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Investigation and Analysis of Data Management Policies in Foreign Information Service Institutions

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Abstract

Selected 10 university libraries abroad as survey subjects, employing the tracking scanning and information extraction methods from library science information analysis and prediction, from the management of Abstract Selected 10 university libraries abroad as survey subjects, employing the tracking scanning and information extraction methods from library science information analysis and prediction, this study analyzes the policy elements of research data management from three aspects: which research data to manage, how to manage research data, and how to maximize the rights and interests of research data stakeholders. The research results indicate that in the e-science environment, research data management represents a future development trend for libraries. When formulating research data management policies, Chinese information service institutions can focus on research data storage specifications (storage obligations, storage content, storage formats), research data quality management specifications (assisting in creating personal research data management plans, actively conducting training, designing metadata standards, standardizing naming formats, designing storage durations, establishing databases), and research data sharing specifications (citation requirements, usage licenses, privacy protection), and improve data policies and policy guidelines based on accumulated practical experience.

Full Text

Investigation and Analysis of Data Management Policies of Overseas Information Service Organizations

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Abstract This study examines the data management policies of ten university libraries overseas using tracking and information extraction methods from library and information analysis. The analysis focuses on three core aspects: what research data to manage, how to manage it, and how to maximize stakeholder rights while ensuring data utilization. The findings indicate that in the e-science environment, research data management (RDM) represents an inevitable trend for libraries. When formulating RDM policies, Chinese information service organizations should emphasize three key areas: research data deposit standards (including deposit obligations, content, and formats), data quality management standards (assisting with personal data management plans, training programs, metadata standards, naming conventions, retention schedules, and repository establishment), and data sharing standards (citation requirements, licensing, and privacy protection). Policies should be refined through cumulative practical experience.

[**Keywords**] information service organization; research data; data deposit; data quality; data sharing

1. The Indispensable Role of Information Service Organizations in Research Data Management

Research data has garnered significant attention from academia, publishing, and library and information services, with numerous scholars exploring this domain [1-5]. Research data refers to original fundamental data reflecting the essence, characteristics, and changing patterns of the objective world, obtained through scientific activities or other means, as well as systematically processed datasets compiled according to specific scientific needs [6]. Research Data Management (RDM) encompasses the entire workflow and practical operations of data selection, organization, description, preservation, access, use, and evaluation, covering extensive activities ranging from standard formulation and data mapping across repositories to metadata creation, semantic annotation, and literature linking. Processed data exhibits universal value-added characteristics [7]. This multifaceted RDM emphasizes coordination with external environments (policies, institutions) and stakeholders [8].

Current research both domestically and internationally includes: Kim [9] demonstrating that RDM services enhance researchers' own data management capabilities; Shen and Varvel [10] investigating the implementation of data repositories at Johns Hopkins University; Stephen Kutay [11] analyzing issues requiring attention in research data management at educational institutions; Davidson [12] examining ongoing data management projects in the UK; renowned information behavior researcher Gary Marchionini introducing iSchool RDM experiences at Wuhan University [13]; and Jelte [14] arguing that data sharing should be the rule rather than the exception. Domestic research primarily focuses on summarizing foreign practices, such as Gu Liping' s analysis of rights issues in RDM

[15], Wu Zhenxin' s comparison of RDM policies across five universities [16], and Wu Xinnian [17] and Shen Mengxuan' s [18] analyses of RDM policy services and practices. Huang Ruhua examined metadata research progress from functional requirements and standard development perspectives [19], while Yang Yunxiu, Gu Liping, and others analyzed data policies of foreign research institutions and funding agencies [20-21].

Studying RDM policies of renowned overseas information service organizations in the US and EU can inform more comprehensive policy development in China. Recent domestic initiatives have pioneered RDM services. During the 2011-2012 CALIS Phase III project, Wuhan University Library piloted RDM services by identifying pilot departments, building a sharing platform, and providing data storage and sharing services university-wide [22-25]. Research outputs include comparisons of foreign university research data lifecycle management models [26], compilations of domestic and foreign university data sharing platforms [27], analyses of foreign policies and domestic research data service development [28], surveys of university user RDM needs [29], Wuhan University Library' s social RDM practices [22], case analyses of RDM implementation [23], and experiences in building research data repositories [30]. The COINFO 2014 conference, jointly organized by Wuhan University, the Institute of Scientific and Technical Information of China, and the University of Southern Queensland in October 2014, specifically addressed research data citation, publication, and sharing [31]. These concrete practices provide a solid foundation for Chinese information service organizations to develop RDM services.

RDM effectively addresses research output integrity and data standardization issues. Through proper data management, research visibility can be enhanced, academic rigor promoted, research quality improved, resource efficiency increased through reuse, new and valuable research questions discovered, scientific integrity advanced, and scientific development furthered [32]. The National Science Library, Chinese Academy of Sciences, has conducted relevant RDM research and practice. Building upon this foundation and responding to evolving data management policies both domestically and internationally, this paper extracts DRM policy elements from an information service practice perspective to provide reference for Chinese RDM policy formulation.

2. Analytical Framework for RDM Policy Elements in Information Service Organizations

Research data management emphasizes the complete process, encompassing data creation, storage, subsequent management and improvement, and ultimately data sharing, as illustrated in Figure 1 [Figure 1: see original paper].

Figure 1. RDM Content Framework [33]

When developing sound RDM policies that comply with funding agencies and research institutions, three fundamental questions arise: What data should the organization manage? How should data be stored and preserved after creation

to maximize utilization while protecting stakeholder rights? These questions guide the policy analysis and can be refined into observable research questions, as shown in Table 1 .

Information service organizations, responsible for collecting, processing, and managing information—including scientific institutes, libraries, information centers, and consulting firms—must implement data management. Whether university-affiliated libraries or specialized information service centers, their research is generally funded by research agencies, requiring policies that both comply with funding agency RDM requirements and incorporate unique institutional provisions. Some must also align with university policies.

Based on the *Compilation of EU Library Cases for Implementing Research Data Management* compiled by the Science and Technology Information Policy Center, this study employed snowball sampling to select ten representative and instructive cases, as shown in Figure 2 [Figure 2: see original paper]: Cambridge University Library (LCAM), MIT Libraries (LMIT), Yale University Library (LYL), New York University Libraries (LNY), Stanford University Libraries (LST), Johns Hopkins University Libraries (LJH), Cornell University Library (LC), King' s College London Library (LKCL), University of Vienna Library (LU), and Radboud University Library (LR).

Table 1. Analytical Framework for RDM Policies of Information Service Organizations

Research Question	Observable Questions
What to manage?	1. Why should information service organizations rather than other departments implement RDM? 2. Are there explicit provisions regarding data content for deposit? 3. Are there explicit provisions regarding data formats for deposit?
How to manage?	1. Are researchers required to submit DMPs? What should DMPs include? 2. Do information service organizations provide RDM training and guidance? 3. What are the structured and standardized formats for research data? 4. What naming conventions should data files follow? 5. Are there explicit regulations on data retention periods? 6. Are there explicit provisions on data storage locations and repository requirements?

Research Question	Observable Questions
How to use?	1. How can data producers' rights be protected during open sharing? 2. Are there explicit provisions on data use licensing? 3. How is research data privacy protection regulated?

3. Key Aspects of Research Data Deposit Content

3.1 Multiple Roles of Information Service Organizations in Supporting RDM In the e-science environment, research data exhibits exponential growth [35]. Libraries can provide diverse data services from multiple perspectives. Auckland [36-37] noted that librarians can offer data consulting, analysis, and storage services. Anna also recognized libraries' important roles in national data management planning, university RDM implementation, and RDM talent cultivation [38-39]. Cox [40] proposed that libraries serve as policy advocates, support and training providers, and repository auditors in RDM. Luis suggested librarians will assume "data curator" responsibilities in future RDM [41]. Lyon mapped libraries' potential roles to the research lifecycle model, identifying ten service layers: RDM collection, planning, information services, data citation, training, licensing, evaluation, storage, acquisition, and impact assessment [42-43].

Given research data' s scientific, economic, and social value, and its irreplaceable nature—once destroyed, it cannot be recovered—information service organizations, as information management centers with expertise in indexing, classification, and ensuring data security, play an indispensable role in research data preservation and utilization.

3.2 Required Research Data Content for Submission Research data content comprises original fundamental data reflecting basic characteristics and changing patterns of objective phenomena, including but not limited to: survey data, experimental data, interview data, educational data, and working papers. Many university libraries enumerate specific data types for RDM. For example, LR stores various collected data (interview data, video data, survey data, quantitative data, MRI data, observational data, experimental data, etc.) [44]. LYL stores survey data, simulation data, experimental data, and other compilable data [45]. LMIT manages conference papers, images, preprints, technical reports, theses, working papers, and research datasets [46]. LJH stipulates that data may include experimental or observational data but must comprise records suitable for further use and evaluation, including published research outputs; data that cannot be further utilized cannot be stored [47].

Some institutions have more flexible requirements. LU accepts research data in various forms—observational, experimental, derived, referenced, normative, or generated data—and even pedagogical research data [48].

3.3 Research Data Format Requirements Data format affects openness and citability and is critical for long-term accessibility. Preferred formats are: open, software-independent, non-proprietary, unencrypted, and non-compiled, as these are more preservable and usable without software constraints. LMIT recommends preferred preservation formats including ODF, ASCII, MPEG-4, TIFF or JPEG2000, and XML to ensure future discoverability [49]. LKCL advises using generic formats for preservation, avoiding software-dependent formats like RTF, Excel, or SPSS [50]. LST requires open formats but permits proprietary formats when conversion would cause data loss, provided a readme.txt file and relevant reading software are included [51]. Some libraries, like LYL, accept any digital file type (video, text, photos, numerical data) [52].

4. Quality Management of Research Data

4.1 Assisting with Personal DMP Creation A sound Data Management Plan (DMP) is prerequisite for data sharing, helping researchers manage data, meet funder requirements, and enhance resource sharing. Many institutions provide DMP templates covering: project/experiment/data description; documentation, organization, and storage; access, sharing, and reuse; and archiving [53] (see Figure 3 [Figure 3: see original paper]). LMIT, LST, LCAM, LYL, LNY, LC, LJH, and LR all require clear descriptions of data creation, content, responsible personnel, publication, sharing rights, and storage locations, offering online templates and the DMPTool to facilitate best practices [53-59]. LMIT and LC also provide DMP example links.

4.2 Conducting RDM Training Programs Librarians are primary RDM implementers, and their understanding directly determines RDM effectiveness. Consequently, many institutions offer specialized training: (1) for librarians to develop comprehensive RDM professional skills for supporting researchers; and (2) for researchers and students to understand data importance and enhance data literacy. LMIT [60-61], LCAM [62], LNY [63], and LJH [64] provide various data management workshops on file organization and version control, all accessible through their websites. LKCL offers similar courses with feedback surveys covering learning expectations, acquired knowledge, desired additional content, course strengths, improvement suggestions, recommendation likelihood, and other comments [65]. LR established a professional research data center requiring all staff to possess RDM service knowledge and offers dedicated RDM courses for doctoral students [66].

4.3 Designing Discipline-Specific Metadata Standards Research data metadata standards include but are not limited to: title, creator, identifier, date, subject, and funder [67]. Given disciplinary differences, institutions develop tailored standards. LMIT specifies metadata elements for data upload (see Table 2) and advises documenting data generation, organization, processing, and abbreviations. LYL [69], LNY [70], and LST [71] provide similar metadata standards, noting that appropriate standards depend on data type, scale, and

discipline. LC particularly provides explanatory files (named "readme") [72-73]. Library-managed research data resources are more structured than researcher self-storage, facilitating preservation, retrieval, and mining.

Table 2. Metadata Elements for Research Data Upload at LMIT [68]

Element	Description
Title	Name of dataset or research project
Creator	Name and address of creator/organization
Identifier	Number for data identification, even if only an internal project reference
Date	Key dates related to data (project start, modification, publication, time period)
Subject	Primary keywords or phrases describing data topic/content
Funder	Funding agency for research project
Rights	Intellectual property rights for data
Language	Available language types
Location	Physical or spatial location of data
Method	How data was generated (software/hardware, experimental protocols, etc.)

4.4 Standardizing File Naming Conventions File names should reflect characteristics and content with sufficient descriptive information for identification, including: project abbreviation, experiment name, location, observer, year, data type, version number, and file type. For automated processing, special characters and spaces are avoided, using "-" or "_" instead. LMIT' s naming format exemplifies this: `[type of file]_[specimen number]_[version]_[collector]_[YYYYMMDD]_[geolocation].[ext]`, such as `image_12345_v1_mcneill_20140117_42.3598N71.0921W.tif`. This clarity is crucial for file organization, resource sharing, and discovery [74]. LYL [69], LC [75], and LST [76] provide similar naming conventions.

4.5 Designing Appropriate Data Retention Periods Retention duration significantly impacts data discovery and access services, supporting the research data lifecycle. Policies include: (1) time-limited retention (4, 7, or 10 years) or (2) indefinite/permanent preservation. LKCL retains published research data from funded projects for 7 years and unfunded data for 4 years as appropriate; data without historical value but with reuse potential is retained for 4 years based on interest, while historically valuable data is preserved indefinitely with subject and national identification [77]. LR requires researchers to maintain data related to their publications for at least 10 years [44]. LU developed the Phaidra system advocating a "once in Phaidra, always in Phaidra" policy for permanent digital resource custody, storage, and indexing [78].

4.6 Establishing Data Repositories with External Linkages Data repositories help researchers manage data, unify citation identifiers, enhance discoverability, and promote long-term preservation. Storage locations include: (1) institutional repositories and (2) public repositories. LJH, LCAM, LU, and LST developed their own repositories—JHU Data Archive [79], DSpace platform [80], u:scholar [81], and SDR [82]—encouraging storage of papers, research data, and other resources. LCAM advises storing critical data in multiple locations [83]. LMIT distinguishes data types: the DSpace platform (co-developed with HP) and DVN platform (co-developed with Harvard) store digital research and teaching outputs; social science data can be stored in ICPSR; the library also assists with storage in DataBib, re3data.org, and OAD [84]. LC, with NSF funding, established the Cornell Geospatial Information Repository (GUGIR) and USDA Economic, Statistics and Market Information System (USDA-ESMIS), plus a Data Staging Repository (DataStaR) [85]. LNY [86] and LYL [69] provide links to disciplinary repositories despite lacking dedicated institutional repositories.

5. Key Aspects of Research Data Open Sharing

5.1 Standardizing Data Citation Formats Data citation encompasses relationships between literature and data, datasets, and other data, impacting researcher performance evaluation. Citations generally include: author, title, publication year, publisher/distributor, and URL/identifier/access location. Repositories typically assign unique identifiers (DOIs) to datasets for accurate identification. Some institutional repositories provide citation formats for reference. LMIT [88] and LJH' s Social Science Data Services [89] specify five required citation elements (author, title, year, publisher, URL/identifier) with examples and links. LYL [90] and LC [91] provide similar formats. LCAM' s FAQ notes that no universal citation format exists, with disciplinary variations, and links to Michigan State University Library and LMIT citation standards [92].

5.2 Establishing Reasonable Data Use Licenses and Scope Intellectual property rights for knowledge products must be defined through conditions and restrictions [93-94]. Licensing options include Creative Commons and Open Data Commons. LCAM encourages DSpace platform reuse, licensing Incremental and DataTrain project data under BY-NC-SA-2.0 (UK) and PrePARé project data under BY-SA-2.0 [95]. LST offers researchers two licensing options for SDR data: Creative Commons (primarily CC0, supplemented by CC BY) and Open Data Commons (PDDL, ODC Attribution License, ODbL) [96]. LMIT distinguishes between researcher-created/collected data (following CC licenses) and third-party data (for educational/research use only) [97].

Use scope may be restricted to: (1) institutional users or (2) external users. LKCL and LR require authors to specify data access and usage permissions during submission. LR stipulates that all published research data is open to verification and shared among library member units (users and information

service organizations), provided that the relationship between research data and academic integrity is carefully managed [44]. LMIT' s DSpace and DVN platforms are globally open, maximizing open sharing.

5.3 Classifying Data Types and Emphasizing Privacy Protection Secure preservation environments are essential for effective data transmission. Data management becomes critical when handling confidential, sensitive, or human subjects data. Data types include: (1) prohibited, (2) restricted, (3) confidential, and (4) public. Privacy protection measures vary by type. LST classifies data into these four categories and provides three storage options: Secure AFS (all types), Standard AFS (public and confidential only), Secure IGFS (public, confidential, restricted), Standard IGFS (public and confidential), and Online Archive Storage (public, confidential, restricted) [98]. Data sharing requires type modification to enable sharing, encouraging researchers to maintain multiple versions: one for public release and another for further research under strict constraints [99]. Human subjects data sharing is supervised by Stanford' s Institutional Review Board (IRB), with data collection limited to REDCap, STRIDE, and Qualtrics—Excel may only analyze de-identified data [100]. LKCL stipulates that individuals control personal data usage rights, with colleges accessing personal research data only when absolutely necessary and preferring anonymized sources [101].

6. Conclusions and Future Directions

6.1 Policy Elements for Information Service Organizations In summary, RDM policies for information service organizations can be categorized into three dimensions addressing the research questions: research data deposit standards, data quality management standards, and data sharing standards (see Table 3). As optimal RDM practitioners, information service organizations provide crucial guidance on data selection, DMP development, data description and preservation, and data sharing and use. Therefore, policies should incorporate content related to data deposit, quality, and sharing, while complying with funding agency and research institution RDM policies.

Table 3. RDM Policy Elements of Overseas Information Service Organizations

Research Question	Policy Element	Policy Content
What to manage? (Deposit Standards)	Multi-faceted RDM support	Information service organizations possess extensive experience in indexing, classification, organization, and ensuring data security

Research Question	Policy Element	Policy Content
	Data content requirements	Various collectable data types (survey, experimental, interview, educational, working papers, etc.)
	Data format requirements	Open, software-independent, non-proprietary, unencrypted, non-compiled formats (e.g., ODF, ASCII, MPEG-4, TIFF/JPEG2000, XML)
How to manage? (Quality Standards)	Assisting personal DMP creation	Researchers must submit DMPs when applying for data preservation to ensure management and sharing
	Conducting RDM training	Offering data management courses for librarians and researchers on data management and open sharing
	Designing metadata standards	Discipline-specific standards helping researchers understand their data and enabling others to discover, use, and cite it properly (title, creator, identifier, date, etc.)
	Standardizing file naming	Names reflecting file characteristics with sufficient description (project abbreviation, experiment name, location, etc.)

Research Question	Policy Element	Policy Content
	Designing retention periods	Typically 4+ years, influenced by data type, funder policy, and university policy
	Establishing repositories	Institutional repositories or other secure storage centers
How to use? (Sharing Standards)	Standardizing data citation	Citations must indicate sources, adhering to research ethics
	Establishing licenses and scope	Licenses per institutional regulations; scope primarily based on researcher requirements, supplemented by repository and university policies
	Classifying data types, protecting privacy	Four types (prohibited, restricted, confidential, public) with differentiated protection; human subjects data requires IRB supervision and specialized collection tools

6.2 Policy Development Requires Practice and Testing Through literature review and comparative analysis, this study extracted preliminary policy elements from ten overseas information service organizations. However, issues emerging in Chinese practice require further subdivision and revision of policy content based on practical experience.

6.3 Future Research Directions As information technology advances and data resources proliferate, data management has become an inevitable trend. Realizing the full potential of research data requires investigation of funding agency policies, research institution policies, academic journal data policies, and emerging Data Level Metrics. This study surveyed existing overseas information service organization policies to form a preliminary framework. Future work should accumulate and deepen implementation plans through researcher

interviews, including Best Practices and *Guidelines for Information Service Organization Data Management Policies*. Key research questions include:

1. How to raise data citation awareness? Can small incentives like "Data Sharer of the Month" motivate researchers to share data?
2. How can research data value be demonstrated beyond citations? How can data citations be tracked using metrics? Are persistent identifiers the only approach?
3. How can RDM services be embedded into university library professional research data centers? How can embedded infrastructure be established at research institutes or universities to improve embedded RDM services?
4. Should controlled vocabularies from terminology servers be established for non-standard data descriptions?
5. Under China's current research policy system, what roles can libraries and librarians play in data management? How can different data types and disciplinary characteristics inform differentiated data management policies?

The Science and Technology Information Policy Center of the National Science Library, Chinese Academy of Sciences, has fully translated *Guidelines for Data Management Policies for Institutional Repositories* and will host the 4th China Open Access Week in October 2015, anticipating collaborative RDM research and advancement.

Acknowledgments: The Science and Technology Information Policy Center of the National Science Library, Chinese Academy of Sciences, compiled and openly shared the report *Compilation of EU Library Cases for Implementing Research Data Management* in its institutional repository (ir.las.ac.cn).

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Note: Figure translations are in progress. See original paper for figures.

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