

Research Data Management Practices in University Libraries: A Study

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ABSTRACT

Research data is the data which is generated when the researchers undertake or execute any research activity or project. The data may be textual, quantitative, qualitative, images, recordings, musical compositions, verbal communication, experimental readings, simulations, codes and so on. It needs to be preserved for future use. In this context, the paper has studied the research data management (RDM) services implemented by different university libraries for managing, organising, curating and preserving research data generated at their universities' departments and laboratories, for reusing and sharing. It has surveyed the central university libraries and the best 20 university libraries of the world to highlight how RDM is extended to the researchers. Further, it has suggested a model for the university libraries in the country to follow for actually deploying RDM services.

Keywords: Research data; Research data management; Data repositories; Data curation; Data preservation

1. INTRODUCTION

Research data is the data which is generated when the researchers undertake or execute any research activity or project. The research data is generated across all fields of study, sciences, social sciences and humanities; but it differs across all these disciplines. The data may be textual, quantitative, qualitative, images, recordings, musical compositions, verbal communication, experimental readings, simulations, codes and so on.

The funding bodies and many international publishers have mandated that the researchers must submit their raw data which they have generated and used to report their research findings. They advocate that research data be deposited to open access data repositories for others to access, browse, use and validate the reported research. The dataset repositories use specialised metadata for describing research data which facilitates their easy discovery, access, and use. Furthermore, the funding bodies have mandated that the grant applicants should clearly define their data management plans (DMP) while submitting their proposals for grants.

Libraries have always played a proactive role, and influenced and shaped the scholarly communication. In this context, the present paper attempts to study the research data management (RDM) practices adopted by the central universities in India. It has also dwelt upon the practices followed by the leading universities of the world.

2. POLICIES ACROSS THE WORLD

The National Science Foundation (NSF) mandates that the applicants must submit an additional document about

DMP while submitting their proposals for seeking grants. The website of NSF clearly mentions that the researchers are required to share their primary data, samples, physical collections and other supporting materials generated during the research projects sponsored by NSF¹¹.

The data generated during the research activities are valuable resources which if properly stored may be accessed, browsed, consulted, used and built upon in future for academic work, research and scientific purposes. The sharing of data can help researchers in reanalysing, re-evaluating and revalidating the reported research findings. The researchers can add their viewpoint which may assist in the generation of new knowledge. Thus they can avoid squandering of time and efforts, and dissipation of energy on data collection and reinventing the wheel²⁸. The National Data Service (NDS) is a US initiative, a consortium of data providers, data aggregators, academic libraries, publishers and computing infrastructure providers. The NDS portal helps the researchers and scientists in publishing their datasets, searching, linking and reusing the already existing datasets²⁷.

The Australian National Data Services (ANDS) provides access to research datasets generated in the labs and universities of Australia. It facilitates and collaborates with the researchers in publishing, sharing, handling, de-identifying using and discovering datasets²⁶.

There are registries of data repositories like FAIR sharing.org, OAD (Open Access Directory of Data Repositories) which provide links to all Open Access data repositories across all the disciplines.

The Digital Curation Centre (DCC) is a globally recognised centre for capacity building in RDM and digital curation. DCC works with research organisations to help,

design, implement and deploy RDM so that open data gains and sustains momentum across the world⁹.

In India, the government supports open data through open government data (OGD, data.gov.in). The portal is used by the government departments and ministries for publishing their datasets, documents, services and tools for the general public to access and use. The national data sharing and accessibility (NDSAP) has been formulated to facilitate sharing of non-sensitive datasets generated in ministries and departments through the use of public funds. The government intends to encourage sharing of datasets for national planning and development.

The Indian Council of Social Science Research (ICSSR) has setup a portal called ICSSR Data Service¹³ for researchers, institutions in social sciences to deposit, use, reuse, and analyse data in order to support, promote and strengthen research endeavours and analyses of policies formulated and implemented across the country. The ICSSR Data Service holds NSSS and ASI datasets¹³.

3. LITERATURE REVIEW

Research data management entails all activities and processes which are undertaken or done to ensure that research data is properly documented, organised, stored, archived and curated so that it is available for access, use and reuse whenever the need arises after the research has been done and reported. A RDM system is designed as per the requirements of the researchers. A research data management system may be based on three-tier architecture. It may have file-based data storage; a database of metadata and a web interface to facilitate access and use of data⁵. There are other related concepts like data curation and data stewardship. Data curation is the management of data right from the stage of its origin to the point of time when it slips into obsolescence, is no longer valid and is fit to be deleted. Data stewardship refers to the efforts taken to protect the integrity and quality of data so as to ensure its usability by the researchers. It also entails adherence or compliance to the standards and protocols of the field. All the stakeholders like researchers, library staff, IT professionals, administrators and other professionals of the data management teams are responsible for data stewardship⁸.

Universities worldwide are focusing on research activities which have tremendously enhanced the production of research data. Till now the organisation and storage of those data were ad-hoc in nature and not focused upon. Now, as the funding bodies have mandated that the researchers and applicants must have RDM plans, it has gained importance and caused concern across the scholarly communication landscape. Libraries have always adapted to the changes brought by the technologies or by the information seeking behaviour of the researchers. In this context too, libraries have stepped in to provide RDM services to their researchers.

The ACRL research planning and review committee publishes every other year the top trends and issues which impact the academic libraries across the world. Its 2016 report highlighted the importance of research data services, data policies and data management plans among the different issues which influence the libraries in higher education². This topic

has acquired so much of importance that the last and the first issues of 2016 and 2017 respectively of *IFLA Journal* have covered the best practices in RDM, followed across the world.

The development of knowledge across different fields depends on how data is analysed, interpreted according to different perspectives. For this easy availability of research data is very essential. The generation of new knowledge is data intensive in nature, and it further necessitates the collection, organisation, preservation of research data for further access and use²².

The stakeholders should tap the potential of data curation and centres should try to add value by preserving data in appropriate formats with proper metadata to describe them.

Research data sharing, access, and reuse benefits scholarship by facilitating new theories to be developed and built upon; it also helps in validating science by reproducing already reported findings^{23,28}.

The concepts of “provenance, selection and appraisal, authenticity, metadata, risk management and trust play a pivotal role in digital curation; other concepts like sustainability, costing, planning and policy, training and education, researcher practices and raising awareness”²³ need to be dwelt upon.

It has been reported that even in US and Canada academic research libraries have not commonly implemented the research data services (RDS) or are in the very initial stage of planning and are more focused towards the needs of the faculty members than for the students²⁵. The researchers 7 studied 140 libraries located in Australia, New Zealand, Ireland and the UK. They found that data management services being provided by the libraries are very rudimentary in nature. They have emphasised that the data management practices should be incorporated in professional education and development programs. It has been observed by the experts that institutional support for data management is not uniform in an organisation or subject field. There is a wide gamut of services for describing research data and their management within and across subject areas and organisations²¹.

The qualitative data as generated in social sciences should also be curated for sharing and reuse. The researchers are reluctant to share data because of personal, confidential information of the participants, which if shared would amount to the breach of privacy. The personal information can be anonymised before it is put in public domain for others to access and reuse¹⁵. Karcher, Kirilove and Weber (2016) have described how Qualitative Data Repository (QDR) curates qualitative and granular data. They have also highlighted that the researchers are not well familiar with the concepts of copyright, confidentiality, ethics and fair use in scholarly communication.

The musical recordings are not considered as data; nevertheless, libraries can store and archive them as per the principles of data curation used for storing and archiving data generated in other fields. The professional musicians share their musical recordings through social media like YouTube, Facebook, and Vimeo. But these certainly cannot serve for storing and curating music recordings for long. They also lack adequate format and metadata support¹⁴.

The recommendations from two data curation summits held in late 2010 have highlighted that the interoperable

metadata for documenting and describing research data should be adopted. The staff should have clear documentation policies for data privacy and ownership; they should have skills to provide data curation support to the researchers³³. Librarians lack skills to provide RDM services; they are yet to become data fluent to provide data curation services. They need to reskill themselves to provide RDMS. Libraries have to play an active role in sensitising the researchers towards the importance of properly documenting, organising and preserving datasets for future. Generally, the researchers are not aware of the importance of preserving research datasets for future²⁴. They lack the ability to express their data management plans and how they will preserve and share them in future³¹. The librarians are expected to support researchers in their research data plans and practices and provide the technical infrastructure and support for actual data storage²⁴. These services should not be one size fits all. The research data management practices vary across the different disciplines¹⁷ and the libraries need to plan and customise the services as per the needs of researchers at different stages of research endeavours. For instance, the needs of the doctoral students can be classified into three categories of initial, middle and final stages of the doctoral programme. Libraries should deploy RDS keeping in mind all the stages of research⁶. The researchers are not very forthcoming with their datasets, this behaviour or tendency needs to be addressed¹². Close collaboration among all the stakeholders is required to initiate, promote, foster and strengthen collective learning and overcome new problems which may come up along the way of research activities. Librarians lack skills to provide RDM services; they are yet to become data fluent to provide data curation services. They need to reskill themselves to provide RDMS. The librarians need to be well aware of the basic concepts and terminologies used in data curation. For instance, the experts have introduced data practices, data, and curation (DPC) vocabulary of 187 terms which are used for implementing curation projects across the different disciplines. The vocabulary can be used for interacting and collaborating for providing data curation and management services¹⁷. There is need to develop digital curation skills in library professionals as well as researchers. Besides this, the computing infrastructure for providing RDM need to be strengthened.

The study conducted by Hickson¹², *et al.* has shown that the researchers were not very forthcoming with their datasets, and that behaviour and tendency needs to be addressed.

Close collaboration is very much required. It will initiate, promote, foster and strengthen bilateral learning and overcome new problems which may come up along the way as researchers carry on with their research endeavours.

Data governance is a pivotal component of research data management services. Digital governance is defined as the exercise of decision-making and authority for data-related matters⁷ includes interalia standards, metadata, and formulation of policies, guidelines for all the stakeholders to follow for describing organising, preserving, accessing and reusing the research data. The issue of quality of data also needs special attention. The quality of data implies that it should be organised and maintained in such a way that it is error free, trustworthy, accurate, complete, acceptable, discoverable,

accessible, intelligible and usable¹⁶. The data sets should have the relevant metadata to succinctly describe them. The qualities of data like completeness, accessibility, credibility and proper documentation facilitate and promote data reuse¹⁰.

The experts^{20,21} have recommended that data literacy modules should be incorporated into the curricula to equip the students and the researchers with the competencies to organise and curate their data sets correctly. The information literacy modules which the libraries have been providing since long^{1,20}; should also include the data literacy component. Library Science schools need to incorporate in their syllabi the various topics of research data management practices and train the students for future. The immersive model may be used for implementing and providing RDMS to the researchers¹⁸ in which all stakeholders are integrated, do work in close collaboration and gain from each other. The MLIS students, future data management professionals, need to know research data practices of different disciplines. Author¹⁸ has described a case study in which the MLIS students work in laboratories in close collaboration with researchers and faculty members and get first hand experience of how data is generated and recorded. Thus immersive model is one in which all stakeholders are integrated, work in close collaboration and gain from each other.

4. METHOD OF THE STUDY

The study covers the 47 Central Universities of India as per the list of University Grants Commission are listed in *Annexure A*. The study of these universities has been done to find if their libraries have initiated any steps to provide RDM services to their researchers. The study also covers the best 20 universities as per Times Higher Education 2016-17 rankings, of the world are listed in *Annexure B*

It has highlighted the practices prevalent among the university libraries and has focused on the following aspects:

- Whether the libraries are providing RDM services by themselves or in collaboration with other units of the universities.
- Identifying the main components of RDM services.
- Whether the libraries have any written on RDM
- Do the libraries have undertaken awareness campaigns to sensitise the researchers towards the importance of preserving research data.

5. DATA COLLECTION AND INTERPRETATION

The websites of 47 central universities and their libraries were visited to find out if the libraries have deployed RDM services to collect, organise and curate data generated at their departments and laboratories. The authors did not observe any mention or link of RDM policies. It is very likely that the libraries are still in the process of developing policies and plans for organising and curating research data.

It is pertinent to mention here that there are 30 government and research institutions which maintain their own data repositories or submit their data to specific subject repositories. These 30 institutions are listed in www.re3data.org which is the registry of data repositories available on the web. The registry has listed 1500 research data repositories across humanities, social sciences, and sciences.

6. FINDINGS OF THE STUDY

The libraries of the best 20 universities have provided comprehensive, in-depth information about how to:

- Develop and write plans for RDM for grant applications. The libraries have provided links for case studies, training material, guides, DMP tools and checkpoints for researchers to develop their research data plans. There are research data consultation groups which help the researchers in maintaining and preserving data life cycles.
- Publish and deposit data to data repositories as per their requirements.
- Describe their data with metadata and save data in appropriate file formats preferably in non-proprietary formats.
- Manage and handle personal, sensitive data and adhere to the protection requirements.
 - Backup data
 - Organise and save qualitative data
 - Reference and cite data
 - License data
- The university libraries studied have RDM policies. Some of the RDM policies were not accessible. It is likely that they are available on the Intranet.
- The libraries of Oxford University, Imperial College London, and University College London have clear Research Data Management policy. The library of ETH, Zurich has spelled its research data management policy under the guidelines for research integrity. The other libraries provide guidelines for the researchers to follow for writing research data management plans and for saving and sharing them.
- Libraries have provided links to the research data policies of NIH, NSF, and international publishers. They have also provided details of general and subject-specific data repositories like Dryad, Figshare, Gen Bank, Qualitative Data Repository, Zenedo; software repositories like GitHub, bitbucket, etc. where the researchers may deposit their datasets.
- Libraries also conduct user education, workshops, face to face interaction, and domain-specific training programmes for the researchers. The John Hopkins University Library provides online training course on guidance, education on how to manage research data
- The majority of the libraries provide RDMS in partnership with the Research and Information Communication Divisions of their universities. This is in harmony with what the experts reported earlier²¹.
- Libraries have created Institutional data repositories like ORA-Data, Scholarly Commons of Oxford and Pennsylvania University, respectively. While other universities like Stanford, Columbia University have common institutional repositories for full-text publications and datasets. Libraries encourage and guide the researchers to archive their datasets to Drop Box, Google Drive and other devices with unlimited storage facility.

7. SUGGESTIONS

It is paramount for all the stakeholders to understand the relevance of research data, their easy availability and retrieval for use by others after the research has been conducted and reported. Especially the administrators have to understand the importance as they have to give administrative and financial concurrence for the preservation and curation of research data plans. Libraries may submit robust proposals for deployment of RDM services, but the real, long-lasting implementation may only be realised if the administration unit institutes a research data policy at the university level and allocates budget for running RDMS in a sustainable manner.

Libraries should take the lead in the curation of the research data generated in universities. Besides curating and preserving research data, libraries can also preserve universities' historical data like photographs, annual reports, yearbooks, etc. Collaboration or partnership is the mantra for successfully undertaking and executing any curation project. Libraries may collaborate with researchers, project investigators and computer divisions of the universities in order to achieve the desired results of data curation for access and use. Close cooperation with the researchers and scientists facilitates easy acceptance of the RDM system.

Libraries should develop computing infrastructure in order to collect, organise and store the datasets. Some of the universities are already having institutional repositories. Implementing RDS will be extending the services of IRs which they have been long providing to their researchers. The libraries may develop a database of profiles of researchers and faculty members. The researchers should be able to log into the database and upload their research interests, projects in progress etc.

- Libraries should develop written policies for RDM in their universities.
- The researchers should be encouraged to get an Open Researcher and Contributor (ORCID) or Researcher ID (Web of Science) which will distinguish them as individual researchers.
- Library science departments should revise their curricula in order to impart Education and Training in the application of new tools and technologies. They should try to introduce short-term programmes, commonly known as continuing education, for mid-level professionals.
- Efforts must be invested in capacity building for providing effective RDM services. Library staff need to continuously update themselves with new technologies, tools of data analysis and visualisation. The staff should be aware of tools like Open Refine, Regular Expressions, Web scraping, Dataverse project, Mendeley Data, etc.

Libraries need to undertake awareness campaigns on a grand scale to sensitise the researchers and project investigators to the importance of data management plans, which need to be developed before the research project begins. They must impart training to the researchers in using metadata to describe their data and how to deposit them in subject-specific data repositories to preserve them for future use. They need to outreach the project investigators and researchers of their universities in order to find out their needs of data organization, curation, and

preservation. Focus group studies should be conducted to find out how the researcher generate and maintain data and what services they expect from the libraries. They may adapt the Purdue University libraries data curation profiles toolkit for conducting interviews with the researchers.

The present study has attempted to give a model, depicted in Fig. 1, for the university libraries to follow for administering RDMS.

8. CONCLUSIONS

The present study has dwelt upon the importance of research data and how university libraries are providing RDM services to their researchers. It has been found that the central universities in India are in the very initial stage of implementing RDM services; whereas the top twenty world's leading university's libraries have deployed them and are playing a pivotal role in supporting the research data needs of their researchers. The provision of an effective research data services is the need of the hour so the library staff should take a concerted approach to update themselves and learn new technical skills to identify, the researchers' needs design, implement and deploy the infrastructure and services needed to organise, store and preserve the research data for access and reuse. They may need to work in collaboration with other stakeholders to ensure deployment of RDS and equitable access to the research datasets.

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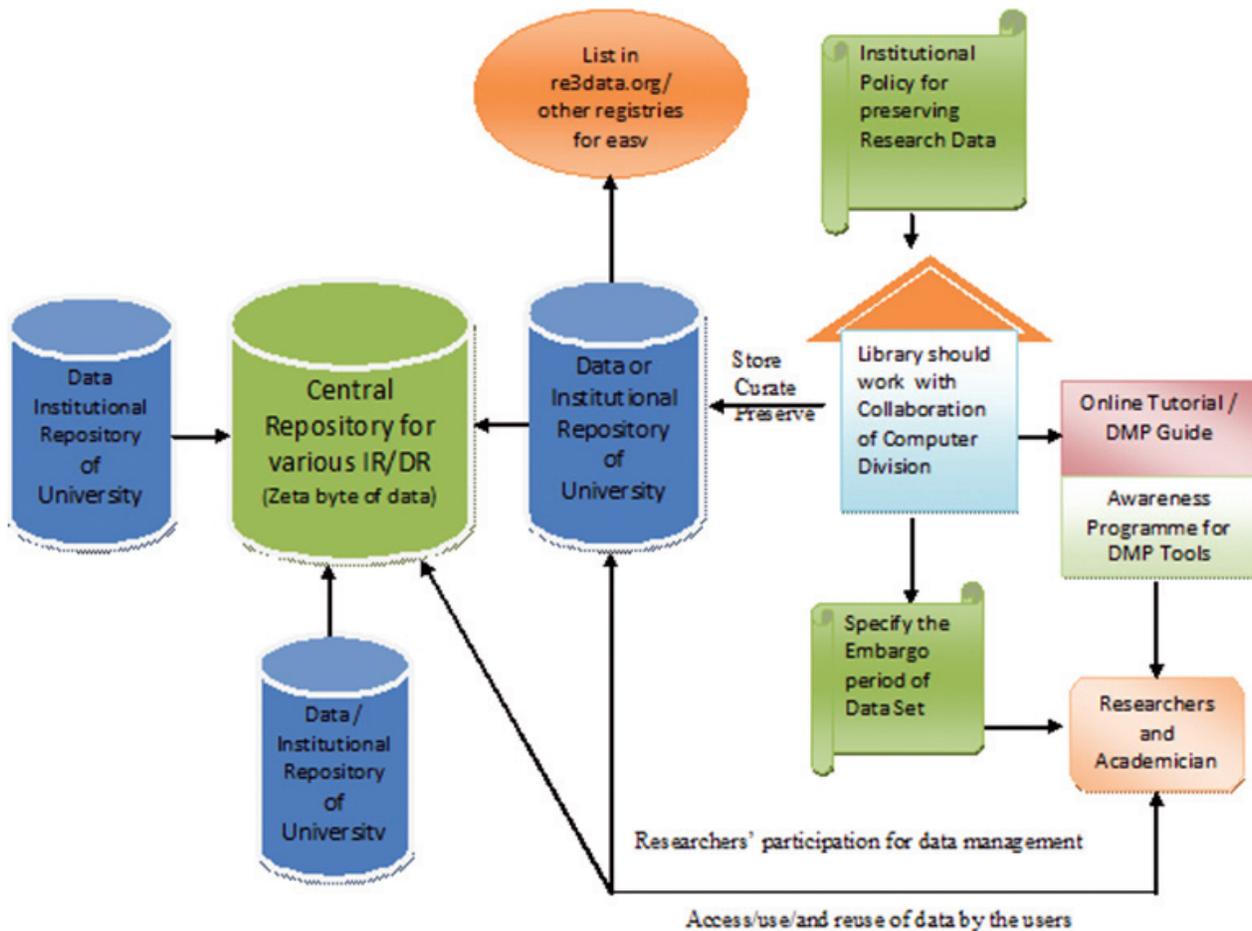


Figure 1. Model for research data management service.

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Dr Archana Shukla obtained her M.A. (English), Master's and PhD in Library and Information Science from Bundelkhand University, Jhansi. Presently working as Reader in the Faculty of Library & Information Science. Her areas of interest includes: Management of library and information centres, information consolidation and repackaging, academic library system, classification and cataloguing.

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Annexure B

List of Central Universities in India

1. Rajiv Gandhi University, Itanagar
2. Assam University, Silchar
3. Tezpur University, Tezpur
4. University of Hyderabad, Hyderabad,
5. Maulana Azad National Urdu University Hyderabad,
6. English and Foreign Languages University Hyderabad,
7. Jamia Millia Islamia, New Delhi
8. University of Delhi, Delhi
9. Jawaharlal Nehru University, New Delhi
10. Indira Gandhi National Open University, New Delhi
11. South Asian University, New Delhi
12. The Indira Gandhi National Tribal University, Amarkantak
13. Dr. Harisingh Gour Vishwavidyalaya, Sagar
14. Mahatma Gandhi Antarrashtriya Hindi Vishwavidyalaya, Wardha
15. Mizoram University, Aizwal
16. North Eastern Hill University, NEHU Campus, Shillong
17. Manipur University, Imphal
18. Central Agricultural University, Imphal
19. Nagaland University, Kohima
20. Pondicherry University, Puducherry
21. Sikkim University, Gangtok
22. Tripura University, Agartala
23. Aligarh Muslim University, Aligarh,
24. Babasaheb Bhimrao Ambedkar University, Lucknow
25. Banaras Hindu University, Varanasi
26. University of Allahabad, Allahabad
27. Rajiv Gandhi National Aviation University, Raibarali
28. Rani Lakshmi Bai Central Agricultural University, Jhansi
29. Visva Bharati, Shantiniketan
30. Hemwati Nandan Bahuguna Garhwal University, Srinagar
31. Central University of Tamil Nadu, Thiruvavur
32. Indian Maritime University, Chennai
33. Central University of Rajasthan, Ajmer
34. Central University of Punjab, Bathinda
35. Central University of Orissa, Koraput
36. Central University of Kerala, Kasaragod
37. Central University of Karnataka, Gulbarga
38. Central University of Jharkhand, Ranchi
39. Central University of Kashmir, Srinagar
40. Central University of Jammu, Jammu
41. Central University of Himachal Pradesh, Kangra
42. Central University of Haryana, Mahendergarh
43. Guru Ghasidas Vishwavidyalaya, Bilaspur
44. Central University of Bihar, Patna
45. Nalanda University, Rajgir
46. Mahatma Gandhi Central University, East Champaran
47. Central University of Gujarat, Gandhinagar

Annexure A

Research data management at selected university libraries of the world

Universities	Library website	Availability of RDS	Data repository	Policies	Library alone or in association with other divisions
University of Oxford	http://www.bodleian.ox.ac.uk/bdlss/digital-services/data-archiving	Under digital services-as data archiving	ORA Data	Bodleian libraries' policy on the management and preservation of research data and records Policy on the management of research data and records	Library alone
California Institute of Technology	http://libguides.caltech.edu/data-management	Research service	Caltech CODA and other subject-specific repositories	Links to policies of nih, nsf	Library alone
Stanford University	http://library.stanford.edu/research/data-management-services	Data management services	Stanford Digital Repository	Plans and guidelines	Library alone
University of Cambridge	http://www.data.cam.ac.uk/	Research data management	ESRC data Repository NERC Data Repository	Research data management policy framework	Library with the Research Office
Massachusetts Institute of Technology	http://libraries.mit.edu/data-management/services/	Research data management	MIT repository, HMDC, ICPSR and IASSIST	Data management plan/guidelines	Library alone

Harvard University	http://guides.library.harvard.edu/dmp	Data management plan	Harvard Dataverse Network	Data management policies: retention and maintenance of research records and data. Research data security policy	Library does with Research division, IT division; Institute for Qualitative Social Science
Princeton University	http://library.princeton.edu/research-data-management	Research data management	Data space	Data management guides –provide general and university-specific guidance	Library with Office of Information Technology
Imperial College London	https://www.imperial.ac.uk/research-and-innovation/support-for-staff/scholarly-communication/research-data-management/introduction-to-research-data-management/	Research data management	Box service with unlimited data storage	Research data management policy imperial research data policy	Library with Research office and ICT Division
ETH Zurich-Swiss Federal Institute of Technology	https://sis.id.ethz.ch/researchdatamanagement/	Research data management	Institutional repository ETH Archive	Data management policy in guideline for research integrity	ETH Scientific IT Services Digital Curation Centre
University of California, Berkeley	http://researchdata.berkeley.edu/	Research data management	DASH	Research data management policy	Library does with Research and IT Department
University of Chicago	http://guides.lib.uchicago.edu/datamanagement	Data management plan	Research Computing Centre Storage system	Guidelines for specific repositories and local storage solution	Library alone
Yale University	http://guides.library.yale.edu/datamanagement	Research data management		Guidelines	Research Data Consultation Group from different departments
University of Pennsylvania	http://guides.library.upenn.edu/data-management	Data planning and management	Scholarly Commons	Provide links to subject-specific and general data repositories	Library alone
University of California, Los Angeles	http://www.library.ucla.edu/support/publishing-data-management/scholarly-communication-services/data-management-curation-services	Data management and curation services	Merit	Provides links to policies of funding bodies, dmp tool	Library alone
University College London	http://www.ucl.ac.uk/library/research-support/research-data	Research data management	Lists various NERC Data Centres	Ucl research data policy	Library with IT division,
Columbia University	http://scholcomm.columbia.edu/data-management/	Research data management	Academic Commons	Links to general and special repositories, detailed plan about how to manage research data	Library alone
John Hopkins University	http://dms.data.jhu.edu/data-management-resources/plan-research/jhu-policies-for-data-management-and-sharing/	Data management services	JHU DATA ARCHIVE	Detailed plan about how to manage research data	Library alone
Duke University	http://library.duke.edu/data/guides/data-management	Data and visualisation services	Duke Digital Repository	Links to general and special repositories, detailed plan about how to manage research data	Library alone
Cornell University	https://data.research.cornell.edu/	Research data management plan	e-Commons, CUGIR.	Policies, plans	IT@Cornell, CISER computing, Cornell University Library
North western University	http://libguides.northwestern.edu/datamanagement	Research support service	Selected data repositories listed for sharing of data	Research data policies	Library and Research Office