Academic Library Opportunity: Examining the Research Data Management Challenges Facing Malaysian Information Science Researchers

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Abstract. Research Data Management (RDM) is pivotal in fostering scientific communication, ensuring long-term data storage, and facilitating research verification. Despite its significance, there is a dearth of empirical studies examining RDM behaviors among researchers in Malaysia. This study fills this research gap by conducting a comprehensive investigation into the state of RDM in Malaysian academic libraries, with a particular focus on the initiatives of Universiti Teknologi MARA. Utilizing a mixed-methods approach, researchers' attitudes, practices, and challenges concerning RDM were explored. Preliminary findings suggest a fragmented approach to RDM, emphasizing the need for standardized practices and increased institutional support. The research underscores the crucial role that academic libraries can play in this context. Libraries are positioned not only as repositories but also as hubs for RDM knowledge dissemination, offering training and support to researchers. The study also delves into potential future directions for RDM in Malaysia, highlighting opportunities for academic libraries to further embed themselves in the research ecosystem. As RDM becomes increasingly integral in the global research landscape, this study serves as a timely examination of Malaysia's current stance and the steps it can take to ensure robust and effective RDM practices.
Keywords: Research Data Management (RDM), Malaysian academic libraries, data management practices, library management.

1   Introduction

In recent years, the transformation of Malaysia into a digitally-driven society has elevated the importance of data management in various sectors, including academia.

The Malaysia Open Science Platform (MOSP), a groundbreaking initiative by the Malaysian Ministry of Science, Technology and Innovation (MOSTI), epitomizes the nation's commitment to fostering a culture of open data and collaborative research. Launched in 2023, MOSP aims to democratize science and cultivate public trust through impactful collaborations among researchers. Within this innovative landscape, the domain of information science has experienced substantial growth, attracting a diverse pool of researchers committed to advancing the field. However, this surge in research activities has introduced a new set of challenges, specifically in the management of research data, an aspect that has yet to be comprehensively explored.

The management of research data is a critical component that underpins the integrity and reproducibility of scientific investigations. The gravity of this issue is further amplified in a multi-disciplinary field like information science, where data types and formats can vary considerably. In Malaysia, where research initiatives are increasingly supported by state-of-the-art infrastructures and funding, the issue of data management is becoming more pressing. The inability to effectively manage data not only jeopardizes the quality of the research but also undermines the credibility of the researchers and, by extension, the institutions they represent. Despite its crucial importance, there exists a paucity of studies that delve into the specific challenges encountered by Malaysian information science researchers in managing their data.

This research aims to fill a significant gap in the existing literature by providing a comprehensive and in-depth investigation into the multifaceted challenges encountered by Malaysian researchers in the field of information science when managing research data. Previous studies have often been general in nature, offering broad overviews that lack the granularity required for actionable insights. This is particularly problematic in the context of Malaysia, where researchers face a unique set of challenges shaped by local cultural, ethical, and institutional factors. There is a compelling need for a targeted exploration that encompasses various aspects such as data collection, storage, sharing, preservation, and ethical considerations.

In alignment with the identified research gaps, the primary objective of this study is to conduct a comprehensive and in-depth investigation into the challenges of research data management among Malaysian information science researchers. The study will critically examine various facets of data management, including but not limited to, data collection, storage, sharing, preservation, and ethical considerations. By capturing the experiences and perspectives of local researchers, this investigation aims to contribute valuable insights that could highlight the pivotal role libraries can play in supporting researchers in their Research Data Management (RDM).

2   Literature Review

2.1 Research Data Management among Researchers

Research data management is becoming increasingly relevant in the academic community. Research data management is the process of organizing and preserving the data generated through research activities in a secure and efficient manner and making

it available for future use and reuse. It involves the selection of appropriate data
formats, the preservation of data for long-term storage, and the sharing of data with
colleagues and the public. Governments and funding organizations are focusing on
proper data storage and sharing (Chigwada et al., 2017). Effective data management
practices are crucial for facilitating the verification of research results and enabling
other researchers to build on existing research (Chigwada et al., 2017). As researchers
continue to be challenged to share their data in order to validate and reuse them, it is
crucial that researchers adopt sound data management practices in order to provide
efficient access to data, understand it, and use it throughout all phases of the project
(Briney et al., 2020). However, many researchers are unprepared for the challenges of
data management, are unable to handle the requirements of data management, and have
concerns regarding the storage, integrity, and backup options for their data (Yoon &
Schultz, 2017).

2.2 Challenges of Research Data Management

Yoon & Schultz (2017) in their study highlighted that research data management
poses various challenges for researchers. One challenge is the need for assistance from
experts in data management. Academic libraries have recognized this need and have
been actively involved in providing research data services to address the full data
lifecycle, including data management plans, digital curation, and metadata creation
However, there are still concerns about data storage, integrity, and backup options.

Another study by Krahe et al. (2019) stated that the diverse nature of data collected
and managed by researchers can also present challenges in data management.
Researchers may face difficulties in managing their data, particularly after project
completion It is important to emphasize the importance of assessing current data
management practices and adopting new practices if necessary.

In the context of specific countries, challenges in research data management have
been identified. For example, in Iraq, there is a lack of proper research data management
practices, including guidelines, human resources, infrastructure, and financial resources
(Mohammed & Ibrahim, 2019). Similarly, in Ghana, collaboration between researchers
and librarians is hindered by differences in vocabulary, which affects research data
management (Zotoo & Liu, 2019).

In a study conducted by Kim et al. (2023), an investigation was carried out to explore
the practices of research data management among researchers at five government
research institutes in South Korea. The study aimed to assess the extent to which these
researchers engage in discussions regarding their research data and to identify the
obstacles they encounter in relation to data sharing. This study additionally examined
the challenges that were experienced by the participants in relation to the sharing of
data. This research discovered that participants had limitations in their willingness to
share their data. The findings also indicate that the predominant approach to data
sharing involved direct exchange of data with an inquisitive researcher.

According to Chigwada (2022), the notion of research data management (RDM) is
somewhat new in Zimbabwe, as well as in other developing nations. The findings
indicate that researchers have knowledge of conventional methods for handling

research data. However, it is crucial for a significant majority of responders, specifically seventy percent (70%), with knowledge regarding digital Research Data Management (RDM) services. This awareness is essential because these individuals rely on machines and external hard drives to preserve their data. By contrast, a significant majority of 97.3% of respondents express a positive perception of Research Data Management (RDM) services, particularly considering the current requirement for Data Management Plans (DMP) in the application process for the majority of research funding. Nevertheless, the findings of the study indicate that researchers maintain stringent control over the accessibility of their research data, with most of them retaining the data on their personal computing devices for a period of five years. The researchers involved in this study have shown a reluctance to publish their data due to concerns regarding potential misuse and licensing complications.

Vinest et al. (2014) pointed out that the primary factors contributing to researchers' reluctance to disclose their data are primarily based on concerns that the disclosure of data may unveil deficiencies in the initial research and analyses. To address these challenges, it is crucial to enhance data literacy and promote the management of research data (Pálsdóttir, 2021). Information specialists and universities can collaborate to design relevant infrastructures and services that support researchers in their data management efforts (Pálsdóttir, 2021).

In nutshell, research data management presents various challenges for researchers, including the need for expert assistance, concerns about data storage and integrity, and the diverse nature of collected data. These challenges are recognized globally, with studies conducted in different countries highlighting specific issues and the importance of collaboration between researchers and librarians. Enhancing data literacy and promoting the role of academic libraries in research data management are crucial for addressing these challenges.

2.3 Research Data Management and Academic Libraries

Academic research libraries play a significant role in research data management. They provide services and support for researchers in managing their data (Tenopir et al., 2014). Perceptions of librarians regarding research data management services in academic libraries have been studied, highlighting the importance of these services in facilitating data management (Tenopir et al., 2014). A library can play a significant role in supporting research data management, and it can also champion efforts to manage raw research data in an effective and efficient manner (Abduldayan et al., 2021).

It is discovered that the use of research data management services is crucial to lessen obstacles to data sharing (Kim et al., 2023). These services are effective in minimizing the amount of effort required and mitigating legal concerns associated with data sharing. Furthermore, it is important to consider potential incentives for academics to participate in data contribution in future endeavors.

In order to meet the needs of researchers in managing their data throughout the research lifecycle, research data management services are essential. Academic libraries have taken an active role in offering support in this field after realizing the value of research data services (Yoon & Schultz, 2017). According to Yoon and Schultz (2017),

these services include a range of data management-related topics, including data storage, integrity, backup alternatives, data management strategies, digital curation, metadata development, and conversion.

For research data management initiatives to be implemented successfully, cooperation between various groups and departments within an institution is crucial. For instance, the central Research Information Technologies unit at UC Berkeley and the library have worked together to create a research data management program that combines IT services like backup and secure storage with library services like resource discovery and instruction. A consistent and comprehensive approach to managing research data is made possible by this collaboration.

To guarantee successful data handling, best practices and guidelines have been devised. The Findable, Accessible, Interoperable, and Reusable (FAIR) Guiding Principles offer a framework for open research data and metadata, recommending the use of persistent identifiers, appropriate authentication and authorization, adoption of community-accepted standards, and use of open licenses (Leonelli et al., 2017). Organizations like the Research Data Alliance (RDA) and the Global Open Data for Agriculture and Nutrition (GODAN) are putting these concepts into practice (Leonelli et al., 2017).

Storage, security, preservation, compliance, quality, sharing, and jurisdiction are important reasons for creating research data management services at institutions (Perrier & Barnes, 2018). Academic libraries' development of data services has accelerated due to the adoption of data management plan requirements by funding organizations like the National Science Foundation (NSF) (Perrier & Barnes, 2018).

Research data management facilitates research and verification, fosters scientific communication and comprehension, and allows for long-term data storage, among other advantages for scientific research (Zhou, 2018). The evolution of the scientific data paradigm and the expansion of the open access movement are the driving forces behind the development of research data management services (Zhou, 2018).

It's critical to comprehend researchers' attitudes and behaviors to successfully support them with data management. Open-ended interview questions can help reveal the requirements and difficulties that researchers are facing (Surkis & Read, 2015). Librarians can engage in meaningful dialogues and offer specialized support by becoming familiar with researchers' work in advance.

In the Malaysian context, according to Ismail, I. et al. (2022), there is hardly any empirical research on the RDM behaviors of researchers based in Malaysia. The study then fills the gap by examining the nascent state of Research Data Management (RDM) in Malaysian academic libraries, particularly focusing on the efforts of Universiti Sains Malaysia (USM). It notes that while RDM is a relatively new concept for researchers in the region, strides are being made to institutionalize this critical aspect of the research life cycle. The paper further delves into the initiatives, challenges, and prospects of RDM in Malaysia. It emphasizes the pivotal role libraries play in cultivating a culture of responsible data management among researchers. The study outlines key areas where academic libraries can contribute, such as providing training, establishing data repositories, and collaborating with researchers to meet data management requirements. Challenges, including lack of awareness among researchers, resource limitations, and

the need for a policy framework, are discussed. The paper concludes by highlighting the essential role of academic libraries in overcoming these challenges and shaping the future of RDM in Malaysia.

In conclusion, academic libraries' research data management services are crucial for meeting the data management requirements of researchers. These services cover a variety of data management facets and necessitate cooperation across several departments within an organization. The FAIR Guiding Principles and other best practices and recommendations offer a foundation for efficient data management. Research data management services have been developed in part due to institutional forces and the evolution of the scientific data paradigm. In order to provide focused support, it is essential to comprehend the RDM of researchers through interviews.

3   Methodology

This study encompasses a time frame of three months, precisely from December 2022 to March 2023. Within this period, five researchers willingly agreed to participate in interviews conducted via the Zoom platform. The utilization of screen recording proved to be advantageous due to the ability to visually observe the references made by the subjects, provided they granted an agreement to share their screens during the interview process. The folders and file names were encompassed in the discussion of their information management approaches. Additionally, the audio quality was of high clarity, leading to enhanced transcribing accuracy.

The utilization of virtual interview formats is a safer alternative considering the ongoing COVID-19 pandemic. The time required for the task was significantly reduced compared to the traditional approach of visiting a physical office and configuring recording equipment. The predominant method of managing files and other information has shifted towards a predominantly screen-based interaction. The utilization of screen-mediated interviews enabled the researcher to remain immersed in the conversation space.

The unstructured interviews, which lasted for one hour each, were transcribed and subsequently translated into the English language. In order to ensure anonymity, the participants' names were substituted with numerical identifiers. The writers thoroughly examined the transcripts to identify recurring themes and develop a nuanced understanding of the diverse methodologies employed by individual researchers. Although the sample size of 5 is not normally representative, the approach has been fruitful, and the obtained data are deemed valuable for future research. Prior to commencing the research, it underwent an ethical evaluation by the UiTM's review board (REC/11/2022 (ST/MR/241)).

The participants selected for this study were academicians affiliated with UiTM (Universiti Teknologi MARA) in the field of Information Science. They were specifically chosen based on their prior research experience or their current involvement in an ongoing research project. Emphasis was placed on identifying scholars who had disseminated their work through an open repository or scholarly journal. The participants were chosen using the snowball sampling method. The semi-

structured interview approach employed in this study aimed to gather specific information from each researcher, either through verbal responses or observations on "How is data and information management conducted in the research process?".

4   Result

4.1   Data Storage and Backup

Google Drive's emergence as the primary platform for data storage, collaboration, and backup among research participants is indicative of a shift toward cloud-based solutions in the academic environment. The service's multifaceted features—ranging from real-time collaboration to robust backup options—have made it an indispensable tool for researchers. Participant R2's statement, 'The team and I agree to do one G drive,' underscores the collective decision-making processes that often go into selecting a platform like Google Drive. This choice is not trivial; it reflects a unified strategy aimed at streamlining data access, fostering team collaboration, and ensuring data security. Furthermore, Participant R5 noted, 'We stored this document in Google Drive,' highlighting the platform's role in specific research activities, such as document storage. This utility extends beyond mere storage; it facilitates document sharing, versioning, and collaboration, thus enhancing research efficiency. Participant R4's comprehensive comment, 'I use the drive completely, Google Drive,' reflects the platform's all-encompassing nature, serving not just as a data repository but also as a collaborative workspace and a backup solution. However, the platform's ubiquity also calls for caution, especially in terms of data security and privacy, an aspect that researchers must not overlook.

Institutional Google Drive accounts offer a more formalized approach to data storage and management, typically featuring added benefits like enhanced security measures and increased storage capacities. Participant R4's detailed account offers a window into the practical aspects of using these institutional accounts. Specifically, R4 states, 'I will take those folders out, I will purchase an external drive for myself, and I will store and download them into the external hard drive.' This comment reveals not only the benefits of institutional accounts but also their limitations, as researchers may still need to rely on external solutions for long-term storage of inactive files. Therefore, while institutional accounts offer numerous advantages, they also highlight gaps in existing data storage solutions that academic institutions must address to meet researchers' evolving needs.

The use of external hard drives as supplementary storage solutions speaks to the limitations of existing cloud-based and institutional storage options. Participant R4's comment, 'The awareness has only just arrived. After UiTM said they would limit it, I said. I do have my own Gmail and my own Google Drive with that Gmail, right?' signals a growing awareness among researchers of these limitations. It highlights the importance of diversifying data storage strategies and the need for academic institutions to clearly communicate their storage policies. R4's awareness suggests a reactive, rather than proactive, approach to data storage, indicating that there is room for institutions to improve communication and education around data management best practices.

4.2   Communication Tools

The prevalence of WhatsApp as a communication tool for quick data exchange reveals a trend toward the adoption of easily accessible, mobile-friendly platforms in academic settings. Participants R5 and R1 both indicated that they 'transferred and saved the file via a WhatsApp group,' highlighting the platform's utility for quick, informal data transfers. While this approach offers the advantage of immediate communication and file sharing, it also raises concerns about data security, traceability, and long-term storage. The informal nature of WhatsApp makes it less suitable for sharing sensitive or critical data, suggesting that researchers should exercise caution and consider more secure alternatives for such purposes.

4.3   Reference Management

The use of manual arrangements for reference management by some researchers reveals an interesting divergence in preferences and perhaps even in philosophy toward academic work. Participant R2 noted, 'We do it manually because it gives more satisfaction ,' while Participant R1 also described having a 'softcopy version' in a folder. These remarks suggest a conscious choice in favor of manual methods, deemed to offer greater satisfaction or control. However, manual methods, while giving the user a sense of closeness to the material, can be time-consuming and prone to error, raising questions about their efficiency and reliability in larger or more complex research projects.

Reference management appears to be an area where researchers exhibit a diversity of preferences and practices. Participant R4, for example, opts for a manual, 'do-it-yourself' approach, stating, 'I will take the time to read and then use a method that's a bit like cataloguing.' This traditional method, while labor-intensive, is viewed as more satisfying by some researchers, including Participant R2, who mentioned the limitations of free trials in software like ReConnect. On the other hand, Participants R2 and R5 expressed a preference for software solutions like Mendeley and EndNote. These tools offer the advantage of automation but require an initial investment of time and sometimes money. This diversity in reference management strategies suggests a broader trend: the academic community is at a crossroads, needing to balance traditional scholarly practices with the efficiencies offered by modern technology.

4.4   Analysis Tools Data

The range of data analysis tools employed by the participants underscores the diversity of research methodologies in contemporary academic settings. Participant R1, for instance, uses 'SEM-AMOS and qualitative tools such as NVivo, and ATLAS.ti,' indicating a mixed-methods approach to research. This diversity in tool selection reflects the complexity and varied nature of academic research, where no single tool can meet all needs. However, this also implies that researchers must be proficient in multiple tools, requiring ongoing learning and adaptation. Institutions could support

researchers by offering training in a variety of data analysis tools, thereby enabling
more robust and versatile research practices.

4.5   File Management

File naming practices among researchers vary but serve the common purpose of
facilitating easy retrieval. Participant R3 notes, 'I will name them according to names
that are easy for me to search. Usually, it is according to the interviewee's name, date,
and department.' While such practices are essential for individual organizations, they
lack standardization, which could be problematic in collaborative environments. The
absence of a standardized naming convention can lead to confusion and inefficiencies,
particularly when multiple researchers are involved in data collection and analysis.

The filing systems used by participants range from manual to digital, often
incorporating elements of both. Participant R1, for example, uses both 'physical' and
'softcopy' versions, indicating a hybrid filing strategy. Participant R5 takes a more
dynamic approach, updating folder labels each semester and categorizing projects
based on their completion status. Such practices underscore the importance of a well-
organized filing system for efficient data management. However, they also highlight
the absence of a standardized system among researchers, potentially complicating data
retrieval and collaboration. As research becomes increasingly collaborative and
interdisciplinary, the lack of standardization in data filing could pose challenges,
indicating a need for more institutional guidance in this area.Table 1 shows the key
findings of the research.

Table 1: Key Findings

Section	Key Findings	Implications
Data Storage and Backup	Google Drive serves as the main platform for data storage, collaboration, and backup.	Google Drive's feature-rich environment makes it the go-to solution for researchers but raises questions about data security and intellectual property.
	Institutional Google Drive accounts come with added benefits like increased storage and enhanced security.	Institutional Google Drive accounts offer enhanced security but may still require external solutions for long-term, inactive data storage.
	External hard drives are used for additional storage, and there's a growing awareness of storage limitations.	Growing awareness of storage limitations implies a need for diversified data storage strategies and better communication from institutions.

Communication Tools	WhatsApp is commonly used for quick data exchange and communication.	WhatsApp's ease of use makes it popular for quick communication but may pose data security risks.
Reference Management	Some researchers opt for manual arrangements for reference management.	While satisfying for some, manual reference management methods may not be scalable or efficient for larger projects.
Filing System	Most participants employ either manual or digital filing systems to manage their data, storing it by folders or project names.	The lack of a standardized filing system may lead to data retrieval and management challenges.
Data Analysis Tools	A variety of data analysis tools, including both quantitative and qualitative, are used by the researchers.	The use of multiple data analysis tools indicates a diverse set of research methodologies but requires proficiency in various software.
File Management	The naming of files for easy retrieval is a practice employed by some researchers, although without any standard system.	The absence of a standardized file naming system may lead to difficulties in data retrieval, especially in collaborative settings.

5   Conclusions

The study embarked on a comprehensive and in-depth investigation into the challenges of research data management (RDM) faced by Malaysian information science researchers. A significant finding is the prevalent use of Google Drive as the main platform for data storage, collaboration, and backup. However, while Google Drive offers convenience and multiple features, it is crucial to recognize that reliance on a single platform could expose researchers to risks like data loss and limited access control. Moreover, the use of external hard drives and WhatsApp for quick data exchange indicates a fragmented approach to RDM, reflecting gaps in knowledge and practice.

Another challenge lies in the lack of standardization in data management practices. While some researchers employ specific file naming conventions, the absence of a standard system makes data retrieval less efficient. In addition, the study found a mix of manual and digital filing systems, suggesting a lack of uniformity and possibly hindering data sharing and collaboration.The findings offer valuable insights into the pivotal role that libraries can play in supporting researchers in their RDM journey. Libraries could act as the central hub for RDM by offering:

1. Educational Programs: Libraries can organize workshops and seminars on best practices in RDM, covering topics like data backup, secure data sharing, and file naming conventions.
2. Awareness: Academic libraries can launch awareness campaigns to educate researchers about the importance of robust RDM practices, thereby driving a cultural shift towards better data management.
3. Research Data Management Services: Offering specialized RDM services, such as data curation, archiving, and metadata creation, can further streamline the research process.
4. Technological Infrastructure: Libraries can invest in state-of-the-art technological infrastructure that supports a wide range of data types and formats, thus facilitating a more integrated and secure RDM process.
5. Consultancy Services: Offering one-on-one consultancy services on RDM can provide researchers with tailored solutions for their projects.
6. Reference Management Solutions: Given the manual arrangements some researchers opt for; libraries could provide software solutions for easier and more efficient reference management.

As Malaysian information science researchers increasingly turn to digital tools for RDM, academic libraries have a golden opportunity to step in and offer robust, integrated solutions. Addressing the challenges and needs identified in this study, including the added dimensions of education, awareness, specialized RDM services, and technological infrastructure, will not only optimize RDM practices but also elevate the role of libraries as indispensable support systems in academic research.

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