensuring transparency and data accessibility, protecting data subjects, and promoting data reuse. The paper also highlights the challenges and recommendations for developing

appropriate DMPs in Africa, including standardised data collection practices, RDM awareness and training, and infrastructure and funding considerations. The review emphasises the value of DMPs in promoting best practices for data management in research projects.

The study by Masinde et al. (2021) examined the experiences of research librarians in managing research data at the University of Nairobi (UON) Library. The study found inadequacies in skills and training capabilities, technological infrastructure, collaborative partnerships and policy guidelines at the UON Library, limiting the managing, sharing, and reusing of research data. Based on these findings, the study recommended the development of an RDM unit at the UON Library to oversee the implementation of RDM activities. The investigation employed a thematic analysis of qualitative data underpinned by the DCC Curation Lifecycle Model and the Community Capability Model Framework. The study targeted senior research librarians at the UON Library and employed purposive sampling to select 7 participants. The study employed a semi-structured interview method to collect qualitative data. The UON Library was selected due to its high research standing, an annual research kitty of 45 million USD, and being the largest student population in Kenya.

The article by Al-Jaradat (2021) investigates the state of research data management (RDM) in public university libraries in Jordan. The study reveals that although Jordanian public university libraries are providing some RDM services, the country lacks national and international RDM policies and effective implementation, hindering the progress and growth of RDM in university libraries. Moreover, there is a wider gap between the required and available skills among library staff in RDM practices, which can be filled by conducting suitable training programs and workshops continuously. The study is useful in initiating new policies for RDM practices in Jordan and other similar countries. Furthermore, it can help other libraries develop strategies for RDM, improve data reuse and sharing, and reduce the financial burden of research projects. The study's limitations include insufficient research on RDM policies and practices in Jordanian universities. Future studies can explore existing policies and loopholes in RDM implementation and focus on the role of funding agencies in curating and managing data.

The study conducted by Abdullahi and Noorhidawati (2021) aimed to identify the attributes that influence data-sharing practices among academics in Nigerian universities. The research focused on organisational culture theory, investigating how individual decisions are influenced

by institutional involvement. A survey questionnaire was used to collect data from Three hundred seventy-eight academics in Nigeria, and a partial least square analysis was employed for evaluation. The findings revealed that organisational, personal, and social attributes significantly influenced data-sharing practices. Organisational attributes such as structure, infrastructure, data repositories, research funders, journal publishers, and policy/guidelines had a positive impact. Personal attributes such as effort expectancy, legitimate concerns, beneficence, conditions for data sharing, and expected rewards showed both positive and negative effects. Social attributes like community culture and discipline norms also played a role in data-sharing practices. The study contributes to understanding data-sharing behaviour and provides insights for academics, journal publishers, and research funders. Recommendations include encouraging data citation practices, designing policies for controlled data access, and addressing ethical and disciplinary issues related to co-authorship.

Schöpfel and Azeroual's critical analysis of the challenges surrounding rewarding and incentivising good research data management practices in the context of open science is insightful. They highlight the importance of open data and data sharing in enhancing the quality and effectiveness of data collection and analysis quality and effectiveness. The authors identify the need for a precise definition of the target behaviour to incentivise good RDM practices and acknowledge that different categories of researchers face varying challenges. While rewarding and incentivising good RDM practices is important, technological, institutional, and financial challenges facing open science need greater attention. The authors advocate for institutions to develop their data management systems and implement open standards to improve interoperability and data sharing, which can lead to cost savings and increased efficiency. This analysis is relevant to stakeholders in the research community and provides practical insights into improving RDM practices in the context of open science.

Ashiq, Saleem, and Asim (2021) surveyed to investigate the perception of library and information science (LIS) professionals in Pakistan about research data management services (RDMS) in university libraries. The study filled the gap in the literature regarding the implementation of RDMS in developing countries like continuously Pakistan. The authors identified the RDMS training needs, motivational factors, possible hindrances, and key reasons to support RDMS among LIS professionals. The study highlights the need for donor agencies and university administrations to take the initiative to provide sufficient training opportunities for LIS professionals. The study also suggests the need for country-level quantitative and

qualitative studies to understand better the challenges and required skills to support RDMS in developing countries. The study provides practical implications for donor agencies, university administrations, professional library associations, LIS schools, and employees' parent organisations to better observe and implement RDMS in developing countries.

The study by Biernacka et al. (2021) focuses on developing a Train-the-Trainer program for research data management (RDM). The program aims to address the lack of education and training in RDM by equipping potential trainers with the necessary knowledge and didactic skills. The program was developed using the ADDIE model, starting with analysing existing training materials and then designing the content and methods for the workshops. The program incorporates various teaching and engagement methods, including activation exercises, worksheets, flip and turn activities, statement slam, keyword strips, and schema-X. These methods facilitate knowledge acquisition, processing, application, replication, and transfer. The program has been tested in pilot workshops and has proven effective in training RDM multipliers. The materials and concepts are freely available for reuse under a CC-BY license, and plans are underway to revise and expand the program for broader implementation.

The paper by Castelli et al. (2021) discusses the development of a Data Management Plan (DMP) for the BIG-MAP project, focusing on battery-material discoveries. The DMP is an operational tool for data interaction among project work packages, and guides open data sharing. The authors emphasise the importance of consistent data management and the benefits of open access to research data for accelerating scientific research. They describe the challenges faced in managing the large amount of data generated and highlight the need for data to be FAIR (findable, accessible, interoperable, reusable). The collaborative process of developing the DMP promotes awareness and ownership among project members, and the authors propose the DMP as a template for other initiatives in the battery research community.

Wang et al. (2021) discuss strategies for university scientific research data management in the era of big data. They emphasise the need to effectively manage the increasing volume of digital research materials and the importance of Research Data Management (RDM) and Research Data Services (RDS) for research institutions. The article suggests conducting thorough research in the early stage of data platform construction, focusing on dynamic data management throughout its life cycle, strengthening data collection and processing, ensuring storage and safety management, and enhancing the value of research data through publication and citation.

The authors emphasise the significance of formulating data management policies and the continuous effort required for sharing and managing scientific research data in universities.

In a study conducted by Lau et al. (2021), data auditing was found to be effective in reinforcing good research data management (RDM) practices in a medical school in Singapore. The researchers conducted surveys with research principal investigators (PIs) and researchers and tracked data deposition rates in the school's data repository. The results showed that data auditing positively impacted self-reported RDM awareness, compliance, and reception for both PIs and researchers. It did not significantly affect data deposition rates over time. The findings supported the effectiveness of data auditing in promoting good RDM practices, and the researchers recommended its adoption as a tool to reinforce research integrity and improve RDM in research institutions worldwide.

The study by Yidavalapati et al. (2021) focused on research data management (RDM) and related services in South Asian academic libraries. The research utilised a quantitative approach and a survey research design, distributing a questionnaire to library professionals in Afghanistan, Bangladesh, India, Pakistan, and Sri Lanka. The sample population consisted of 67 library professionals from various institutes in these countries. The findings revealed that 83.6% of institute libraries provided RDM services, and the study recommended supporting staff attendance at conferences and workshops on RDM, participation in MOOCs for related courses, conducting in-house staff workshops, and addressing compliance with funder requirements and preservation as major issues. The study highlighted the importance of skill development in data description, documentation, curation, metadata, visualisation, and technical and ICT skills. The respondents expressed the need for support from institutes or funding organisations to enhance staff skills through conferences, workshops, courses, and collaborations with academic programs. The study also identified various challenges in RDM, including compliance, infrastructure, limited awareness, legal issues, and budget constraints. The conclusion emphasised the significance of training, skill development, and addressing managerial issues to improve RDM services in South Asian academic libraries.

Arora and Chakravarty (2021) conducted a study on the Re3data platform to examine global research data management (RDM) practices. The findings revealed that life sciences and natural sciences had more organised RDM activities than humanities, social sciences, and engineering. Scientific and statistical data formats were used most, and multidisciplinary

keywords were prevalent. Dublin Core emerged as the widely used metadata standard. While 56% of repositories supported quality management, there was a lack of information in 44% of cases. English was the dominant language, and software usage varied. The study recommended bridging the gap between disciplines, focusing on RDM in developing countries, formulating national policies, raising awareness, and establishing repositories. The study shed light on RDM practices and emphasised the significance of effective data management and preservation.

Borkakoti and Singh (2021) conducted a study to explore the perception of library professionals regarding research data management (RDM) in central universities and institutes of national importance in North East India. The study investigated various aspects of RDM, including stakeholders, awareness of the National Data Sharing and Accessibility Policy (NDSAP), formulation of institutional RDM policies, training needs for library professionals, motivations, and challenges. The findings revealed that researchers approach the library for research data, and most professionals intend to facilitate RDM. The top priority for library professionals in RDM is the opportunity to learn new skills. The study highlighted the necessity of upskilling library staff as the most challenging task. The professionals recognised research support offices and IT departments as key stakeholders for RDM. Additionally, the study emphasised the importance of setting mandates by research funding agencies for data sharing and outlined measures to encourage data sharing among researchers. The benefits of providing RDM were ranked, with learning new skills being the most preferred. Challenges identified included upskilling library staff, inadequate funding and staff, misconceptions among researchers, and coordination of stakeholders. The study suggests initiating RDM, formulating institutional policies, enhancing skills through training, and incorporating RDM into library science curricula. The findings contribute to the evolving perception of library professionals and can guide the implementation of RDM services in academic institutions.

Borycz (2021) explores the implementation of data management workflows through integrated library consultancy. Research data management (RDM) is crucial for reproducible and open scientific research, but universities often lack comprehensive data assistance. Integrating information specialists like librarians into research groups can enhance data management by providing personalised workflows. Workflows should include file organisation, data management roles, data storage/sharing guidelines, and training. Librarians are well-suited to assist in creating and evaluating these workflows due to their interaction with faculty and

knowledge of data management tools. The study emphasises the importance of personal interaction in implementing workflows and highlights the potential benefits of librarians in improving research efficiency. By developing data management workflows with library support, barriers to data utilisation can be reduced, leading to increased publication rates, reproducibility, and citation rates.

Andrikopoulou et al. (2022) conducted a literature review to explore the impact of Research Data Management (RDM) initiatives on academic libraries' and librarians' image and identity. The study suggests that involvement in RDM practices can reshape the role and identity of libraries within universities and contribute to their continued relevance. It emphasises the need to develop librarians' skills and competencies in RDM and discusses the dynamics of collaboration and competition in RDM. The article concludes with an agenda for future research, highlighting areas such as skill sets and competencies needed for RDM, the professional identity of research data managers, interactions with other professional groups, and the impact of RDM on library policies and technologies. The study recognises RDM as a transformative force for libraries and librarians, impacting their identity and image.

Bishop et al. (2022) conducted a qualitative study to explore the roles and perspectives of data services librarians on research data management (RDM) services in higher education. The study interviewed 10 data services librarians from the top 10 public and private universities in the US News and World Report 2020 ranking. The study aimed to provide insight into the job tasks of librarians, the structure of RDM services, the implementation and evaluation of data management plans (DMPs), the offered research data management training, and the education, training, and experience of data services librarians. The study found that the typical job tasks of data services librarians include locating secondary data, reviewing data management plans, conducting outreach, collaborating, and offering RDM training. The study also proposed a matrix of job tasks that indicates different types of data services librarians to inform further study.

The survey conducted by Arndt et al. (2022) among researchers in the Helmholtz Association provided insights into research data management and data publication practices. The results showed that while most respondents generated their research data, the application of FAIR principles was low. Data storage predominantly occurred on internal servers, limiting accessibility. Data documentation was primarily done digitally, but structured documentation

and the use of international standards were limited. Data collection challenges included a lack of resources, technical solutions, and incentives. Many respondents had not published data, citing obstacles such as time constraints and legal/ethical concerns. Motivations for data publication focused on reusability and good scientific practice. The survey identified a need for support and training in research data management tools and metadata enrichment. The findings will guide the Helmholtz Metadata Collaboration in addressing gaps and developing targeted support for researchers implementing FAIR data practices.

Adacta is a research data management (RDM) system designed by Gossler et al. (2022) to address the need for traceability between samples, devices, and data in the catalysis community. It goes beyond traditional RDM systems by storing data and creating a traceable digital twin of the testing environment, ensuring a time-accurate record of critical components measuring catalyst performance. The software aims to integrate with electronic laboratory notebooks and facilitate direct simulations using the stored data. It specifically caters to the challenges faced in catalysis research, such as complex data structures and the need for reproducibility. While existing tools for catalysis RDM exist, they lack integration and a focus on digital twin creation and traceability. Adacta fills this gap by applying FAIR principles and best practices, preserving the rich data structures associated with catalysis research and development. The software is being developed as a commercial product applicable to academic and industrial environments, with ongoing advancements in transformations, linking with other resource media, simulation coupling, and data security.

Birkbeck et al. (2022) conducted a literature analysis to identify the challenges in researcher research data management (RDM) practices that hinder the sharing and reusing of research data. The authors found four thematic areas that emerged from the analysis: alignment of research management and data management, resourcing, researcher openness, and research data governance. They observed that researchers often lack the necessary support and knowledge to manage research data, leading to limited data sharing effectively. The study highlights the need for further investigation, practical tools, decision aids, and training to address the unmet needs in RDM practices. The authors emphasise the importance of user-centred RDM training courses and the role of the Information Systems community in supporting researchers to implement good RDM practices. The study reveals researchers' complex challenges in managing and sharing research data, underscoring the need for improved RDM practices and support.

The article by Chew et al. (2022) focuses on the development and evaluation of an online research data management (RDM) training module at the University of New South Wales (UNSW), Australia. The study addressed low engagement in RDM practices among researchers and Higher Degree Research (HDR) candidates at UNSW. The online training module was designed to improve RDM knowledge and practices among newly enrolled HDR candidates. The evaluation of the training module involved surveys and focus group sessions with the participants. The findings indicated that most of the candidates were satisfied with the quality of the training and found it helpful. The module improved candidates' understanding of RDM and their ability to classify research data. The study highlights the importance of investing in RDM training and emphasises the need for collaboration among institutional stakeholders to promote RDM best practices.

Kanza and Knight (2022). "Behind every great research project is great data management." The article emphasises the importance of research data management (RDM) for successful research. It discusses key areas such as data organisation, storage, data management plans, data publication, reproducibility, and data ethics (Kanza & Knight, 2022). The authors highlight the need for early planning, sensible organisation, version control, suitable storage strategies, adherence to standards, ethical considerations, and effective communication in collaborative projects. They provide ten tips for effective data management, including starting early, creating a data management plan, focusing on organisation, implementing version control, considering storage and standards, addressing ethics, allocating resources, future-proofing data, and promoting communication. By following these guidelines, researchers can enhance the quality, accessibility, and reproducibility of their data, contributing to the advancement of scientific knowledge.

Mthembu and Ocholla (2022). "Development strategies as catalysts for provision of the RDM services in the South African higher education institutions." The study examines the strategies for research data management (RDM) at the University of Zululand in South Africa. Using the Community Capability Maturity Model Framework (CCMF) and the Digital Curation Centre (DCC) lifecycle model, the researchers conducted qualitative interviews with librarians, technicians, heads of departments, and the deputy vice chancellor of research. The findings indicate that the university needs an RDM policy, infrastructure, and investment to support RDM services. There are also limited capacity-building programs specifically addressing

RDM. The study highlights the need for RDM policies, adequate resources, and training to manage research data in higher education institutions effectively. The results contribute to developing RDM strategies and policies in South African universities.

Xu et al. (2022). "Effect of online research data management instruction on social science graduate students' RDM skills." This study examines the impact of a four-hour online research data management (RDM) instruction intervention on social science graduate students' RDM knowledge and skills. The intervention was designed based on the research data life cycle and covered data management plans, sharing, and metadata. A total of 84 students participated, with 40 students receiving the online instruction and 44 in the control group. The results indicate that students who received the online RDM instruction had significantly higher RDM knowledge scores than the control group. Additionally, the effectiveness of the instruction varied across disciplinary focuses. The study highlights the importance of discipline-specific RDM instruction and suggests the need for tailored training for different disciplines.

According to Machimbidza et al. (2022), the feasibility of Research Data Management (RDM) services at the Zimbabwe School of Mines (ZSM) is limited. The study revealed that ZSM lacks the necessary technological infrastructure, legal environment, and librarian skills for effective RDM implementation. Insufficient technology hampers data creation, storage, access, and analysis, while the absence of policies and standards inhibits addressing intellectual property, copyright, ethics, and data protection. Although ZSM librarians possess basic IT skills, they lack the specific knowledge required for RDM. The study emphasises the need for significant investment in technology, policy development, and librarian training to establish successful RDM services at ZSM. Feasibility studies are crucial before implementing RDM in higher education institutions, considering the challenges African institutions face regarding infrastructure and resources.

According to Herres-Pawlis et al. (2022), research data management (RDM) practices in the chemical sciences need improvement. While funders require RDM to ensure sustainable data deposition, many laboratories still rely on paper notebooks and store data in proprietary or non-machine-readable formats. The authors argue that data should no longer be treated as mere supplements to research papers but should have their standards and be openly shared. Electronic lab notebooks (ELNs) and laboratory information management systems (LIMS) are proposed as tools for better data management and integration with research and publication

processes. The authors call for establishing minimum information (MI) standards to support structured data reporting and emphasise the importance of RDM education in curricular teaching. They highlight the role of organisations like the International Union of Pure and Applied Chemistry (IUPAC) in developing standards and promoting cultural change in RDM practices. The authors stress the need for stakeholder collaboration to ensure the findability, accessibility, interoperability, and reusability (FAIR) of chemical research data.

Mozgova et al. (2022) present a concept for implementing a Research Data Management System (RDMS) according to the FAIR data principles for large collaborative projects. The article describes an RDMS for the organisation of documentation and measurement requests in researching and developing oxygen-free production technologies. The RDMS integrates a Knowledge Management System (KMS) based on Semantic MediaWiki (SMW) and a Data Management System (DMS) based on CKAN software. The authors discuss the importance of efficient research data management in collaborative projects and provide examples from various disciplines such as mechanical engineering and production technology (CRC1194), microgels research (CRC 985), and magnetic materials development (CRC/TRR 270). The concept of a joint RDMS combines SMW and CKAN, enabling semantic annotation and facilitating mutual access to the KMS and DMS. The proposed RDMS concept can be generalised and applied to other research domains, promoting a universal approach to research data management.

Beer et al. (2022) present the Leibniz Data Manager (LDM), a research data management repository that utilises Semantic Web technologies to enable FAIR principles. The LDM supports researchers in documenting, analysing, and sharing research datasets by leveraging existing vocabularies such as DCAT and DataCite. It integrates heterogeneous datasets and metadata from various repositories, and data services implemented as Jupyter Notebooks allow for on-the-fly analyses. The LDM facilitates the entire research data management lifecycle, including planning, collecting, processing, analysing, publishing, preserving, and reusing data. It extends the CKAN open data repository system and is available as a Docker container. The demonstration showcases dataset creation and management, metadata exploration, dataset analysis using various data formats, and integration with external repositories. The LDM emphasises the importance of machine-readable metadata and Semantic Web technologies in enabling efficient research data management.

Santharooban (2022) conducted a case study on the research support service model at Eastern University, Sri Lanka (EUSL). The study analysed documents and students' feedback to understand the implementation and impact of the service. The research support service at EUSL focuses on training undergraduates and providing individual research consultations. The service was highly appreciated by students and commended by the University Grants Commission. Challenges in implementing the service include the conventional mindset of librarians, lack of skills and resources, and insufficient marketing. Despite these challenges, the service has increased the recognition of the library and its professionals, leading to their involvement in institutional research committees. The study emphasises the importance of academic libraries in supporting the research process and suggests expanding service models to adapt to new requirements.

Marlina et al. (2022) developed a research data management (RDM) readiness model specific to the Indonesian context. The model comprises four categories: technology, organisation, environment, and people. Factors such as hardware, software, security, policy, management support, strategy, structure, culture, knowledge, skill, situation awareness, training, and external pressures were identified. The fuzzy Delphi method validated the factors and indicators through expert consensus. The model includes 13 factors with 32 indicators, emphasising the importance of technological resources, organisational support, individual competencies, and compliance with government regulations and funder policies. The proposed model serves as a tool for research institutions in Indonesia to assess their readiness for RDM implementation, identify areas for improvement, and reduce failures in RDM practices.

Chen et al. (2022) investigated the research data practices of graduate students in Civil and Environmental Engineering (CEE). They interviewed CEE graduate students from Carnegie Mellon University and the University of Colorado Boulder and identified several themes. The study found that graduate students often manage research data as faculty delegate this responsibility to them. The emerging themes included concerns about data quality, a gap between values and practices, the importance of disseminating data for reproducibility, and reliance on peer and self-directed learning. The study recommended strategies for librarians and campus services to support better CEE graduate students' data practices, including resources for data evaluation, tools for data management, promoting reproducibility, and facilitating communication and learning opportunities.

"Mavodza (2022) conducted a review of Research Data Management (RDM) efforts in UAE public university libraries. The findings suggest that RDM activities are emerging, but awareness of their importance varies. The paper emphasizes the need for organizing tangible RDM efforts to facilitate data retrieval and availability relevant to the region. The author raises questions about the leadership role of academic libraries, the existence of an enabling environment, and possible reasons for delays in RDM activities. The study concludes by highlighting the importance of policy frameworks, data protection legislation, user training, and professional development for librarians. The paper provides insights into the progress, challenges, and potential for further development in RDM practices in UAE academic libraries."

Zotoo et al. (2022) conducted a study on research data management (RDM) in China, focusing on the role of librarians in bringing about a paradigm shift. Despite the release of an RDM policy in 2018, RDM practices in China remain underdeveloped. The study aimed to investigate the relationship among critical stakeholders in RDM, particularly from the perspective of librarians, to accelerate the RDM agenda. Structural Equation Modeling (SEM) was employed to analyse stakeholder relationships. The findings revealed significant positive relationships among different stakeholders, with institutions mediating the positive effect of librarians on researchers' work. The impact of the government on librarians was not significant, possibly due to poor attitudes toward librarians. The study suggests librarians should take a leadership role in RDM and be involved in decision-making processes to drive positive change. This research contributes to understanding the role of librarians in RDM and strengthening the relationships among stakeholders.

Senft et al. (2022) conducted an online survey among different user groups in agricultural sciences in Germany to assess research data management (RDM) practices and needs. The study revealed challenges and deficits in handling research data, hindering access and efficient reuse. The diverse agricultural research data landscape, including various data types and disciplines, poses challenges for developing a common RDM approach. The survey indicated a lack of awareness and practice of RDM, with only a small proportion of data providers making their data publicly available. The study suggests potential solutions, such as enhancing data publications, facilitating data reuse, ensuring data quality, and developing supportive services. These findings provide a basis for developing RDM, infrastructures, and services to

foster a cultural change in handling research data in agricultural sciences in Germany and beyond.

Rantasaari (2022) conducted a study on the effectiveness of multi-stakeholder research data management (RDM) training in improving research quality, integrity, reliability, and reproducibility. The study focused on the Basics of Research Data Management (BRDM) course between 2019 and 2021. The course aimed to enhance RDM competencies among doctoral students and postdoc researchers in STEM and HSS disciplines. The study analysed self-ratings of competencies and participant feedback using quantitative and qualitative methods. The results showed that participants' competencies improved after the course, with an average increase of one point on a four-level scale. Participants reported changes in their research practices, including improved data management, documentation, and awareness of legal and data privacy issues. The study identified further learning needs, such as metadata and description, discipline-specific cultures, and backup and storage. The BRDM course met the criteria for successful training, including active participation, demand for RDM training, increased knowledge and understanding of RDM, and positive post-training feedback.

Chen (2022) conducted a study on the practice of cloud computing-based data services for university scientific research management. The article analyses the current state of SR data management in universities, revealing lower adoption rates in domestic institutions than in Europe and the United States. It explores the impact of cloud computing on SR data management, indicating its potential to reduce costs, improve efficiency, enhance data storage and security, and offer flexibility. The research emphasises the significance of high-quality SR data management services in ensuring data security and supporting the smooth progress of SR projects. Chen's work highlights the importance of applying cloud computing in university SR data management to address the evolving needs and challenges of SR activities.

Wiley (2022) conducted a case study examining the research data management practices of aerospace, industrial, and mechanical science engineering faculty at the University of Illinois Urbana-Champaign (UIUC). The study explored the alignment of data management planning with researchers' workflows, challenges, and awareness of research data services through semi-structured interviews and qualitative analysis. The aim was to understand faculty data management practices better and improve the research data services provided to them. The results highlighted the faculty's diverse research areas and funding agencies, data organisation

methods, and perspectives on data reuse and sharing. The study also assessed their awareness of campus research data services and institutional repositories. The findings inform the development of research data management services and highlight opportunities to enhance collaboration with engineering faculty at UIUC.

Xu (2022) conducted a scoping review on research data management (RDM) practices in academic libraries. The study aimed to examine RDM best practices and empirical studies, focusing on the characteristics of the studies, RDM practices, RDM target audiences, and RDM instruction. The review included various studies and employed a systematic coding scheme to analyse the data. The findings revealed that RDM training predominantly targeted librarians, followed by faculty, graduate, and undergraduate students. Data sharing and data curation were the most commonly studied RDM aspects, while workshops were the most prevalent format for RDM instruction. The review also highlighted the positive effects of RDM instruction, with most studies reporting beneficial outcomes. The lack of quantitative studies assessing the effects of RDM interventions was identified as a gap. The study contributes to understanding the practice and impact of RDM training in academic libraries. It suggests future research directions, including exploring online and blended learning formats in response to the COVID-19 pandemic.

The study by M'kulama et al. (2022) examined the readiness of the University of Zambia (UNZA) to participate in research data management (RDM) services. Findings revealed a lack of awareness and knowledge about RDM among senior officers and inadequate skills among library staff. UNZA has a robust information and communication technology infrastructure. The study emphasised the need for awareness campaigns, skills training for library staff, and the development of a research data management policy. The findings suggest that UNZA is partially ready to practice open science, but improvements are necessary to promote RDM and enhance open science practices at the university.

The study by Maurya and Subaveerapandiyan (2022) investigated the research data preservation practices of Library and Information Science (LIS) faculties in Asian universities. The survey-based study collected responses from 125 university faculties across various Asian countries. The findings revealed that statistical data and textual files were the most commonly generated types of research data. Microsoft Excel was the preferred data analysis tool. Laptops/PCs and hard drives were the main storage devices used, while cloud-based solutions

and flash drives were also utilised. Security measures included password restrictions and encryption. Faculty members expressed the need for data discovery, preservation, sharing, and visualisation services from academic institute libraries. The study concluded that LIS faculties possessed adequate skills and knowledge in data curation and preservation but expected more support from their academic libraries.

Oo et al. (2022) conducted a systematic review to identify successful features of research data management (RDM) training features. They found that RDM is a complex area that challenges institutions in upskilling individuals and promoting best practices. The review analysed 28 articles and identified three key themes. The first theme highlighted the importance of a user-centric design process, including conducting needs analyses, tailoring the training to different audiences, contextualising the content, piloting the training, and continuously refining it based on feedback. The second theme emphasised the practical aspects of training, such as including real-life examples and learning-by-doing activities. The third theme highlighted the collaborative approach to training design and delivery, involving internal and external stakeholders. Successful RDM training was measured by active participation, increased knowledge and confidence, demand for training, and positive post-training feedback. The review provides valuable insights for institutions and academic developers to design effective RDM training programs.

Bishop et al. (2022) conducted a qualitative study to examine the roles and perspectives of data services librarians in research data management (RDM) services in higher education. The study involved interviews with 10 data services librarians from top-ranked public and private universities in the US. The findings revealed the diverse job tasks performed by data services librarians, including locating secondary data, reviewing data management plans (DMPs), conducting outreach, collaborating with researchers, and offering RDM training. Fewer librarians were involved in data curation or managing institutional repositories. The study highlighted the need for further delineation of job titles and responsibilities in the emerging field of RDM. The authors proposed a matrix of job tasks to differentiate different types of data services librarians and inform future research and training efforts. The study emphasised the growing importance of research data skills for librarians and the need for specialised roles to meet the evolving demands of RDM.

In their study, Lefebvre and Spruit (2023) introduce laboratory forensics as an investigative approach to research data management in the context of Open Science. They analyse the quality of the information in digital evidence underlying published results and propose laboratory analytics capabilities as the basis for effective research data management. The authors identify disparities in data management practices within research units and emphasise the need for capabilities such as linked research data, traceable resources, ontology-based management, and an open data value strategy. They highlight the importance of clear links between experimental outputs, traceability in scientific workflows, and using ontologies to reduce ambiguity. The study's practical implications include providing guidance to research professionals and promoting open science readiness for robust digitalisation of laboratory work. Laboratory forensics and open science readiness offer potential solutions to improve data quality and reproducibility in research.

Fu et al. (2023). "Developing research data management services in a regional comprehensive university: The case of Central Washington University." This study explores the needs of researchers in a regional comprehensive university for research data management (RDM) services and proposes a phased three-year implementation plan for the university libraries. A survey was conducted to collect data from researchers at Central Washington University (CWU). The findings indicate that the needs of researchers in a regional comprehensive university differ from those in research-intensive universities. Researchers at CWU expressed a desire for libraries to offer managed data services, and the study suggests implementing RDM services based on the specific needs identified. The study highlights the importance of assessing and evaluating researchers' needs before developing RDM programs in regional comprehensive universities. This research provides insights and guidance for other institutions planning to establish RDM services.

Chen et al. (2023) study examine the development and adoption of Dataverse, a global research data management consortium. Findings indicate that while membership has increased in the past five years, the growth and reuse of data collections at member institutions' portals remain limited. Most members have fewer than 100 data sets, suggesting that research data management is still in its early stages. Only a few portals have experienced significant usage and collection growth. Additionally, the study identifies characteristics of highly ranked universities among the members and highlights the presence of research data management services offered by university libraries. The findings emphasise the need for further research

on data discovery, metadata implementation, and research data management policies to promote effective data sharing and support services in academic libraries.

Salazar et al. (2023) present a perspective article on the potential connections between open science and the digital economy. They introduce the concept of research data management plans (RDMs) as a vital element in data-driven research projects, emphasising their role in bridging the gap between open science and the digital economy. The authors highlight the importance of implementing RDMs in publicly funded projects to facilitate the exploitation of research outcomes and balance the interests of data producers, consumers, and the economy. They discuss the principles of open science, such as open access and open data, and European regulations related to data and the digital economy. The article also explores the benefits of RDMs, including professional, economic, and institutional advantages. The authors surveyed the NFDI4Cat community to evaluate the acceptance and feasibility of their RDMP model, considering factors such as data classification, retention periods, and reward strategies. The article emphasises the need for seamless integration of open science and the digital economy, with RDMs playing a crucial role in achieving this harmonisation.

Donner (2023) conducted a systematic literature review to explore the organisational factors involved in implementing a research data management system (RDMS) in higher education institutes (HEI). The study used Leavitt's classical model of organisational change to understand the requirements and interactions of organisational factors, such as task, structure, technology, and people. The findings highlighted the impact of organisational structure, infrastructure, labour culture, and strategic considerations on RDMS implementation. Key factors identified included the development of an RDM strategy, sustainable financial support, collaboration between institutional units, policy development, support services, legal considerations, and the role of libraries. The study emphasised the complexity and interrelation of these factors, providing insights for HEI management and libraries in implementing effective RDMS.

Lehmann et al. (2023) propose an architectural approach integrating intelligent digital twins and FAIR data management principles to establish reliable research data management. The paper introduces a centralised infrastructure for managing large amounts of heterogeneous research data acquired from scientific devices. Digital twins enable reconfigurability, real-time data transmission, and bidirectional communication, enhancing data management efficiency.

The authors present a proof of concept using a photometer as a demo implementation. The approach addresses challenges in data replication, representation, interoperability, and access authorisations. It provides a novel, sustainable, open research data management solution in equipment-intense research institutes.

Llebot and Castillo (2023) conducted a content analysis of institutional research data policies in "very high research activity" institutions in the United States to assess their support for the FAIR principles (Findable, Accessible, Interoperable, and Reusable). They evaluated 40 policies based on 31 criteria and found that while the policies generally support good data management practices, they are not explicitly used to implement the FAIR principles. Only one policy mentioned FAIR, and data sharing was often mentioned in the context of funder requirements rather than as a principle. The authors suggest modifying policies to encourage researchers to follow the FAIR principles and emphasise the importance of institutional support in implementing FAIR practices. They also highlight the need for future research on policy implementation and the distribution of responsibilities between researchers and institutions.

Martin-Melon et al. (2023) examined research data services (RDS) in Spanish academic libraries. Of 48 public universities, only 9 (18.75%) offered RDS, while 11 (22.9%) did not provide any. Advising on data management was available in 58% of libraries, with preservation and data management plans being the most common areas. About 75% of libraries offered guides on RDS, covering topics like data preservation, open research data, and legal aspects. 67% recommended using institutional repositories for data preservation. Training courses on data management were conducted by 23% of libraries, mainly for teaching and research staff. Only five universities (10.42%) had a data management plan, and 16 (33.33%) had open research data policies. The study suggests further exploration to understand users' needs and enhance RDS implementation.

Pham et al. (2023) compared data management plans (DMPs) for 21 funded projects using automated analysis and manual evaluation. The automated analysis revealed that elements related to data availability (90%), metadata (86%), and data sharing (81%) were reliably provided. Manual analysis showed that 86% of DMPs were adequate, with strong discussions on data management personnel, data sharing, and limitations to data sharing. The automated analysis produced less granular but similar results to manual evaluation, suggesting its efficiency. The study emphasises the importance of machine-actionable DMPs for open

science, facilitating data discovery and reuse. It also identifies areas needing improvement, such as data size, retention, and long-term data management personnel information. Recommendations include standardised metrics and evaluations involving data experts.

Zhou et al. (2023) conducted a mixed methods study to assess research data management (RDM) needs among social science graduate students. Findings revealed low confidence in RDM and limited awareness of on-campus RDM services, data repositories, and data sharing practices. Training needs identified include data documentation, organisation, analysis with open-access software, and data preservation. Tailored RDM training for social science graduate students is crucial to equip them with essential skills for successful research in the evolving data-driven landscape.

Sheikh et al. (2023) conducted a qualitative literature review to explore the evolution and conceptual framework of research data management (RDM) in academic libraries. The study highlights the pivotal role of libraries and librarians in providing RDM services and identifies the challenges they face. RDM has become a crucial aspect of research due to the increasing use of digital data, but its implementation varies between developed and developing countries. Libraries play a key role in supporting RDM, but it requires investment in new positions and training for librarians. Challenges include institutional commitment, collaboration, infrastructure, lack of policies, funding, and necessary skills for librarians to offer RDM services. The study emphasises the importance of up-skilling librarians to meet the evolving demands of RDM.

The article by Rod et al. (2023) presents a case study of reshaping research data management (RDM) services at McGill University in Canada. The initiative involves collaboration between multiple stakeholders, including the Vice-Principal Research and Innovation, Library, IT Services, and Research Ethics units. The authors emphasise the need for a collaborative approach to support RDM, given the growing importance of data management in academic research. Academic libraries have often taken on the role of providing RDM services, but this model seeks to centralise and coordinate efforts across different campus units. The study utilises Jira's service desk software for user management and presents descriptive statistics on engagement with the new RDM unit and services offered. The authors highlight the importance of continual assessment and benchmarking to align services with researchers' evolving needs and funder requirements. They also suggest opportunities for collaboration with other

institutions exploring similar service models. The COVID-19 pandemic has accelerated the shift towards virtual research practices, leading to a need for rethinking RDM service provision to address emerging challenges.

Rahaman (2023) discusses the NIH's new Data Management and Sharing (DMS) Policy to promote open data and scientific data sharing in biomedical research. The policy requires data management plans for all NIH-funded research, increasing transparency and reproducibility. Librarians in health sciences support researchers in data management, dissemination, and compliance with data-sharing requirements. Open data allows the free use and redistribution of data, enhancing research integrity and collaboration. The article emphasises the librarian's role in supporting researchers through workshops, educational support, and identifying suitable data repositories. As the research data landscape evolves, librarians play a crucial role in facilitating open data practices and staying informed about shifting policies and practices.

Chaput and Walsh (2023) share their experience as data management librarians collaborating on a federal grant proposal for PFAS remediation. They highlight the conflicts and inequalities between staff and faculty collaborators, including time availability and salary expectations. The librarians describe their role in the grant writing process, supporting data management needs for interdisciplinary research teams. They propose recommendations for achieving parity between faculty and staff collaborators, emphasising the importance of knowing one's worth, skills, and limitations. Additionally, they suggest having early conversations about work scope and compensation to avoid potential issues later on. The grant was not funded, but the librarians received positive feedback and recommended including a full-time position for data management in future grant submissions.

The study by Dorcas et al. (2023) examines research data management (RDM) practices in academic libraries from a social science perspective in Africa. The research identifies gaps in the literature and explores the role of data librarians, current practices, and training requirements for effective RDM services. It highlights the need for improved data literacy, collaboration, and adoption of digital technologies to address the changing information needs of library users. The study emphasises the significance of RDM services in academic libraries to enhance knowledge sharing, Open Science initiatives, and best practices in developing countries. Recommendations include training data librarians, fostering partnerships, and aligning with international institutions to stay relevant in the digital era.

Klingner et al. (2023) surveyed as part of the NFDI-Neuro initiative in Germany to assess research data management (RDM) practices and data sharing in neuroscience. The survey involved 218 participants from various neuroscience disciplines and professional positions. Results showed that while data sharing within institutions was common (79%), only 45% shared data publicly through repositories. The main challenges identified included the lack of data and metadata standards, provenance tracking methods, secure infrastructure for sensitive data, RDM literacy, and resources. Despite the obstacles, most respondents (91%) expressed willingness to share data and enhance their RDM skills. The survey highlights the need for training, infrastructure, tools, and resources to promote transparent and reproducible research practices in neuroscience.

The study conducted by Bhoi et al. (2023) examines the current state of research data management (RDM) practices in India's top-ranked higher education institutions (HEIs). The research investigates various aspects of RDM, including RDM services, policy implementation, responsible stakeholders, funding support, and obstacles to adoption. Unlike most existing literature, the study views RDM capacity as an institutional concern rather than just a library concern. Data was collected through a survey and website analysis, focusing on India's top 50 NIRF-ranked institutes. The study found that RDM is still in its early stage in these institutions, with limited implementation of RDM policies and services. The findings highlight the need for greater coordination and collaboration among stakeholders to enhance RDM practices in Indian HEIs.

Pratt et al. (2023) present the McMaster University Research Data Management (RDM) Institutional Strategy for 2023-2025. The strategy emphasises the importance of research data as the evidentiary basis for scholarly activities and aims to promote research excellence, integrity, transparency, and reproducibility. The authors define Research Data Management as a suite of practices applied throughout the research lifecycle, supporting analysis, research, creative works, and dissemination. The strategy involves broad engagement and consultation with the research community at McMaster, aiming to provide a researcher-focused framework with guidelines, infrastructure, policies, training, and services. Key goals include developing governance and policies, expanding RDM services and training, promoting data ethics and sensitive data management, facilitating data deposit and sharing, enhancing data

documentation and access, and ensuring data security. The strategy aligns with institutional priorities and aims to foster a culture of good RDM practices and data stewardship.

Nahotko et al. (2023) conducted a big data-driven investigation into the maturity of library research data services (RDS). The study aimed to assess the nationwide level of library RDS maturity using the RDS maturity model proposed by Cox et al. (2019) and employing natural language processing (NLP) tools for big data analysis. Web scraping based on 72 keywords allowed the authors to select 38 (2021) and 42 (2022) academic libraries running RDS. The content of these libraries' websites was analysed to identify the geographical distribution of RDS, the scope of research data activities (compliance, stewardship, and transformation), and the potential for future enhancements. The study demonstrated the potential of unstructured library data for quantitative scientific research, highlighting the value of big data tools in assessing RDS maturity. Although the study focused on libraries in Poland, its methodology can be used in other countries for comparison purposes.

Williamson (2023) describes the establishment of the National Center for Data Services (NCDS) as a centralised hub for research data services in health sciences libraries. Funded by the National Library of Medicine (NLM), NCDS offers training, resources, and learning pathways to support librarians in providing data services. The focus is on developing data science skills and meeting new data requirements from funders and publishers. NCDS promotes equity, diversity, and accessibility and collaborates with NNLM's regional medical libraries and national offices. The hub provides a comprehensive toolkit for librarians and researchers to comply with NIH's data management and sharing policy. Early engagement has been positive, with high participation rates and demand for offerings.

Barrett (2023) discusses strategies and initiatives from the RDAP Summit 2022 that can be integrated into Research Data Services (RDS) programs to promote diversity, equity, inclusion, and accessibility (DEIA). RDS teams can incorporate DEIA components into data training by providing practical experiences for graduate students and utilising collaborative working groups. Data visualisation should also consider DEIA implications to ensure inclusive communication of research findings. Additionally, addressing DEIA in grant research through tools like DataPro can preemptively address potential issues and promote ethical practices. RDS teams are crucial in identifying and rectifying DEIA risks to make data research processes more inclusive and equitable.

Xu et al. (2023) investigated the impact of synchronous online instruction on graduate students' research data management (RDM) skills using two different approaches: teacher-centred instruction via lecture and student-centred instruction with active learning activities. Both experimental groups receiving online RDM instruction scored higher than the control group without instruction. The study showed that interactive teaching with active engagement resulted in higher learning outcomes than teacher-centred instruction. The findings suggest that simply transferring a lecture-based approach to online teaching is insufficient for optimal student engagement and learning. Interactive online instructional strategies, like collective note-taking and Google Jamboard activities, were found effective for engaging learners and enhancing student learning outcomes.

Hackett and Kim (2023) explore conceptual models for research data services (RDS) in academic libraries. They review various models proposed in the literature, each aiming to guide and evaluate the development and implementation of RDS. The models encompass different aspects of RDS, such as influencing factors, capabilities, service categories, and maturity levels. The authors highlight the importance of conceptual models as tools for strategic planning, benchmarking, and communication with library administration. While RDS implementation varies among institutions, the models provide a common language for researchers and practitioners to discuss and assess RDS offerings. The paper emphasizes the evolving nature of RDS and the need for continued empirical research to refine and adapt these conceptual models based on changing roles and stakeholders in RDS provisioning.

Cooper et al. (2023) present a case study on implementing the Active Research Data Management Element using the Idea platform at Western Sydney University. The platform manages research data from collection to archiving, providing secure cloud storage and automating metadata creation and storage. Metadata schema, based on RIF-CS format, ensures discoverability and reusability of research data. The study emphasizes the importance of standardized metadata for efficient research data management and recommends the adoption of automated systems to streamline data capture and reduce manual administrative tasks.

Mosha and Ngulube (2023) conducted a study on teaching research data management (RDM) courses in Tanzanian higher learning institutions (HLIs). They used survey questionnaires and in-depth interviews to gather data from postgraduate students and key informants. Findings

revealed a low level of RDM literacy among respondents, with a majority expressing the need for HLIs to start teaching RDM courses. Key informants highlighted the importance of competency-based, adaptive, and constructive teaching techniques and online tutorials for teaching RDM. The study concludes that RDM courses are essential for students, researchers, and the community, promoting data sharing, collaboration, and data citations. The authors recommend integrating RDM courses into HLIs' curriculums and providing capacity building for staff teaching RDM.

Javed (2023) conducted a qualitative study on the challenges and requirements of heterogeneous research data management in environmental sciences. The research identified issues with the current data storage approach and highlighted the need for an effective system. Interviews revealed challenges like data inconsistencies and scattered storage. The requirements for a solution included automation, open access, centralised storage, online lab notes, systematic data management, secure repositories, reduced hardware storage, and metadata support. The findings contribute to research data management knowledge and offer practical insights to improve data handling, integrity, and collaboration. The study suggests developing comprehensive data management solutions tailored to specific research needs. Hions in sample size and limitations context were acknowledged, calling for future research with larger and diverse samples to generalise findings.

The study by Si et al. (2023) investigates the current development of scientific data management policies in China. The researchers collected 209 policies from various sources and analyzed them using a three-dimensional framework based on policy tools, stakeholders, and lifecycle theories. The findings reveal four stages of policy development: infancy, preliminary exploration, comprehensive promotion, and key implementation. The policies utilize three types of policy tools: supply-side, environmental-side, and demand-side, involving multiple stakeholders throughout the data lifecycle. There is an imbalance in the application of policy tools to different stages and stakeholders. The study suggests strategies to optimize the policy system, emphasizing the need for balanced policy tools, stakeholder participation, and comprehensive supervision. This comprehensive analysis provides insights and implications for improving China's scientific data management policy system.

Lorenz et al. (2023) present the Cat4KIT project, which aims to develop a cross-institutional data catalog and Research Data Management (RDM) framework to make environmental

research data Findable, Accessible, Interoperable, and Reusable (FAIR). While data accompanying scientific articles are often published in large repositories, day-to-day or actively-used data from research projects is exchanged through simple cloud storage services and email, limiting its openness and accessibility. The Cat4KIT framework consists of four modules/services: providing access to data on storage systems through standardised interfaces, harvesting and transforming metadata into standardized formats, making metadata publicly accessible through well-defined catalog services, and enabling users to search, filter, and explore data from decentralised research data infrastructures. The project collaborates with scientists, software developers, and potential end-users, incorporating a wide range of research data. Existing open-source solutions and community standards, such as THREDDS, STA, S3, and Spatio-Temporal Assets Catalog (STAC), are applied to ensure easy integration and extension to other research data infrastructures. The presentation showcases the current status of Cat4KIT as an interinstitutional platform for the FAIRification of day-to-day research data in the environmental sciences.

Azami et al. (2023) conducted a systematic literature review to identify dimensions and practices of research data management (RDM). They categorised RDM into four dimensions: data, researchers, organisations, and technology. Key practices include data processing, protection, legal issues, and sharing. Researchers' dimension involves education and motivation, while organisations focus on human resources and policy-making. Establishing software and hardware infrastructures is crucial in the technology dimension. The study highlights the importance of coordinated efforts among stakeholders for successful RDM implementation.

Asafu-Adjaye and White (2023) conducted a mixed-methods study to explore research support provided by academic librarians to faculty members at the University of Ghana. They found that research support activities by librarians are available and deemed relevant to faculty members. Technological advancements in academic libraries are not fully utilised, with the Online Public Access Catalogue (OPAC) being the most used service and selective dissemination of information (SDI) being the least used. Librarians have not extensively used social media for communication, but faculty members have shown interest in it. The study recommends regularly updating librarian knowledge on research support tools and services to better assist faculty in their research endeavours.

Rod (2023) conducted an empirical study investigating the perspectives of data-related librarians on skills and training in Canadian academic libraries. Twelve semi-structured interviews revealed four major skill themes: experience conducting original research, proficiency in coding and quantitative methods, MLIS-related skills like metadata understanding, and adaptability to learn new skills quickly on the job. While some participants supported the MLIS, others felt it needed more data-specific courses for data-related librarian positions. The study highlights the importance of research, technical expertise, and adaptability in data-related librarian roles and suggests potential areas for improvement in MLIS programs.

The paper "Consolidating Research Data Management Infrastructure: Towards Sustainable Digital Scholarship" by Gooch and Strange (2023) addresses the challenge of sustaining digital research outputs, particularly in the Humanities. It emphasises the importance of proper data management planning to ensure long-term accessibility and usability. The growth of digital humanities projects has led to concerns over data loss and obsolescence. The University of Oxford's approach involves transitioning to Software as a Service (SaaS) solutions to improve sustainability and reduce costs. The Sustainable Digital Scholarship service (SDS) offers researchers a standardised platform for data storage and management platform, promoting collaboration and discoverability. The paper advocates preserving digital legacies for future generat by prioritising shared infrastructures and open dataions.

The research paper "Research data management services in academic libraries: a comparative study of South Asia and Southeast Asia" by Sinha et al. (2023) investigates the current state of research data management (RDM) services in academic libraries in South Asian and Southeast Asian countries. The study uses a survey method with purposive sampling to collect data on the types of RDM services offered, required RDM skills, and challenges library professionals face. The findings reveal that while data repository, data management training, and maintaining web resources are standard RDM services, advisory services on data analysis and supporting reproducibility are given less attention. The study emphasises the need for more competent and dedicated staff for effective RDM services. It also highlights the importance of awareness and infrastructure to overcome challenges in implementing RDM services in these regions.

Amanullah and Abrizah's 2023 study explored research data management (RDM) services in Malaysian academic libraries and the librarians' roles in implementing them. The research involved website analysis, an online survey, and librarian interviews. Findings revealed that

Malaysian academic libraries primarily offer RDM services related to bibliographic management tools, institutional repositories, and research data openness. More advanced services like data analysis and citation are less common. Despite librarians' awareness of RDM and their roles, full implementation of RDM services is still lacking. The study recommends collaboration among academic libraries to improve RDM practices and better support researchers.

Conclusion

This lengthy article provides a comprehensive and detailed analysis of research data management practices in academic libraries, shedding light on the critical role they play in supporting data-driven research. By drawing insights from a diverse range of global studies, it identifies challenges and offers strategic recommendations to bolster RDM services and facilitate open science principles in academic research.

References

Abdullahi, K. A., & Noorhidawati, A. (2021). Attributes that influence academics' data sharing in Nigeria: The effects of organization culture. *Information Research-An International Electronic Journal*, *26*(3). https://doi.org/10.47989/irpaper908

Adika, F. O., & Kwanya, T. (2020). Research data management literacy amongst lecturers at Strathmore University, Kenya. *Library Management*, *41*(6/7), 447–466. https://doi.org/10.1108/LM-03-2020-0043

Ahmad, Y., Burns, R., Kazhdan, M., Meneveau, C., Szalay, A., & Terzis, A. (2011). Scientific data management at the Johns Hopkins institute for data intensive engineering and science. *ACM SIGMOD Record*, *39*(3), 18–23. https://doi.org/10.1145/1942776.1942782

Akmon Manager of Education and Outreach, Dharma. (2014). NSF datanet partners update. *Bulletin of the Association for Information Science and Technology*, *40*(6), 22–25. https://doi.org/10.1002/bult.2014.1720400608

Al-Jaradat, O. M. (2021). Research data management (RDM) in Jordanian public university libraries: Present status, challenges and future perspectives. *The Journal of Academic Librarianship*, *47*(5), 102378. https://doi.org/10.1016/j.acalib.2021.102378

Amanullah, S. W., & Abrizah, A. (2023). The landscape of research data management services in Malaysian academic libraries: Librarians' practices and roles. *The Electronic Library*, *41*(1), 63–86. https://doi.org/10.1108/EL-06-2022-0135

Andrikopoulou, A., Rowley, J., & Walton, G. (2022). Research Data Management (RDM) and the Evolving Identity of Academic Libraries and Librarians: A Literature Review. *New Review of Academic Librarianship*, *28*(4), 349–365. https://doi.org/10.1080/13614533.2021.1964549

Aoki, T., Kajita, S., Motoki, T., Iyemori, T., & Kawaguchi, T. (2019). Promoting Common Understanding on Research Data Management using Rubric. *2019 8th International Congress on Advanced Applied Informatics (IIAI-AAI)*, 387–390. https://doi.org/10.1109/IIAI-AAI.2019.00085

Arias-Coello, A., Simon-Blas, C., Arranz-Val, P., & Simon-Martin, J. (2018). Research Data Management in Three Spanish Universities. In S. Kurbanoğlu, J. Boustany, S. Špiranec, E. Grassian, D. Mizrachi, & L. Roy (Eds.), *Information Literacy in the Workplace* (pp. 195–204). Springer International Publishing. https://doi.org/10.1007/978-3-319-74334-9_21

Arndt, W., Gerlich, S. C., Hofmann, V., Kubin, M., Kulla, L., Lemster, C., Mannix, O., Rink, K., Nolden, M., Schweikert, J., Shankar, S., Söding, E., Steinmeier, L., & Süß, W. (2022). *A survey on research data management practices among researchers in the Helmholtz Association* (p. 39) [Report]. HMC-Office, GEOMAR Helmholtz Centre for Ocean Research. https://doi.org/10.3289/HMC_publ_05

Arora, S., & Chakravarty, R. (2021). Preserving Global Research Data: Role and Status of Re3data in RDM. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/5550

Asafu-Adjaye, M. A., & White, E. (2023). Exploring Research Support by Academic Librarians to Faculty Members. *Practical Academic Librarianship: The International Journal of the SLA Academic Division*, *13*(1), Article 1. https://pal-ojs-tamu.tdl.org/pal/article/view/7163

Ashiq, M., Saleem, Q. U. A., & Asim, M. (2021). The Perception of Library and Information Science (LIS) Professionals about Research Data Management Services in University Libraries of Pakistan. *Libri*, *71*(3), 239–249. https://doi.org/10.1515/libri-2020-0098

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

Awre, C., Baxter, J., Clifford, B., Colclough, J., Cox, A., Dods, N., Drummond, P., Fox, Y., Gill, M., Gregory, K., Gurney, A., Harland, J., Khokhar, M., Lowe, D., O'Beirne, R., Proudfoot, R., Schwamm, H., Smith, A., Verbaan, E., … Zawadzki, M. (2015). Research Data Management as a "wicked problem". *Library Review*, *64*(4/5), 356–371. https://doi.org/10.1108/LR-04-2015-0043

Azami, M., Sadatmoosavi, A., & Chashmyazdan, M. (2023). Research Data Management Frameworks: A Systematic Literature Review. *International Journal of Information Science and Management (IJISM)*, *21*(3), 1–18. https://doi.org/10.22034/ijism.2023.1977759.0

Ball, A. J. (2014, September 17). *Research Data Management: RENU Autumn Workshop: Open Access & Data Curation for Universities*. RENU Autumn Workshop: Open Access & Data Curation for Universities, Oxford, UK United Kingdom.

Baolong, Y., Hong, W., & Haodong, Z. (2018). Research and application of data management based on Data Management Maturity Model (DMM). *Proceedings of the 2018 10th International Conference on Machine Learning and Computing*, 157–160. https://doi.org/10.1145/3195106.3195177

Barrett, C. H. (2023). Inclusion in Data: Incorporating DEIA Components into Research Data Services Practices. *Journal of EScience Librarianship*, *12*(1), Article 1. https://doi.org/10.7191/jeslib.627

Beer, A., Brunet, M., Srivastava, V., & Vidal, M.-E. (2022). Leibniz Data Manager – A Research Data Management System. In P. Groth, A. Rula, J. Schneider, I. Tiddi, E. Simperl, P. Alexopoulos, R. Hoekstra, M. Alam, A. Dimou, & M. Tamper (Eds.), *The Semantic Web: ESWC 2022 Satellite Events* (pp. 73–77). Springer International Publishing. https://doi.org/10.1007/978-3-031-11609-4_14

Bellgard, M. I. (2020). ERDMAS: An exemplar-driven institutional research data management and analysis strategy. *International Journal of Information Management*, *50*, 337–340. https://doi.org/10.1016/j.ijinfomgt.2019.08.009

Bhoi, N. K., Patel, J., & Dutta, B. (2023). State of Research Data Management Practices in the Top-ranked Higher Education Institutions in India. *International Information & Library Review*, *0*(0), 1–19. https://doi.org/10.1080/10572317.2023.2167051

Biernacka, K., Helbig, K., & Buchholz, P. (2021). Adaptable Methods for Training in Research Data Management. *Data Science Journal*, *20*(1), Article 1. https://doi.org/10.5334/dsj-2021-014

Birkbeck, G., Nagle, T., & Sammon, D. (2022). Challenges in research data management practices: A literature analysis. *Journal of Decision Systems*, *31*(sup1), 153–167. https://doi.org/10.1080/12460125.2022.2074653

Bishop, B., Gunderman, H., Davis, R., Lee, T., Howard, R., Samors, R., Murphy, F., & Ungvari, J. (2020). Data Curation Profiling to Assess Data Management Training Needs and Practices to Inform a Toolkit. *Data Science Journal*, *19*(1), Article 1. https://doi.org/10.5334/dsj-2020-004

Bishop, B. W., Orehek, A. M., Eaker, C., & Smith, P. L. (2022). Data Services Librarians' Responsibilities and Perspectives on Research Data Management. *Journal of eScience Librarianship*, *11*(1), Article 1. https://doi.org/10.7191/jeslib.2022.1226

Bishop, B. W., Ungvari, J., Gunderman, H., & Moulaison-Sandy, H. (2020). Data management plan scorecard. *Proceedings of the Association for Information Science and Technology*, *57*(1), e325. https://doi.org/10.1002/pra2.325

Blask, K., & Förster, A. (2020). Designing an information architecture for data management technologies: Introducing the DIAMANT model. *Journal of Librarianship and Information Science*, *52*(2), 592–600. https://doi.org/10.1177/0961000619841419

Borda, A., Gray, K., & Fu, Y. (2020). Research data management in health and biomedical citizen science: Practices and prospects. *JAMIA Open*, *3*(1), 113–125. https://doi.org/10.1093/jamiaopen/ooz052

Borgman, C. L. (2012). The conundrum of sharing research data. *Journal of the American Society for Information Science and Technology*, *63*(6), 1059–1078. https://doi.org/10.1002/asi.22634

Borkakoti, R., & Singh, S. (2021). Research Data Management in Central Universities and Institutes of National Importance: A Perspective from North East India. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/5848

Borycz, J. (2021). Implementing Data Management Workflows in Research Groups Through Integrated Library Consultancy. *Data Science Journal*, *20*, 9–9. https://doi.org/10.5334/dsj-2021-009

Brochu, L., & Burns, J. (2019). Librarians and Research Data Management–A Literature Review: Commentary from a Senior Professional and a New Professional Librarian. *New Review of Academic Librarianship*, *25*(1), 49–58. https://doi.org/10.1080/13614533.2018.1501715

Brown, R. A., Wolski, M., & Richardson, J. (2015). Developing new skills for research support librarians. *The Australian Library Journal*, *64*(3), 224–234. https://doi.org/10.1080/00049670.2015.1041215

Brown, S., Alvey, E., Danilova, E., Morgan, H., & Thomas, A. (2018). Evolution of Research Support Services at an Academic Library: Specialist Knowledge Linked by Core Infrastructure. *New Review of Academic Librarianship*, *24*(3–4), 337–348. https://doi.org/10.1080/13614533.2018.1473259

Bugaje, M., & Chowdhury, G. (2018). Identifying Design Requirements of a User-Centered Research Data Management System. In M. Dobreva, A. Hinze, & M. Žumer (Eds.), *Maturity and Innovation in Digital Libraries* (pp. 335–347). Springer International Publishing. https://doi.org/10.1007/978-3-030-04257-8_35

Bunkar, A. R., & Bhatt, D. D. (2020). Perception of Researchers & Academicians of Parul University towards Research Data Management System & Role of Library: A Study. *DESIDOC Journal of Library & Information Technology*, *40*(03), 139–146.

Burgi, P.-Y., Blumer, E., & Makhlouf-Shabou, B. (2017). Research data management in Switzerland: National efforts to guarantee the sustainability of research outputs. *IFLA Journal*, *43*(1), 5–21. https://doi.org/10.1177/0340035216678238

Castelli, I. E., Arismendi-Arrieta, D. J., Bhowmik, A., Cekic-Laskovic, I., Clark, S., Dominko, R., Flores, E., Flowers, J., Ulvskov Frederiksen, K., Friis, J., Grimaud, A., Hansen, K. V., Hardwick, L. J., Hermansson, K., Königer, L., Lauritzen, H., Le Cras, F., Li, H., Lyonnard, S., … Vegge, T. (2021). Data Management Plans: The Importance of Data Management in the BIG-MAP Project**. *Batteries & Supercaps*, *4*(12), 1803–1812. https://doi.org/10.1002/batt.202100117

Chan, L., & Loizides, F. (2017). *Expanding Perspectives on Open Science: Communities, Cultures and Diversity in Concepts and Practices: Proceedings of the 21st International Conference on Electronic Publishing*. IOS Press.

Chaput, J., & Walsh, R. (2023). Data Management Librarians Role in a Large Interdisciplinary Scientific Grant for PFAS Remediation: Considerations and Recommendations. *Journal of EScience Librarianship*, *12*(1), Article 1. https://doi.org/10.7191/jeslib.616

Charbonneau, D. H. (2013). Strategies for Data Management Engagement. *Medical Reference Services Quarterly*, *32*(3), 365–374. https://doi.org/10.1080/02763869.2013.807089

Chard, K., Foster, I., & Tuecke, S. (2017). Globus: Research Data Management as Service and Platform. *Proceedings of the Practice and Experience in Advanced Research Computing 2017 on Sustainability, Success and Impact*, 1–5. https://doi.org/10.1145/3093338.3093367

Chawinga, W. D., & Zinn, S. (2020). Research data management at an African medical university: Implications for academic librarianship. *The Journal of Academic Librarianship*, *46*(4), 102161. https://doi.org/10.1016/j.acalib.2020.102161

Chen, D. (2022). Practice on the Data Service of University Scientific Research Management Based on Cloud Computing. *2022 World Automation Congress (WAC)*, 424–428. https://doi.org/10.23919/WAC55640.2022.9934710

Chen, H., Chiu, T.-H., & Cline, E. (2022). Academic libraries and research data management: A case study of Dataverse global adoption. *Information Discovery and Delivery*, *51*(2), 166–178. https://doi.org/10.1108/IDD-04-2022-0028

Chen, X., Dommermuth, E., Benner, J. G., Kuglitsch, R., Lewis, A. B., Marsteller, M. R., Mika, K., & Young, S. (2022). Understanding Research Data Practices of Civil and Environmental Engineering Graduate Students. *Issues in Science and Technology Librarianship*, *100*, Article 100. https://doi.org/10.29173/istl2678

Chew, A. W., Oo, C. Z., Wong, A. L., & Gladding, J. (2022). An initial evaluation of research data management online training at the University of New South Wales. *IFLA Journal*, *48*(4), 510–522. https://doi.org/10.1177/03400352211054120

Chigwada, J., Chiparausha, B., & Kasiroori, J. (2017). Research Data Management in Research Institutions in Zimbabwe. *Data Science Journal*, *16*, 31–31. https://doi.org/10.5334/dsj-2017-031

Chiware, E. R. T. (2020a). Data librarianship in South African academic and research libraries: A survey. *Library Management*, *41*(6/7), 401–416. https://doi.org/10.1108/LM-03-2020-0045

Chiware, E. R. T. (2020b). Open research data in African academic and research libraries: A literature analysis. *Library Management*, *41*(6/7), 383–399. https://doi.org/10.1108/LM-02-2020-0027

Choi, M., & Lee, S. (2020). Research Data Management Status of Science and Technology Research Institutes in Korea. *Data Science Journal*, *19*(1), Article 1. https://doi.org/10.5334/dsj-2020-029

Clements, A., & McCutcheon, V. (2014). Research Data Meets Research Information Management: Two Case Studies Using (a) Pure CERIF-CRIS and (b) EPrints Repository Platform with CERIF Extensions. *Procedia Computer Science*, *33*, 199–206. https://doi.org/10.1016/j.procs.2014.06.033

Conference, E. F. for M. I., Mantas, J., & Informatics, E. F. for M. (2012). *Quality of Life Through Quality of Information: Proceedings of MIE2012*. IOS Press.

Cooper, J., Leahy, A., Kmiec, M., & Donelly, T. (2023). Metadata: A Case Study at Western Sydney University: Assessment of Metadata Schema for Active Research Data Managemen. *Western Sydney University*, 29. https://doi.org/10.26183/T8X5-HF62

Cox, A. M., Kennan, M. A., Lyon, L., & Pinfield, S. (2017). Developments in research data management in academic libraries: Towards an understanding of research data service maturity. *Journal of the Association for Information Science and Technology*, *68*(9), 2182–2200. https://doi.org/10.1002/asi.23781

Cox, A. M., & Pinfield, S. (2014a). Research data management and libraries: Current activities and future priorities. *Journal of Librarianship and Information Science*, *46*(4), 299–316. https://doi.org/10.1177/0961000613492542

Cox, A. M., & Pinfield, S. (2014b). Research data management and libraries: Current activities and future priorities. *Journal of Librarianship and Information Science*, *46*(4), 299–316. https://doi.org/10.1177/0961000613492542

Davidson, J., Jones, S., Molloy, L., & Kejser, U. B. (2014). Emerging Good Practice in Managing Research Data and Research Information within UK Universities. *Procedia Computer Science*, *33*, 215–222. https://doi.org/10.1016/j.procs.2014.06.035

de Waard, A. (2016). Research data management at Elsevier: Supporting networks of data and workflows. *Information Services & Use*, *36*(1–2), 49–55. https://doi.org/10.3233/ISU-160805

Delserone, L. M. (2008). At the Watershed: Preparing for Research Data Management and Stewardship at the University of Minnesota Libraries. *Library Trends*, *57*(2), 202–210. https://doi.org/10.1353/lib.0.0032

Dogan, G., Taskin, Z., & Aydinoglu, A. U. (2021). Research data management in Turkey: A survey to build an effective national data repository. *IFLA Journal*, *47*(1), 51–64. https://doi.org/10.1177/0340035220917985

Donner, E. K. (2023). Research data management systems and the organization of universities and research institutes: A systematic literature review. *Journal of Librarianship and Information Science*, *55*(2), 261–281. https://doi.org/10.1177/09610006211070282

Dorcas, I. I., Jiyane, V. G., Ibinaiye, J. W., & Tijani, R. (2023). Analyses of a Decade of Research Gap in Data Management Practices in Academic Libraries: A Social Science Perspectives. *International Journal of Social Science Research and Review*, *6*(5), Article 5. https://doi.org/10.47814/ijssrr.v6i5.1108

Doty Research Data Librarian, J., Herndon Head of Data and GIS Services, Joel, Lyle Director, J., & Stephenson Director, L. (2014). Learning to curate. *Bulletin of the Association for Information Science and Technology*, *40*(6), 31–34. https://doi.org/10.1002/bult.2014.1720400610

Dunie, M. (2017). The importance of research data management: The value of electronic laboratory notebooks in the management of data integrity and data availability. *Information Services & Use*, *37*(3), 355–359. https://doi.org/10.3233/ISU-170843

Fadlelmola, F. M., Zass, L., Chaouch, M., Samtal, C., Ras, V., Kumuthini, J., Panji, S., & Mulder, N. (2021). Data Management Plans in the genomics research revolution of Africa: Challenges and recommendations. *Journal of Biomedical Informatics*, *122*, 103900. https://doi.org/10.1016/j.jbi.2021.103900

Fazal, F., & Chakravarty, R. (2019). Role of Library in Research Support: A Study of Bharathiar University. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/2780

Fitzgerald, A. M., Pappalardo, K. M., Fitzgerald, B. F., Austin, A. C., Abbot, J. W., Cosman, B. L., O'Brien, D. S., & Singleton, B. (2007). *Building the Infrastructure for Data Access and Reuse in Collaborative Research: An Analysis of the Legal Context*. The OAK Law Project. http://www.oaklaw.qut.edu.au/

Fitzgerald, P. A., Pappalardo, K., & Austin, A. (2008). *Practical data management: A legal and policy guide*.

Fransson, J., Lagunas, P. T., Kjellberg, S., & Toit, M. du. (2016). Developing integrated research data management support in close relation to doctoral students' research

practices. *Proceedings of the Association for Information Science and Technology*, *53*(1), 1–4. https://doi.org/10.1002/pra2.2016.14505301094

Frederick, A., & Run, Y. (2019). The Role of Academic Libraries in Research Data Management: A Case in Ghanaian University Libraries. *Open Access Library Journal*, *6*(3), Article 3. https://doi.org/10.4236/oalib.1105286

Fu, P., Blackson, M., & Valentino, M. (2023). Developing research data management services in a regional comprehensive university: The case of Central Washington University. *IFLA Journal*, *49*(2), 443–451. https://doi.org/10.1177/03400352221116923

Giffels, J., Vollmer, S. H., & Bird, S. J. (2010). Editors' Overview: Topics in the Responsible Management of Research Data. *Science and Engineering Ethics*, *16*(4), 631–637. https://doi.org/10.1007/s11948-010-9243-1

Goben, A., & Griffin, T. (2019). In Aggregate: Trends, Needs, and Opportunities from Research Data Management Surveys. *College & Research Libraries*, *80*(7), 903–924. https://doi.org/10.5860/crl.80.7.903

Gooch, M., & Strange, D. (2023). Consolidating research data management infrastructure: Towards sustainable digital scholarship. *ACM Journal on Computing and Cultural Heritage*. https://ora.ox.ac.uk/objects/uuid:cc21ec81-9ca0-4e81-b865-25392972f075

Gossler, H., Riedel, J., Daymo, E., Chacko, R., Angeli, S., & Deutschmann, O. (2022). A New Approach to Research Data Management with a Focus on Traceability: Adacta. *Chemie Ingenieur Technik*, *94*(11), 1798–1807. https://doi.org/10.1002/cite.202200064

Grant, R. (2017). Recordkeeping and research data management: A review of perspectives. *Records Management Journal*, *27*(2), 159–174. https://doi.org/10.1108/RMJ-10-2016-0036

Hackett, C., & Kim, J. (2023). Planning, implementing and evaluating research data services in academic libraries: A model approach. *Journal of Documentation*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JD-01-2023-0007

Haddow, G., & Mamtora, J. (2017). Research Support in Australian Academic Libraries: Services, Resources, and Relationships. *New Review of Academic Librarianship*, *23*(2–3), 89–109. https://doi.org/10.1080/13614533.2017.1318765

Halbert, M., Moen, W., & Keralis, S. (2012). The DataRes research project on data management. *Proceedings of the 2012 IConference*, 589–591. https://doi.org/10.1145/2132176.2132300

Hamad, F., Al-Fadel, M., & Al-Soub, A. (2021). Awareness of Research Data Management Services at Academic Libraries in Jordan: Roles, Responsibilities and Challenges. *New Review of Academic Librarianship*, *27*(1), 76–96. https://doi.org/10.1080/13614533.2019.1691027

Hassanzadeh, O., Kementsietsidis, A., & Velegrakis, Y. (2012). Data Management Issues on the Semantic Web. *2012 IEEE 28th International Conference on Data Engineering*, 1204–1206. https://doi.org/10.1109/ICDE.2012.141

He, Y., Faircloth, B. S., Hewitt, K. K., Rock, M. L., Rodriguez, S., Gonzalez, L. M., & Vetter, A. (2020). Data management and use through research practice partnerships: A literature review. *Educational Research Review*, *31*, 100360. https://doi.org/10.1016/j.edurev.2020.100360

Helbig, K. (2016). Research Data Management Training for Geographers: First Impressions. *ISPRS International Journal of Geo-Information*, *5*(4), Article 4. https://doi.org/10.3390/ijgi5040040

Henderson, M. E., & Knott, T. L. (2015). Starting a Research Data Management Program Based in a University Library. *Medical Reference Services Quarterly*, *34*(1), 47–59. https://doi.org/10.1080/02763869.2015.986783

Henderson, M., Raboin, R., Shorish, Y., & Tuyl, S. (2014). Research data management on a shoestring budget: Research Data Management on a Shoestring Budget. *Bulletin of the American Society for Information Science and Technology*, *40*. https://doi.org/10.1002/bult.2014.1720400606

Herres-Pawlis, S., Bach, F., Bruno, I. J., Chalk, S. J., Jung, N., Liermann, J. C., McEwen, L. R., Neumann, S., Steinbeck, C., Razum, M., & Koepler, O. (2022). Minimum Information Standards in Chemistry: A Call for Better Research Data Management Practices. *Angewandte Chemie International Edition*, *61*(51), e202203038. https://doi.org/10.1002/anie.202203038

Herzmann, D. E., Abendroth, L. J., & Bunderson, L. D. (2014). Data management approach to multidisciplinary agricultural research and syntheses. *Journal of Soil and Water Conservation*, *69*(6), 180A-185A. https://doi.org/10.2489/jswc.69.6.180A

Higman, R., & Pinfield, S. (2015). Research data management and openness: The role of data sharing in developing institutional policies and practices. *Program: Electronic Library and Information Systems*, *49*(4), 364–381. https://doi.org/10.1108/PROG-01-2015-0005

Hiom, D., Fripp, D., Gray, S., Snow, K., & Steer, D. (2015). Research data management at the University of Bristol: Charting a course from project to service. *Program: Electronic Library and Information Systems*, *49*(4), 475–493. https://doi.org/10.1108/PROG-02-2015-0019

Huang, Y., Cox, A. M., & Sbaffi, L. (2021). Research data management policy and practice in Chinese university libraries. *Journal of the Association for Information Science and Technology*, *72*(4), 493–506. https://doi.org/10.1002/asi.24413

Javed, H. (2023). *Challenges and requirements of heterogenous research data management in environmental sciences: A qualitative study* [Master thesis, University of Oulu]. http://jultika.oulu.fi/files/nbnfioulu-202306292783.pdf

Johnson, L. M., Butler, J. T., & Johnston, L. R. (2012). Developing E-Science and Research Services and Support at the University of Minnesota Health Sciences Libraries. *Journal of Library Administration*, *52*(8), 754–769. https://doi.org/10.1080/01930826.2012.751291

Johnston, L., & Jeffryes, J. (2014). Data Management Skills Needed by Structural Engineering Students: Case Study at the University of Minnesota. *Journal of Professional Issues in Engineering Education and Practice*, *140*(2), 05013002. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000154

Joo, S., & Peters, C. (2020). User needs assessment for research data services in a research university. *Journal of Librarianship and Information Science*, *52*(3), 633–646. https://doi.org/10.1177/0961000619856073

Kanza, S., & Knight, N. J. (2022). Behind every great research project is great data management. *BMC Research Notes*, *15*(1), 20. https://doi.org/10.1186/s13104-022-05908-5

Keller, A. (2015). Research Support in Australian University Libraries: An Outsider View. *Australian Academic & Research Libraries*, *46*(2), 73–85. https://doi.org/10.1080/00048623.2015.1009528

Kennan, M. A. (2018). Chapter 21—Managing research data. In K. Williamson & G. Johanson (Eds.), *Research Methods (Second Edition)* (pp. 505–515). Chandos Publishing. https://doi.org/10.1016/B978-0-08-102220-7.00021-2

Khan, H. R., Chang, H.-C., & Kim, J. (2018). Unfolding Research Data Services: An Information Architecture Perspective. *Proceedings of the 18th ACM/IEEE on Joint Conference on Digital Libraries*, 353–354. https://doi.org/10.1145/3197026.3203887

Kim, J. (2020). Academic library's leadership and stakeholder involvement in research data services. *Proceedings of the Association for Information Science and Technology*, *57*(1), e304. https://doi.org/10.1002/pra2.304

Klingner, C. M., Denker, M., Grün, S., Hanke, M., Oeltze-Jafra, S., Ohl, F. W., Radny, J., Rotter, S., Scherberger, H., Stein, A., Wachtler, T., Witte, O. W., & Ritter, P. (2023). Research Data Management and Data Sharing for Reproducible Research—Results of a Community Survey of the German National Research Data Infrastructure Initiative Neuroscience. *ENeuro*, *10*(2). https://doi.org/10.1523/ENEURO.0215-22.2023

Koltay, T. (2017a). Data literacy for researchers and data librarians. *Journal of Librarianship and Information Science*, *49*(1), 3–14. https://doi.org/10.1177/0961000615616450

Koltay, T. (2017b). Research 2.0 and Research Data Services in academic and research libraries: Priority issues. *Library Management*, *38*(6/7), 345–353. https://doi.org/10.1108/LM-11-2016-0082

Koopman, M. M., & de Jager, K. (2016). Archiving South African digital research data: How ready are we? *South African Journal of Science*, *112*(7–8), 1–7. https://doi.org/10.17159/sajs.2016/20150316

Kumari, M., & Parmar, M. (2021). Perceptions and Practices on Research Data Management in the Universities of Gujarat: A Survey. *Journal of Advanced Research in Library and Information Science*, *8*(1), 36–41.

Kvale, L., & Stangeland, E. (2017). Skills for research data management – developing RDM courses at the university of Oslo. *Proceedings of the Association for Information Science and Technology*, *54*(1), 728–730. https://doi.org/10.1002/pra2.2017.14505401134

Latham, B. (2017). Research Data Management: Defining Roles, Prioritizing Services, and Enumerating Challenges. *The Journal of Academic Librarianship*, *3*(43), 263–265. https://doi.org/10.1016/j.acalib.2017.04.004

Latif, A., Limani, F., & Tochtermann, K. (2019). A Generic Research Data Infrastructure for Long Tail Research Data Management. *Data Science Journal*, *18*, 17–17. https://doi.org/10.5334/dsj-2019-017

Lau, H. X., Lee, S. L. C., & Ali, Y. (2021). Effectiveness of data auditing as a tool to reinforce good research data management (RDM) practice: A Singapore study. *BMC Medical Ethics*, *22*(1), 103. https://doi.org/10.1186/s12910-021-00662-y

Lee, D. J., Stvilia, B., & Wu, S. (2017). Practices of metadata use in research information management systems. *Proceedings of the Association for Information Science and Technology*, *54*(1), 734–735. https://doi.org/10.1002/pra2.2017.14505401136

Lefebvre, A., Bakhtiari, B., & Spruit, M. (2020). Exploring research data management planning challenges in practice. *It - Information Technology*, *62*(1), 29–37. https://doi.org/10.1515/itit-2019-0029

Lefebvre, A., & Spruit, M. (2023). Laboratory Forensics for Open Science Readiness: An Investigative Approach to Research Data Management. *Information Systems Frontiers*, *25*(1), 381–399. https://doi.org/10.1007/s10796-021-10165-1

Lehmann, J., Schorz, S., Rache, A., Häußermann, T., Rädle, M., & Reichwald, J. (2023). Establishing Reliable Research Data Management by Integrating Measurement Devices Utilizing Intelligent Digital Twins. *Sensors*, *23*(1), Article 1. https://doi.org/10.3390/s23010468

Llebot, C., & Castillo, D. J. (2023). Are Institutional Research Data Policies in the US Supporting the FAIR Principles? A Content Analysis. *Journal of EScience Librarianship*, *12*(1), Article 1. https://doi.org/10.7191/jeslib.614

Lorenz, C., Hadizadeh, M., Barthlott, S., Fösig, R., Çayoğlu, U., Ulrich, R., & Bach, F. (2023). *CAT4KIT: A cross-institutional data catalog framework for the FAIRification of environmental research data* (EGU23-15367). EGU23. Copernicus Meetings. https://doi.org/10.5194/egusphere-egu23-15367

Machimbidza, T., Mutula, S., & Ndiweni, M. (2022). Exploring the feasibility of Research Data Management services in Zimbabwean academic libraries: The case of Zimbabwe School of Mines. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/6760

Majid, S., Foo, S., & Zhang, X. (2018). Research Data Management by Academics and Researchers: Perceptions, Knowledge and Practices. In M. Dobreva, A. Hinze, & M. Žumer (Eds.), *Maturity and Innovation in Digital Libraries* (pp. 166–178). Springer International Publishing. https://doi.org/10.1007/978-3-030-04257-8_16

Makani, J. (2015). Knowledge management, research data management, and university scholarship: Towards an integrated institutional research data management support-system framework. *VINE*, *45*(3), 344–359. https://doi.org/10.1108/VINE-07-2014-0047

Man, R., Zhou, G., & Fan, J. (2020). Research on Scientific Data Management in Big Data Era. *Proceedings of the 4th International Conference on Computer Science and Application Engineering*, 1–6. https://doi.org/10.1145/3424978.3425010

Marlina, E., Hidayanto, A. N., & Purwandari, B. (2022). Towards a model of research data management readiness in Indonesian context: An investigation of factors and indicators through the fuzzy delphi method. *Library & Information Science Research*, *44*(1), 101141. https://doi.org/10.1016/j.lisr.2022.101141

Marlina, E., & Purwandari, B. (2019). Strategy for Research Data Management Services in Indonesia. *Procedia Computer Science*, *161*, 788–796. https://doi.org/10.1016/j.procs.2019.11.184

Masinde, J., Chen, J., Wambiri, D., & Mumo, A. (2021). Research Librarians' Experiences of Research Data Management Activities at an Academic Library in a Developing Country. *Data and Information Management*, *5*(4), 412–424. https://doi.org/10.2478/dim-2021-0002

Matusiak, K. K., & Sposito, F. A. (2017). Types of research data management services: An international perspective. *Proceedings of the Association for Information Science and Technology*, *54*(1), 754–756. https://doi.org/10.1002/pra2.2017.14505401144

Maurya, A., & Subaveerapandiyan, A. (2022). Research Data Preservation Practices of Library and Information Science Faculties. *DESIDOC Journal of Library & Information Technology*, *42*(4), 259–264. https://doi.org/10.14429/djlit.42.4.17538

Mavodza, J. (2022). Research Data Management: A review of UAE academic library experience. *Open Information Science*, *6*(1), 16–27. https://doi.org/10.1515/opis-2022-0128

M'kulama, A., Zulu, Z., Chewe, P., & Mwiinga, T. (2022). Preparedness for Open Science through Research Data Management at the University of Zambia in COVID-19 and Post-COVID Eras. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/7268

Morgan, A., Duffield, N., & Walkley Hall, L. (2017). Research Data Management Support: Sharing Our Experiences. *Journal of the Australian Library and Information Association*, *66*(3), 299–305. https://doi.org/10.1080/24750158.2017.1371911

Mosha, N. F., & Ngulube, P. (2022). Teaching research data management courses in higher learning institutions in Tanzania. *Library Management*, *44*(1/2), 166–179. https://doi.org/10.1108/LM-04-2022-0033

Mozgova, I., Altun, O., Sheveleva, T., Castro, A., Oladazimi, P., Koepler, O., Lachmayer, R., & Auer, S. (2022). Knowledge Annotation within Research Data Management System for Oxygen-Free Production Technologies. *Proceedings of the Design Society*, *2*, 525–532. https://doi.org/10.1017/pds.2022.54

Mozgova, I., Koepler, O., Kraft, A., Lachmayer, R., & Auer, S. (2020). Research Data Management System for a large Collaborative Project. *DS 101: Proceedings of NordDesign 2020, Lyngby, Denmark, 12th - 14th August 2020*, 1–12. https://doi.org/10.35199/NORDDESIGN2020.48

Mthembu, M., & Ocholla, D. (2022). Development strategies as catalysts for provision of the RDM services in the South African higher education institutions. *South African Journal of Libraries and Information Science*, *88*(1), 1–8. https://doi.org/10.7553/88-1-2127

Mushi, G. (2021). Research data management and services: Resources for different data practitioners. *IASSIST Quarterly*, *45*(3–4), Article 3–4. https://doi.org/10.29173/iq995

Myneni, S., Patel, V. L., Bova, G. S., Wang, J., Ackerman, C. F., Berlinicke, C. A., Chen, S. H., Lindvall, M., & Zack, D. J. (2016). Resolving complex research data management issues in biomedical laboratories: Qualitative study of an industry–academia collaboration. *Computer Methods and Programs in Biomedicine*, *126*, 160–170. https://doi.org/10.1016/j.cmpb.2015.11.001

Nahotko, M., Zych, M., Januszko-Szakiel, A., & Jaskowska, M. (2023). Big data-driven investigation into the maturity of library research data services (RDS). *The Journal of Academic Librarianship*, *49*(1), 102646. https://doi.org/10.1016/j.acalib.2022.102646

Ng'eno, E., & Mutula, S. (2018). Research Data Management (RDM) in agricultural research institutes: A literature review. *Inkanyiso: Journal of Humanities and Social Sciences*, *10*(1), Article 1. https://doi.org/10.4314/ijhss.v10i1

Ningning, G. (2010). Proposing Data Warehouse and Data Mining in Teaching Management Research. *2010 International Forum on Information Technology and Applications*, *1*, 436–439. https://doi.org/10.1109/IFITA.2010.286

Nwabugwu, M., & Godwin, L. (2020). Research data management (RDM) services in libraries: Lessons for academic libraries in Nigeria. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/4238

Oo, C. Z., Chew, A. W., Wong, A. L. H., Gladding, J., & Stenstrom, C. (2022). Delineating the successful features of research data management training: A systematic review. *International Journal for Academic Development*, *27*(3), 249–264. https://doi.org/10.1080/1360144X.2021.1898399

Payal, M., Awasthi, S., & Tripathi, M. (2019). A Selective Review of Literature on Research Data Management in Academic Libraries. *DESIDOC Journal of Library & Information Technology*, *39*(6), 338–345. https://doi.org/10.14429/djlit.39.06.14451

Perrier, L., Blondal, E., Ayala, A. P., Dearborn, D., Kenny, T., Lightfoot, D., Reka, R., Thuna, M., Trimble, L., & MacDonald, H. (2017). Research data management in academic institutions: A scoping review. *PLOS ONE*, *12*(5), e0178261. https://doi.org/10.1371/journal.pone.0178261

Perrier, L., Blondal, E., & MacDonald, H. (2018). Exploring the experiences of academic libraries with research data management: A meta-ethnographic analysis of qualitative studies11All data from this publication is available from the Zenodo Repository, https://doi.org/10.5281/zenodo.1324412. *Library & Information Science Research*, *40*(3), 173–183. https://doi.org/10.1016/j.lisr.2018.08.002

Pham, N.-M., Moulaison-Sandy, H., Bishop, B. W., & Gunderman, H. (2023). Data Management Plans: Implications for Automated Analyses. *Data Science Journal*, *22*, 2–2. https://doi.org/10.5334/dsj-2023-002

Pinfield, S., Cox, A. M., & Smith, J. (2014). Research Data Management and Libraries: Relationships, Activities, Drivers and Influences. *PLOS ONE*, *9*(12), e114734. https://doi.org/10.1371/journal.pone.0114734

Piracha, H., & Ameen, K. (2018). Research Data Management Practices of Faculty Members. *Pakistan Journal of Information Management & Libraries*, *20*, 60–75. https://doi.org/10.47657/2018201321

Pm, N. A., & Saeed, S. (2019). Research Data Management and Data Sharing among Research Scholars of Life Sciences and Social Sciences. *DESIDOC Journal of Library & Information Technology*, *39*(06), 290–299. https://doi.org/10.14429/djlit.39.06.14997

Pratt, I., Evering, D., & Brodeur, J. J. (2023). *McMaster University Research Data Management (RDM) Institutional Strategy, 2023-2025* [McMaster RDM Institutional Strategy Working Group]. https://macsphere.mcmaster.ca/handle/11375/28392

Rahaman, T. (2023). Open Data and the 2023 NIH Data Management and Sharing Policy. *Medical Reference Services Quarterly*, *42*(1), 71–78. https://doi.org/10.1080/02763869.2023.2168103

Rantasaari, J. (2022). Multi-Stakeholder Research Data Management Training as a Tool to Improve the Quality, Integrity, Reliability and Reproducibility of Research. *LIBER Quarterly: The Journal of the Association of European Research Libraries*, *32*(1), Article 1. https://doi.org/10.53377/lq.11726

Read, K. B. (2019). Adapting data management education to support clinical research projects in an academic medical center. *Journal of the Medical Library Association : JMLA*, *107*(1), 89–97. https://doi.org/10.5195/jmla.2019.580

Redkina, N. S. (2019). Current Trends in Research Data Management. *Scientific and Technical Information Processing*, *46*(2), 53–58. https://doi.org/10.3103/S0147688219020035

Richardson, J., Nolan-Brown, T., Loria, P., & Bradbury, S. (2012). Library Research Support in Queensland: A Survey. *Australian Academic & Research Libraries*, *43*(4), 258–277. https://doi.org/10.1080/00048623.2012.10722287

Rod, A. B. (2023). It Takes a Researcher to Know a Researcher: Academic Librarian Perspectives Regarding Skills and Training for Research Data Support in Canada. *Evidence Based Library and Information Practice*, *18*(2), Article 2. https://doi.org/10.18438/eblip30297

Rod, A. B., Zhou, B., & Rousseau, M.-E. (2023). There's no "I" in Research Data Management: Reshaping RDM Services Toward a Collaborative Multi-Stakeholder Model. *Journal of EScience Librarianship*, *12*(1). https://doi.org/10.7191/jeslib.624

Rolando Research Data Librarian, L., Carlson Research Data Services Manager, J., Hswe Digital Content Strategist and Head, ScholarSphere user services, Patricia, Parham Research Data Project Librarian, S. W., Westra Lorry I. Lokey Science Data Services Librarian, B., & Whitmire Assistant Professor and Data Management Specialist, Amanda L. (2015). Data Management Plans as a Research Tool. *Bulletin of the Association for Information Science and Technology*, *41*(5), 43–45. https://doi.org/10.1002/bult.2015.1720410510

Ruusalepp, R., & Dobreva, M. (2012). *Digital Preservation Services: State of the Art Analysis* [DC-NET project]. https://www.um.edu.mt/library/oar/handle/123456789/311

Salazar, A., Wentzel, B., Schimmler, S., Gläser, R., Hanf, S., & Schunk, S. A. (2023). How Research Data Management Plans Can Help in Harmonizing Open Science and Approaches in the Digital Economy. *Chemistry – A European Journal*, *29*(9), e202202720. https://doi.org/10.1002/chem.202202720

Santharooban, S. (2022). Research Support Service Model of Academic Library: Case Study at Eastern University, Sri Lanka. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/7018

Schembera, B., & Bönisch, T. (2017). Challenges of Research Data Management for High Performance Computing. In J. Kamps, G. Tsakonas, Y. Manolopoulos, L. Iliadis, & I. Karydis (Eds.), *Research and Advanced Technology for Digital Libraries* (pp. 140–151). Springer International Publishing. https://doi.org/10.1007/978-3-319-67008-9_12

Schirrwagen, J., Cimiano, P., Ayer, V., Pietsch, C., Wiljes, C., Vompras, J., & Pieper, D. (2019). Expanding the Research Data Management Service Portfolio at Bielefeld University According to the Three-pillar Principle Towards Data FAIRness. *Data Science Journal*, *18*, 6–6. https://doi.org/10.5334/dsj-2019-006

Schlembach, M. C., & Brach, C. A. (2012). Research Data Management and the Role of Libraries. In *Special Issues in Data Management* (Vol. 1110, pp. 129–144). American Chemical Society. https://doi.org/10.1021/bk-2012-1110.ch008

Schneider, R. (2013). Research Data Literacy. In S. Kurbanoğlu, E. Grassian, D. Mizrachi, R. Catts, & S. Špiranec (Eds.), *Worldwide Commonalities and Challenges in Information Literacy Research and Practice* (pp. 134–140). Springer International Publishing. https://doi.org/10.1007/978-3-319-03919-0_16

Schöpfel, J., & Azeroual, O. (2021). Rewarding Research Data Management. *Companion Proceedings of the Web Conference 2021*, 446–450. https://doi.org/10.1145/3442442.3451367

Schröder, W., & Nickel, S. (2020). Research Data Management as an Integral Part of the Research Process of Empirical Disciplines Using Landscape Ecology as an Example. *Data Science Journal*, *19*(1), Article 1. https://doi.org/10.5334/dsj-2020-026

Searle, S., Wolski, M., Simons, N., & Richardson, J. (2015). Librarians as partners in research data service development at Griffith University. *Program: Electronic Library and Information Systems*, *49*(4), 440–460. https://doi.org/10.1108/PROG-02-2015-0013

Senft, M., Stahl, U., & Svoboda, N. (2022). Research data management in agricultural sciences in Germany: We are not yet where we want to be. *PLOS ONE*, *17*(9), e0274677. https://doi.org/10.1371/journal.pone.0274677

Sesartic, A., & Töwe, M. (2016). Research Data Services at ETH-Bibliothek. *IFLA Journal*, *42*(4), 284–291. https://doi.org/10.1177/0340035216674971

Shahi, A., Carlson, K., Chettupuzha, A. J. A., Haas, C. T., West, J. S., & Akinci, B. (2012). *Construction Research Data Management*. 678–687. https://doi.org/10.1061/9780784412329.069

Shahi, A., Haas, C. T., West, J. S., & Akinci, B. (2014). Workflow-Based Construction Research Data Management and Dissemination. *Journal of Computing in Civil Engineering*, *28*(2), 244–252. https://doi.org/10.1061/(ASCE)CP.1943-5487.0000251

Sheikh, A., Malik, A., & Adnan, R. (2023). Evolution of research data management in academic libraries: A review of the literature. *Information Development*, 02666669231157405. https://doi.org/10.1177/02666669231157405

Shelly, M., & Jackson, M. (2018). Research data management compliance: Is there a bigger role for university libraries? *Journal of the Australian Library and Information Association*, *67*(4), 394–410. https://doi.org/10.1080/24750158.2018.1536690

Si, L., Liu, L., & He, Y. (2023). Scientific data management policy in China: A quantitative content analysis based on policy text. *Aslib Journal of Information Management*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/AJIM-05-2022-0257

Singh, N. K., Monu, H., & Dhingra, N. (2018). Research Data Management Policy And Institutional Framework. *2018 5th International Symposium on Emerging Trends and Technologies in Libraries and Information Services (ETTLIS)*, 111–115. https://doi.org/10.1109/ETTLIS.2018.8485259

Sinha, P., Subaveerapandiyan, A., & Sinha, M. K. (2023). Research data management services in academic libraries: A comparative study of South Asia and Southeast Asia. *Global Knowledge, Memory and Communication*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/GKMC-01-2023-0033

Smits, D. A. B., & Teperek, M. (2020). Research Data Management for Master's Students: From Awareness to Action. *Data Science Journal*, *19*, 30–30. https://doi.org/10.5334/dsj-2020-030

Snyder, D. C., Epps, S., Beresford, H. F., Ennis, C., Levens, J. S., Woody, S. K., Tcheng, J. E., Stacy, M. A., & Nahm, M. (2012). Research Management Team (RMT): A Model for Research Support -Services at Duke University. *Clinical and Translational Science*, *5*(6), 464–469. https://doi.org/10.1111/cts.12010

Špiranec, S., & Kos, D. (2018). Data Literacy and Research Data Management: The Croatian State of Affairs. In S. Kurbanoğlu, J. Boustany, S. Špiranec, E. Grassian, D. Mizrachi, & L. Roy (Eds.), *Information Literacy in the Workplace* (pp. 148–157). Springer International Publishing. https://doi.org/10.1007/978-3-319-74334-9_16

Steinerová, J., & Ondrišová, M. (2019). Research Data Literacy Perception and Practices in the Information Environment. In S. Kurbanoğlu, S. Špiranec, Y. Ünal, J. Boustany, M. L. Huotari, E. Grassian, D. Mizrachi, & L. Roy (Eds.), *Information Literacy in Everyday Life* (pp. 545–555). Springer International Publishing. https://doi.org/10.1007/978-3-030-13472-3_51

Surkis, A., & Read, K. (2015). Research data management. *Journal of the Medical Library Association : JMLA*, *103*(3), 154–156. https://doi.org/10.3163/1536-5050.103.3.011

Tammaro, A. M., & Casarosa, V. (2014). Research Data Management in the Curriculum: An Interdisciplinary Approach. *Procedia Computer Science*, *38*, 138–142. https://doi.org/10.1016/j.procs.2014.10.023

Tammaro, A. M., & Caselli, S. (2020). Training Data Stewards in Italy: Reflection on the FAIR RDM Summer School. In M. Ceci, S. Ferilli, & A. Poggi (Eds.), *Digital Libraries: The Era of Big Data and Data Science* (pp. 163–172). Springer International Publishing. https://doi.org/10.1007/978-3-030-39905-4_16

Tenopir, C., Birch, B., & Allard, S. (2012). Academic libraries and research data services: Current practices and plans for the future. *An ACRL White Paper*. https://trace.tennessee.edu/utk_dataone/20

Thielen, J., & Hess, A. N. (2017). Advancing Research Data Management in the Social Sciences: Implementing Instruction for Education Graduate Students Into a Doctoral Curriculum. *Behavioral & Social Sciences Librarian*, *36*(1), 16–30. https://doi.org/10.1080/01639269.2017.1387739

Todorova, T., Krasteva, R., & Tsvetkova, E. (2019). Data Literacy and Research Data Management: The Case at ULSIT. In S. Kurbanoğlu, S. Špiranec, Y. Ünal, J. Boustany, M. L. Huotari, E. Grassian, D. Mizrachi, & L. Roy (Eds.), *Information Literacy in Everyday Life* (pp. 535–544). Springer International Publishing. https://doi.org/10.1007/978-3-030-13472-3_50

Töwe, M., & Barillari, C. (2020). *Who Does What? – Research Data Management at ETH Zurich* (1). *19*(1), Article 1. https://doi.org/10.5334/dsj-2020-036

Tripathi, D. P., & Pandy, S. R. (2018). Developing a Conceptual Framework of Research Data Management for Higher Educational Institutions. *2018 5th International Symposium on Emerging Trends and Technologies in Libraries and Information Services (ETTLIS)*, 105–110. https://doi.org/10.1109/ETTLIS.2018.8485193

Tupan, T., & Kamaludin, K. (2020). Publication of Research Data Management in Open Access Journal Analysis based on Scopus Data. *Baca: Jurnal Dokumentasi Dan Informasi*, *41*(2), Article 2. https://doi.org/10.14203/j.baca.v41i2.701

Van Loon, J. E., Akers, K. G., Hudson, C., & Sarkozy, A. (2017). Quality evaluation of data management plans at a research university. *IFLA Journal*, *43*(1), 98–104. https://doi.org/10.1177/0340035216682041

Verbaan, E., & Cox, A. M. (2014). Occupational Sub-Cultures, Jurisdictional Struggle and Third Space: Theorising Professional Service Responses to Research Data Management. *The Journal of Academic Librarianship*, *40*(3), 211–219. https://doi.org/10.1016/j.acalib.2014.02.008

Wang, B., & Liu, Z. (2018). Development of Scientific Research Management in Big Data Era. In Q. Zhou, Y. Gan, W. Jing, X. Song, Y. Wang, & Z. Lu (Eds.), *Data Science* (pp. 1–7). Springer. https://doi.org/10.1007/978-981-13-2203-7_1

Wang, W., Zhang, X., Shi, Y., Gao, F., & Xu, W. (2021). Exploration and Analysis of University Scientific Research Data Management Strategies under Big Data Environment. *Journal of Physics: Conference Series*, *1881*(3), 032059. https://doi.org/10.1088/1742-6596/1881/3/032059

Wiley, C. (2022). Research Data Management: A Case Study Examining Aerospace, Industrial and Mechanical Science Engineering Faculty Research Practices. *Science & Technology Libraries*, *0*(0), 1–8. https://doi.org/10.1080/0194262X.2022.2153780

Wiley, C. A., & Burnette, M. H. (2019). Assessing Data Management Support Needs of Bioengineering and Biomedical Research Faculty. *Journal of eScience Librarianship*, *8*(1), Article 1. https://doi.org/10.7191/jeslib.2019.1132

Wiley Engineering Research and Data Services Librarian, Christie. (2014). Metadata use in research data management. *Bulletin of the Association for Information Science and Technology*, *40*(6), 38–40. https://doi.org/10.1002/bult.2014.1720400612

Wiljes, C., & Cimiano, P. (2019). Teaching Research Data Management for Students. *Data Science Journal*, *18*, 38–38. https://doi.org/10.5334/dsj-2019-038

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., … Mons, B. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data*, *3*, 160018. https://doi.org/10.1038/sdata.2016.18

Williamson, P. O. (2023). Developing a Centralized Hub for Research Data Services: Trainings and Resources in Health Sciences Contexts. *Journal of EScience Librarianship*, *12*(1), Article 1. https://doi.org/10.7191/jeslib.642

Wilms, K. L., Stieglitz, S., Ross, B., & Meske, C. (2020). A value-based perspective on supporting and hindering factors for research data management. *International Journal of Information Management*, *54*, 102174. https://doi.org/10.1016/j.ijinfomgt.2020.102174

Wilms, K., Meske, C., Stieglitz, S., Rudolph, D., & Vogl, R. (2016). How to Improve Research Data Management. In S. Yamamoto (Ed.), *Human Interface and the Management of Information: Applications and Services* (pp. 434–442). Springer International Publishing. https://doi.org/10.1007/978-3-319-40397-7_41

Wissik, T., & Ďurčo, M. (2015). Research Data Workflows: From Research Data Lifecycle Models to Institutional Solutions. *NEALT Proceedings Series*, 94–107. https://ep.liu.se/en/conference-article.aspx?series=&issue=123&Article_No=8

Wright, A. (2016). Electronic Resources for Developing Data Management Skills and Data Management Plans. *Journal of Electronic Resources in Medical Libraries*, *13*(1), 43–48. https://doi.org/10.1080/15424065.2016.1146640

Wu, M., & Chen, X. (2016). Library service design based on the needs of chemistry research data management and sharing survey. *Proceedings of the Association for Information Science and Technology*, *53*(1), 1–4. https://doi.org/10.1002/pra2.2016.14505301137

Wu, S., Stvilia, B., & Lee, D. J. (2017). How do Chinese researchers use research information management systems?: An exploratory study. *Proceedings of the Association for Information Science and Technology*, *54*(1), 829–830. https://doi.org/10.1002/pra2.2017.14505401174

Xu, Z. (2022). Research Data Management Practice in Academic Libraries. *Journal of Librarianship and Scholarly Communication*, *10*(1), Article 1. https://doi.org/10.31274/jlsc.13700

Xu, Z., Zhou, X., Kogut, A., & Clough, M. (2022). Effect of online research data management instruction on social science graduate students' RDM skills. *Library & Information Science Research*, *44*(4), 101190. https://doi.org/10.1016/j.lisr.2022.101190

Xu, Z., Zhou, X., Watts, J., & Kogut, A. (2023). The effect of student engagement strategies in online instruction for data management skills. *Education and Information Technologies*, 1–18. https://doi.org/10.1007/s10639-022-11572-w

Yidavalapati, J., Sinha, P., & Subaveerapandiyan, A. (2021). Research Data Management and Services in South Asian Academic Libraries. *Library Philosophy and Practice (e-Journal)*. https://digitalcommons.unl.edu/libphilprac/6457

Yoon, A., & Schultz, T. (2017). Research Data Management Services in Academic Libraries in the US: A Content Analysis of Libraries' Websites. *College & Research Libraries*, *78*(7), 920–933. https://doi.org/10.5860/crl.78.7.920

Yun, W., & Jingxin, X. (2011). Research for developing the ITS Data Management System to meet user requirements. *2011 International Conference on Electric Technology and Civil Engineering (ICETCE)*, 1435–1439. https://doi.org/10.1109/ICETCE.2011.5776398

Zeeland, H. van, & Ringersma, J. (2017). The development of a research data policy at Wageningen University & Research: Best practices as a framework. *LIBER Quarterly: The Journal of the Association of European Research Libraries*, *27*(1), Article 1. https://doi.org/10.18352/lq.10215

Zhang, Y., & Chen, H. (2015). Data management and curation practices: The case of using DSpace and implications. *Proceedings of the Association for Information Science and Technology*, *52*(1), 1–4. https://doi.org/10.1002/pra2.2015.1450520100109

Zhao, L. (2014). Riding the Wave of Open Access: Providing Library Research Support for Scholarly Publishing Literacy. *Australian Academic & Research Libraries*, *45*(1), 3–18. https://doi.org/10.1080/00048623.2014.882873

Zikos, D., & Mantas, J. (2011). Research Management: The case of RN4CAST. In *User Centred Networked Health Care* (pp. 985–988). IOS Press. https://doi.org/10.3233/978-1-60750-806-9-985

Zilinski librarian, L. D., Barton metadata specialist, A., Zhang digital user experience specialist, T., Pouchard computational science and big data information scientist, Line, & Pascuzzi molecular biosciences information specialist, P. (2016). Research Data Integration in the Purdue Libraries. *Bulletin of the Association for Information*

Science and Technology, *42*(2), 33–37. https://doi.org/10.1002/bul2.2016.1720420212

Zotoo, I. K., Liu, G., Lu, Z., & Essien, F. K. (2022). Research Data Management in China: Can Librarians Bring a Paradigm Shift? *Open Access Library Journal*, *9*(2), Article 2. https://doi.org/10.4236/oalib.1108341