ISBN: 978-93-90847-20-4

3. Preserving Global Research Data: Role and Status of Re3data in RDM

Surbhi Arora

Research Scholar,
Department of Library and Information Science,
Panjab University,
Chandigarh, India.

Razia Rahil

Professor,
Department of Library and Information Science,
Panjab University,
Chandigarh, India.

Abstract:

Purpose: Considering that scientific data is being increasingly renowned as an important raw material for current and future technological advances, many research collaborators have joined together to create mechanisms to secure and preserve it. However, irrespective of the generation of rich analysis results, this study was undertaken to examine the RDM activities on the global Registry of Research Data Repositories platform (Re3data) to increase its level of visualization.

Design/Methodology/Approach: The study approached the Re3 website, a global registry of research data repositories to collect the data. The researcher specifically assessed the 9 alternative search strategies that are available in the Re3 database; namely subject, content, keyword, metadata standards, quality management, repository languages, software, repository types and country.

Findings: It is observed that behaviors related to structured study results are more evident in developed countries as opposed to developing countries, although the U.S. is placed first. Results also indicated that research data is more structured in the case of scientific and statistical formats and disciplinary databases, particularly the life sciences. Overall, the software is mainly used for processing data and the English language is strongly supported. Dublin core metadata is often used to increase the quality of data from analysis.

Originality/Value: This study presented an overall picture of the research data practices throughout the investigation on the Re3data platform. The research proposed best practices focused on RDM operations to improve the amount of Research Data activities.

Keywords:

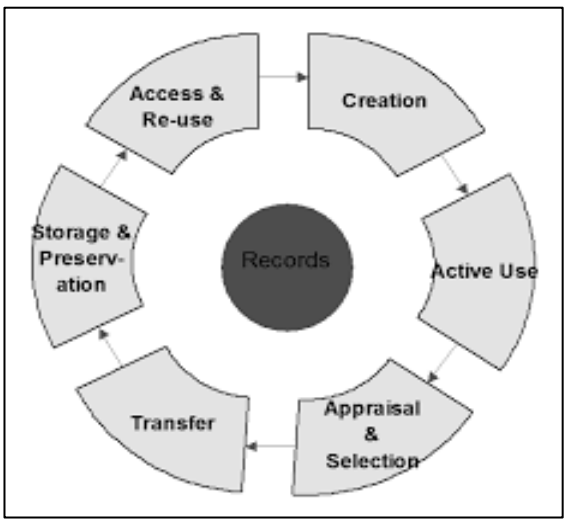
Research Data Management, Research Data, Scientific data, Re3data, Repository.

3.1 Introduction:

Research data is the data produced or generated in the form of pictures, tables, diagrams, videos, etc.(digital) and questionnaires, pictures, etc. (non-digital) as an important outcome of any research project (the University of Leeds, n.d). Long term preservation of research data contributes to more reliable research outcomes, more accessibility to research community and enhances quality and efficiency. There are repositories which are spread across the world actively engaged in preserving such valuable data. Re3 data is a global registry of global research data repositories, launched in 2012. The aim of the Re3data is to have permanent and long-term storage of research data in order to avoid duplication of work, sharing of data, to increase visibility of research data for the researchers, funding bodies, publishers and scholarly institutions. Re3data is a collective work of different types of organizations. Research Data Management (RDM) is 'the organization of data, from its entry to the research cycle through the dissemination and archiving of valuable results. It aims to ensure reliable verification of results and permits new and innovative research built on existing information' (Whyte & Tedds, 2011, Paragraph 4). It covers the managing, sharing, dissemination and reuse of data (Australian Research Council, 2018).

3.2 Research Data Life Cycle and RISE Framework:

Pennock (2007) gave a lifecycle approach to manage and curate digital information. The objective of the study was to maintain the authenticity and effectiveness of digital information for future reuse. Lifecycle comprises of 6 components i.e. creating data followed by processing data, analyzing data, preserving data, giving access to data, and reusing the data (Eynden, 2013). Data phase creation, approach for collecting and improving proper research data and metadata preparation followed by data processing that includes the input of the research data description with its metadata throughout the validity audit activities. Analyzing the data operation defines the performance well while preserving the data performs well-placed data storage plan, formatting, and medium research. Giving access to data means distributing data for reuse in line with copyright guidelines and proper citations.



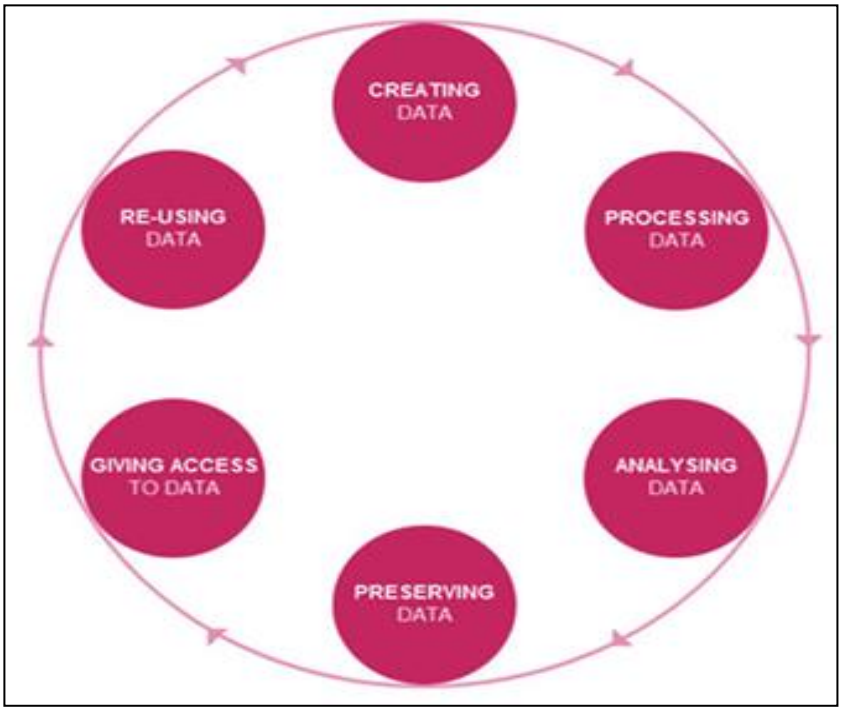


Figure 3.1: Lifecycle model (Pennock, 2007) and UKDA lifecycle model (Eynden, 2013)

Table 3.1: Lifecycle components (Chakravarty, 2015)

SN	Lifecycle components	Description
1	Creating Data	It contains data management planning, sharing and metadata creation.
2	Processing Data	It is about inputting data with its description at an appropriate location, checking its validity, and then saving it.
3	Analyzing Data	Regarding clarification of research output and understanding.
4	Preserving Data	It is about storing and getting data backup and its metadata in the appropriate location, format, and medium.
5	Giving access to data	It concerns the establishment of guidance on copyright, its distribution and promotion of saved records.
6	Re-using Data	It is about the reuse of data in supplying the copyright holder with adequate citation and quotation.

The six components approach to the life cycle is important to guide and develop the RDM services. The lifecycle approach starts from the planning stage of creating the data and metadata because digital materials are flexible and vulnerable to alteration throughout their life cycle from technical changes, so planning is a must. Library personnel, IT staff, and other stakeholders are involved in the processing, and analyzing the research data such as

library which can provide a certified repository to preserve the data with its reliability. Reliable re-use of digital materials is possible only if materials are designed in such a manner as to maintain their quality and credibility (Pennock, 2007). The Research Infrastructure Self-Evaluation (RISE) framework was developed by the Digital Curation Center (DCC) in 2017 to facilitate RDM services planning and development at the institutional level, primarily for the Higher Education Institutions (HEIs). The framework has been divided into ten research data support services and 21 capabilities.

Figure 3.2: The RISE Capability Model (DCC, 2017)

Table 3.2: Research Infrastructure self- Evaluation (RISE) Framework (DCC, 2017)

Research Infrastructure self- Evaluation (RISE) Framework				
	Parts	**Level one**	**Level two**	**Level three**
RDM Policy and strategy	Policy development	Roles and responsibility of researchers, staff, other stakeholders, and funders expectation policy	Good RDM practice with its updated process	Promotion of RDM policies to increase its uses

Research Infrastructure self- Evaluation (RISE) Framework				
	Awareness raising and stakeholder engagement	Promotion of research data policies among its relevant stakeholders	Guidance regarding the practical implementation of policies to the institutional context	Marketing of policies
	RDM implementation roadmap	RDM structure is defined by fund requirements	RDM structure according to institution strategy and researcher priority	Roadmap needed to support RDM
Business plans and sustainability	Staff investment	About the responsibility of staff	Trained the staff to redesign their roles	RDM services by redesigned staff
	Technology investment	Investment in technical infrastructure	Coordinates with central technical services	Invest in technical infrastructure in all aspects of RDM
	Cost modeling	Grants for RDM services	Grant for standard RDM services	Support of cost modeling for RDM standard
Advisory services	Advisory services	Online guidance such as through helpdesk email. Content can be institutional specific	The orientation of services and policies to researchers	Guidance to fulfill the need for a specific institution
Training	Online Training	Online RDM courses	RDM courses with supplemented material and support	Regarding review and update of online material
	Face to Face training	Updated face to face RDM training on a request basis	Face to face training for all	Training based on the knowledge of researchers

Research Infrastructure self- Evaluation (RISE) Framework				
				and professional staff.
Data management planning (DMP)	DMP	Guidance regarding funder mandated DMP to researchers	Templates, research office may provide help to researchers to develop DMP	Institutional support service
Active data management	Scalability and synchronization	Service for manage and access of data through multiple devices	Additional storage on request	Automated additional storage services
	Collaboration support	External collaboration with local access rights	Collaborations through access to tools	Through a virtual research environment
	Security management	Prevention of data with its authenticity	Tools service for researchers to de-identifies encrypts or control access to data as required	Standard service to share and secure sensitive data
Appraisal and risk assessment	Data collection policy	Data deposit with legal compliance	Retention service of datasets to preserve long term value to the institution	Service regarding developing datasets that meet the needs of users
	Security, legal and ethical risk assessment	Ensure data collection according to legal and ethical criteria	Manage the legal and ethical risks relevant to its depositors and users	Guidance on risk assessment and solution to control the risk
	Metadata collection to inform decision making	To access the research data from the research project	Recording of metadata of research data describes its risks, cost, and benefits to the institution	Value addition in described metadata to fulfill the need of users

Research Infrastructure self- Evaluation (RISE) Framework				
Preservation	Preservation planning and action	Services to hold data, its metadata, and other related information	Regarding preservation plans such as migration	Tools and expert services to maintain the significance of data and its related information
	Continuity support	Automated storage support of one backup copy	Automated storage support of two backup copies, one online and another is offline	Service regarding automatic storage of data and metadata in multiple locations
Access and publishing	Monitoring locally produced datasets	About gathering of research project knowledge to satisfy funding decision criteria	Recording of metadata to enhance the quality of an institution's research output	Recording of metadata and to connect it with other activities and outputs to organize institution strategy
	Data publishing mandate	The minimum external requirement for access to metadata publicly	To access the data with proper citation	Support service to discover and review the data for user groups and organizations
	Level of data curation	A brief inspection of data and metadata for compliance purpose	To sustain the value of data	Maintain the quality of data on the time of customized it
Discovery	Cataloging scope of Metadata	Catalogues of metadata that can be easily searched, edited, and linked according to funder's expectations	Metadata catalogue service with best standard to enhance the value of institution data assets	Reuse of data according to leading standards

- **Description:**

The RISE framework describes 21 capabilities, distributed across ten Research Data Support Services (RDSS). The ten RDSS i.e. RDM policy and strategy followed by Business plans and sustainability, Advisory Services, Training, DMP, Active data management, Appraisal and risk assessment, preservation, access and publishing, discovery, all depending on the requirement of institutional context. RISE has three skill levels in each field which corresponds to specific service value levels. Level one is for compliance, level two is for providing locally-tailored services and level three is for sector-leading activity. Service rates differ according to administrative context.

3.3 Literature Review:

Piracha& Amen (2018) examined RDM policy and planning in the university libraries of Pakistan. The study aimed to evaluate the policy framework and planning regarding RDM. Data were collected from 30 higher education commission high ranking university libraries by using mixed method explanatory sequential design. The respondent rate was 78%. Results indicated that library heads just heard about RDM, while few libraries were at the planning stage due to lack of knowledge and awareness. The study concluded that library professionals had insufficient knowledge about RDM and there was a need for motivation, coordination with researchers, and skilled knowledge for the service provider.

Thielen & Nicholas Hess (2018) examined advanced RDM in the social sciences discipline. The aim of the study was to explore how a research data librarian and an educational librarian were collaborating to provide tailored RDM instructions for a previously unconsidered community of students: doctoral education students. The study was based on primary data, and a case study was conducted to collect the information. Results indicated that participants believed that practice concerning several data management practices covered by the librarians would change. The study concluded that social science librarians need to conduct workshops, practical suggestions, and training programs at their institutions to strengthen the advanced RDM.

L. Lang and. Al. (2018) performed a case study to analyze the crossroads research support: capability and partnership at the University of Willington in Victoria. The aim of the study was to reposition library services according to the researchers' needs and contextualize them within the lifecycle of the research without reducing other responsibilities. The study was based on primary data. To collect the information, a case study was conducted. The study found that new skills and competencies were needed and positive progress was achieved through collaborative participation throughout the university. The study concluded that providing skills to stakeholders in collaboration with the library can provide RDM services without any reduction in other library activities.

Shelly & Jackson (2018) examined the role of libraries to support RDM services. The aim of the study was to identify university groups and role of libraries to provide RDM services. The study was based on primary data and to collect the information. 13 Australian universities were examined using the content analysis method. The study showed that there was not a clear approach to RDM.

Generally, strong encouragement was given to secure and store research data during and after the project. But overall, there was a lack of practical assistance. The article concluded that libraries were quite active to support the RDM services. There was a need for advice and practical suggestion to researchers on RDM, particularly in the areas of creating metadata and loading data to repositories. Zhou (2018) examined the perceptions and practices of Academic libraries to provide RDM service. The purpose of the study was to explore the RDM services and effective recommendations for academic libraries to conduct data management services. The paper was based on summarizing and analyzing the implications of RDM. The study identified many core elements of RDM service practices such as policy design, architecture, service quality, funding model, and staffing. The study concluded as a whole that RDM service was still in its initial stage. It must go through links such as policy formulation, infrastructure building, service content design, service team formation, service user mining, and fundraising.

3.4 Study Scope:

For investigation and collection of data The Re3, Registry of Research Data Repository website is selected for various reasons: first, re3data has become the global database of knowledge about research data repositories. Second, it indexes and gives detailed information about more than 2450 research data repositories. Third, re3data has become the most comprehensive reference source for research data infrastructures globally. Fourth, it increases the accessibility and visibility of research data repositories from all over the world. Last, it promotes trustworthy, reliable and up-to-date research repositories.

The study seeks to enable librarians, research scholars and other stakeholders to become aware of numerous worldwide research data management activities.

3.5 Study Objectives:

Based on the scope of the study, the study strives to accomplish the following objectives:

a. To identify out the most approachable subject to exchange the research data.
b. To identify out the most recommended format of research data.
c. To assess the most adopted keyword analysis type.
d. To identify the most preferred metadata standard.
e. To assess the level of quality management.
f. To determine the preferred language.
g. To analyse the software type for analysis of research data.
h. To identify highly active contributor repository.
i. To find out the country that is most involved in sharing the study results.

3.6 Methodology

The Re3 website is chosen to collect, interpret and explore the findings. The study approached 9 search strategies that are available in the Re3database. These 9 approaches include subject, content, keyword, metadata standards, quality management, repository languages, software, repository types, and country. The data was analyzed using MS Excel.

3.7 Results and Discussion:

3.7.1 Subject Categories:

A total of 3843 research data repositories are registered, in the Re3 platform that can be broadly categorized into 4 major disciplines i.e. Life Sciences, Natural Sciences, Humanities & Social Sciences and Engineering Sciences. It was observed that Life Sciences accounted for the maximum repositories (35%) followed by Natural Sciences (32%),

Humanities and Social Sciences (22%) and Engineering Sciences (11%). It can be interpreted that RDM is more organized activity in case of Life Sciences and Natural Sciences in comparison to Humanities, Social Sciences and Engineering Sciences.

Table 3.3: Subject Categories

Rank	Subjects	Frequency	Percentage
1	Life Sciences	1336	35%
2	Natural Sciences	1238	32%
3	Humanities and Social Sciences	838	22%
4	Engineering Sciences	431	11%

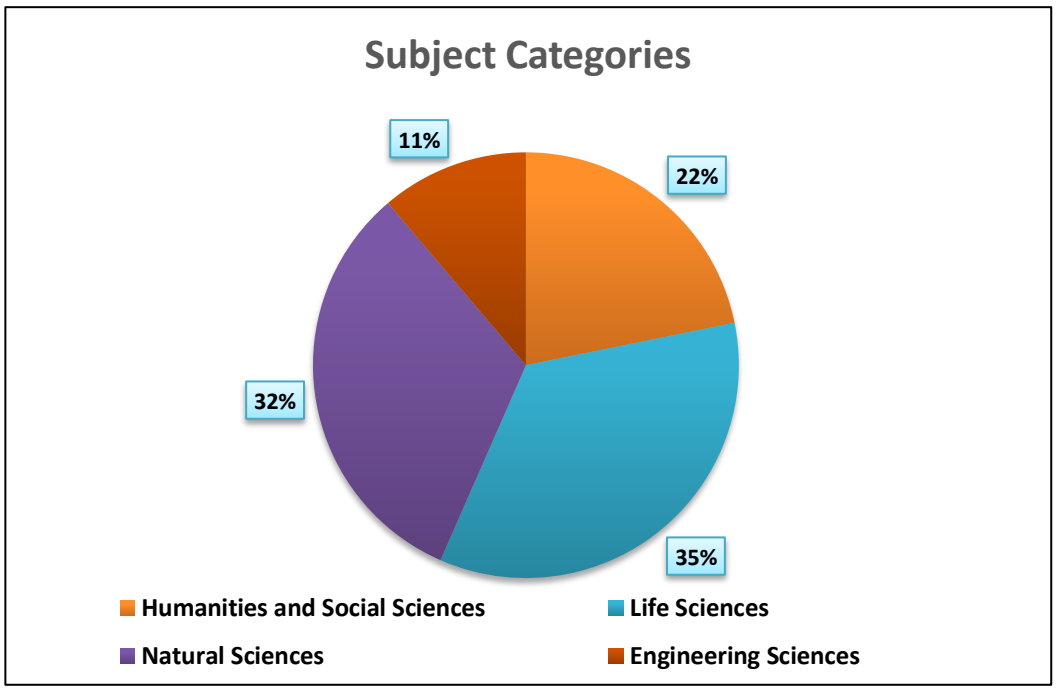


Figure 3.3: Subject Type

Research is not a monopoly of STEM but enjoys equal significance attached with it in AHSS.

In this context, the one of the primary responsibility of all the disciplines engaged in active research whether STEM or AHSS is to ascertain the preservation and availability of research data for posterity.

In the present case, however, lower contribution of Engineering in comparison to Humanities and Social Sciences is unforeseeable.

3.7.2 Content Types:

All registered databases on Re3 platform include 15 types of analysis data i.e. Scientific and statistical data formats (13%) followed by Standard office documents (13% approx.), Images (11%), Raw data (10%), Plain data (10% approx.), other (8%), structured graphics (8% approx.), structured text (7%), archived data (5%), databases (4%), audiovisual data (4%), software applications (4%), networked data (1%), source code (1%) and configuration data (1%).

This can be clarified that the maximum number of science and statistical data is handled while the minimum of one is handled for configuration data.

Table 3.4: Content Types

Rank	Content types	Frequency	Percentage
1	Scientific and Statistical data formats	1530	13%
2	Standard office documents	1512	13%
3	Images	1253	11%
4	Raw data	1104	10%
5	Plain text	1091	10%
6	Other	889	8%
7	Structured graphics	866	8%
8	Structured text	752	7%
9	Archived data	558	5%
10	Databases	513	4%

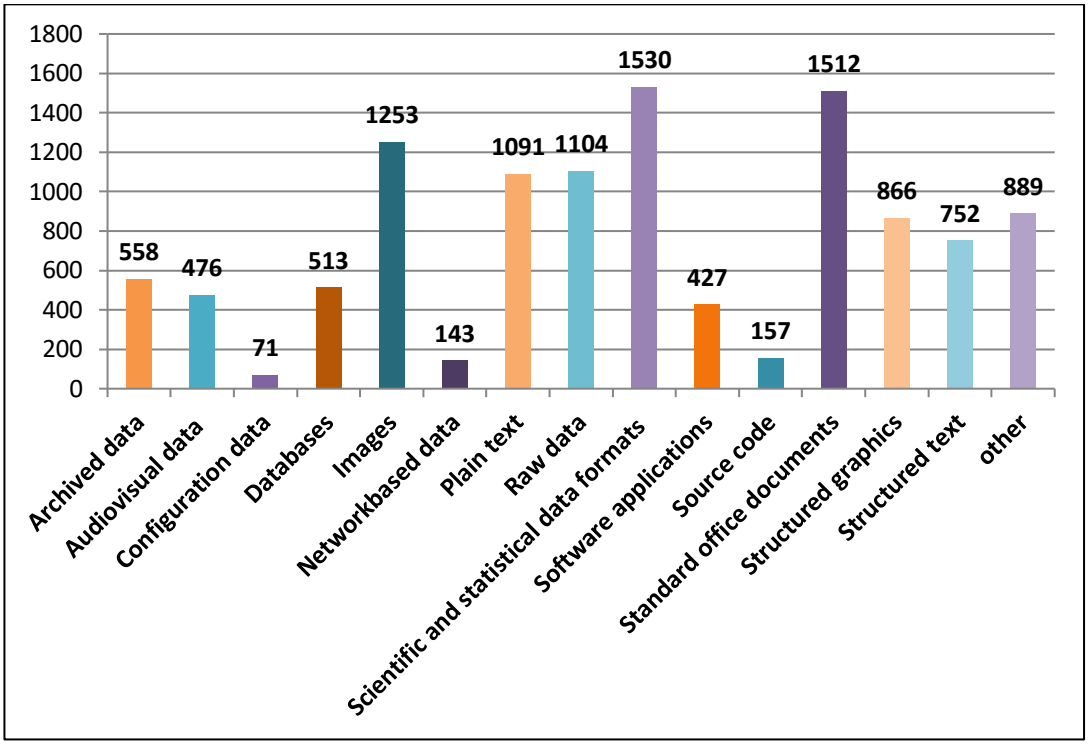


Figure 3.4: Content Types

All formats of research data are important whether these are photographs, plain data, standard office documents or formats of scientific and statistical data. Throughout this sense, the organizations, librarians, researchers and other stakeholders are largely responsible for handling all sorts of data formats.

In this present finding, configuration data, source code, networked data and database enjoy fewer contributions as comparison to scientific and statistical data formats.

3.7.3 Keywords Types:

All research data repositories registered in the Re3 platform are classified into 30 keyword categories. These categories include multidisciplinary followed by genomics, bioinformatics, genetics, health, biology, biodiversity, climate, DNA, atmosphere, meteorology, agriculture, FAIR, statistics, environment, cancer, climate change, ecology, weather, hydrology, economics, gene expression, ecosystem, education, oceanography, molecular biology, human, remote sensing, climatology, proteins.

It was analyzed that multidisciplinary repositories coordinate to organize maximum research data (11%) followed by genomics (6%) and bioinformatics (5%).

The atmosphere was observed as the least one category to organize the research data (3%) followed by DNA (4%) and climate (4%).

Table 3.5: Keyword Types

Rank	Keywords	Frequency	Percentage
1	Multidisciplinary	227	11%
2	Genomics	134	6%
3	Bioinformatics	113	5%
4	Genetics	109	5%
5	Health	99	5%
6	Biology	92	4%
7	Biodiversity	89	4%
8	Climate	79	4%
9	DNA	77	4%
10	Atmosphere	71	3%

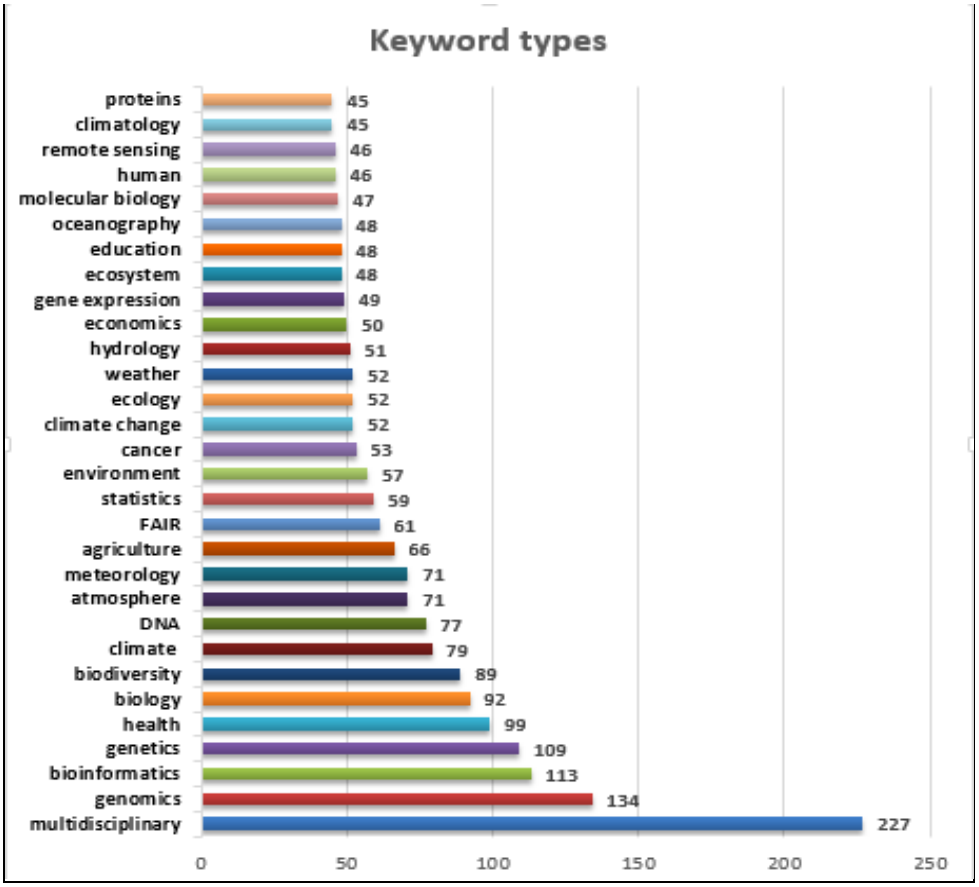


Figure 3.5: Keyword Types

The logical keyword gives maximum ways to find out any research data. In this context, it is important at the time of research data management, to select the most relevant keyword related to the research data. In the present output, the Atmosphere, DNA, and Climate keyword used minimum as comparison to the multidisciplinary keyword which contributes maximum.

3.7.4 Metadata Standards:

A reliable research data repository is either certified or supported to a metadata standard and the Re3data platform highly supports that standards. 28 kinds of metadata specifications are used in the Re3data application to consistently coordinate the analysis data i.e. Dublin Core, DDI - Data Documentation Initiative, Data Cite Metadata Schema, ISO 19115, Repository-Developed Metadata Schemas, FGDC/CSDGM - Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata, DIF - Directory Interchange Format, CF (Climate and Forecast) Metadata Conventions, other, EML - Ecological Metadata Language, SPASE data model, PROV, Genome metadata etc. It is evaluated that research Data was widely structured using the Dublin Metadata format (23%), while Genome metadata, SPASE data pattern, AVM- Astronomy Visualization Metadata and MIDAS heritage models used are as small as one (1%).

Table 3.6: Metadata Standards

Rank	Metadata Standards	Frequency	Percentage
1	Dublin Core	308	23%
2	DDI - Data Documentation Initiative	170	13%
3	DataCite Metadata Schema	168	13%
4	ISO 19115	150	11%
5	Repository-Developed Metadata Schemas	136	10%
6	FGDC/CSDGM - Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata	94	7%
7	DIF - Directory Interchange Format	40	3%
8	CF (Climate and Forecast) Metadata Conventions	38	3%
9	Other	37	3%
10	EML - Ecological Metadata Language	34	3%

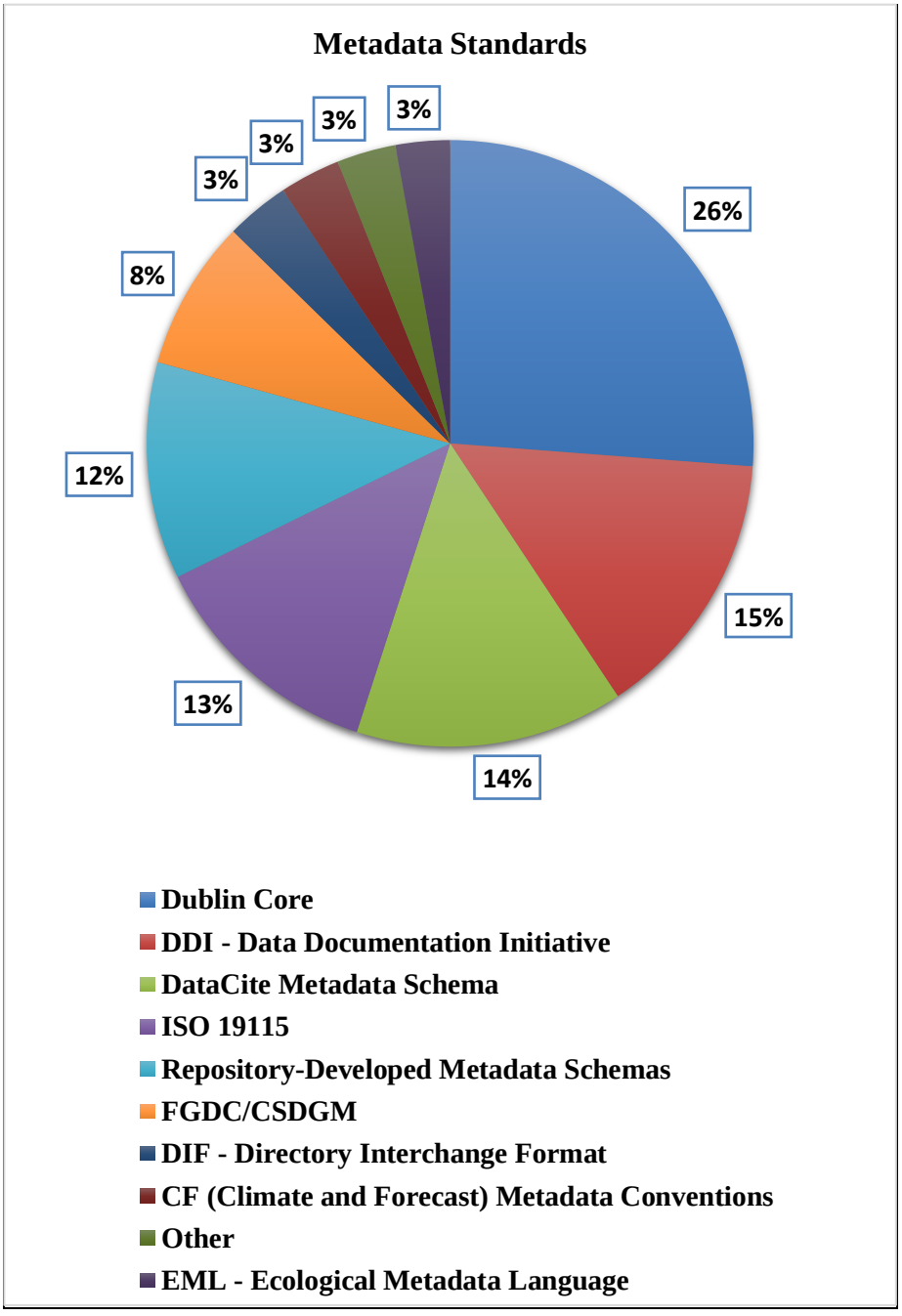


Figure 3.6: Metadata Standards

There are different kinds of metadata standards for defining the object of any data. Therefore much of the data management personnel's essential duty is to handle any element of data within acceptable metadata requirements. For this case, there is a lower contribution of SPASE data pattern, AVM- Astronomy Visualization Metadata, and MIDAS heritage as a comparison to Dublin Core metadata standards, DDI, and Data Cite metadata schema.

3.7.5 Quality Management Types:

Repositories that promote or do not support quality control are included in the quality management program division. Within the Re3 network, all licensed study data archives are grouped into three quality monitoring systems, i.e. Sure, Uncertain, and No. It has been found that 56% of repositories have information on quality control, 42% of repositories are uncertain whether or not they are assistance. Yet, 2%of databases do not have information relevant to quality control. It can be determined that most evidences from the study improve knowledge of quality control.

Table 3.7: Quality Management Types

Rank	QM	Frequency	Percentage
1	Sure	1393	56%
2	Uncertain	1050	42%
3	No	40	2%

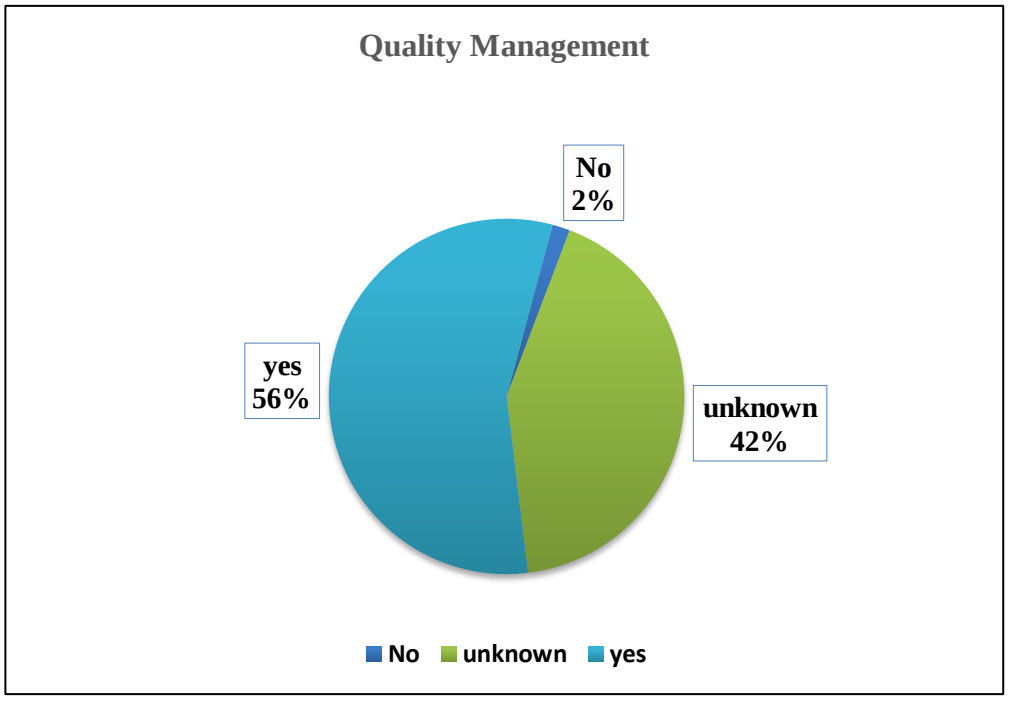


Figure 3.7: Quality Management Type

Reliability of research data repositories are depend on its quality management factor such as through issue of standard certification. Through this context, one of the organization's main obligations is to increase the consistency of data repositories. In the present output, 44% of total repositories are unknown or do not have a factor in quality control.

3.7.6 Language Types:

All databases listed on the Re3data portal support Multilanguage, i.e. a 60-language cluster. The researcher has divided all the languages into two categories namely English and other languages (a cluster of 59 languages). The highest number of repositories is evaluated to endorse English language, i.e. 8 percent of all languages. It can be considered that highly research data is organized in English language.

Table 3.8: Language Types

Sr. No.	Language	Frequency	Percentage
1	English	2411	8%
2	Other	27015	92%

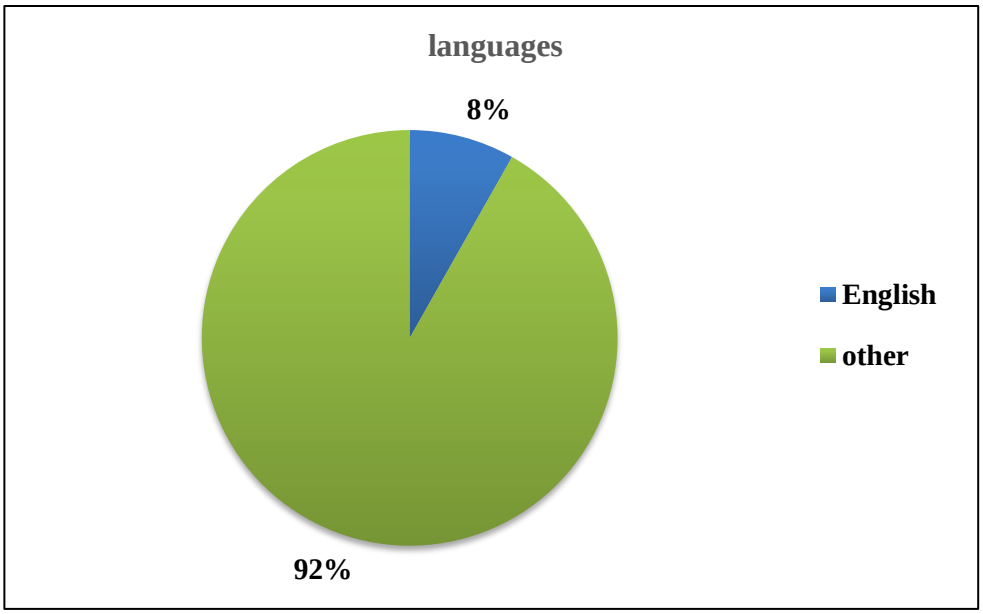


Figure 3.8. Language Types

The major role of any research is to provide more output and benefits to the society therefore, it is the duty of data management personnel to manage the research data into all regional languages. The librarians and other stakeholders can manage the research data into regional as well as international languages to avoid language barriers. In the present study, all languages are contributed fewer than the English language.

3.7.7 Software Types:

Technology is the best method for organizing, curating and archiving research results, and Re3 platform uses 13 software types, i.e. Unknown where the name of the package is not defined (58%), followed by Other (22%), DataVerse (4%), MySQL (4%), DSpace (4%),

CKAN (3%), Fedora (2%), EPrints (2%), Nesstar (1%), eSciDoc, Digital Commons, dLibra and Opus (1%). It is examined that the maximum data of the research is arranged into software whose names are undisclosed. With the addition of uncertain and other types, DataVerse software has been identified as mainly used applications to handle data from analysis, while Opus is least used one.

Table 3.9. Software Types

Rank	Software types	Frequency	Percentage
1	Unknown	1233	58%
2	other	465	22%
3	DataVerse	87	4%
4	MySQL	78	4%
5	DSpace	76	4%
6	CKAN	71	3%
7	Fedora	37	2%
8	EPrints	32	2%
9	Nesstar	21	1%
10	eSciDoc, Digital Commons	3	1%

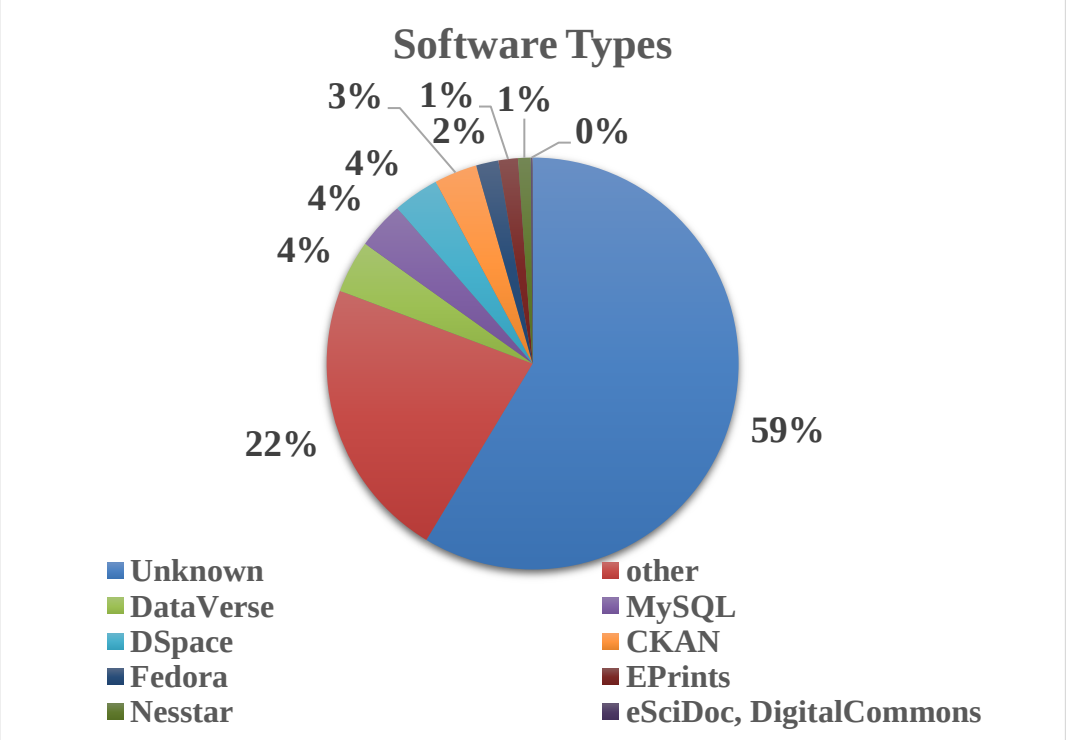


Figure 3.9. Software Types

Owing to different formats of research data, different types of software are needed. It means research data should be managed according to its type such as digital commons use for the institutional repository and Dataverse is kind of open source software. In the present case, eSciDoc, Digital Commons used as fewer than other softwares while a large part of the software is unknown.

3.7.8 Repository Types:

Three types of repositories i.e. Disciplinary, Institutional and Other, registered in the Re3 platform. Disciplinary repositories organized research data which is related to a specific subject. Institutional repositories contain research data management related to a specific institution or it is also known as green route of repository. Other repository types include organized data except disciplined and institutional types. It is observed that research data is more organized in case of disciplinary repository (69%), while other (10%) is least one.

Table 3.10. Repository Types

Number	Repository type	Frequency	Percentage
1	Disciplinary	1978	69%
2	Institutional	611	21%
3	Other	283	10%

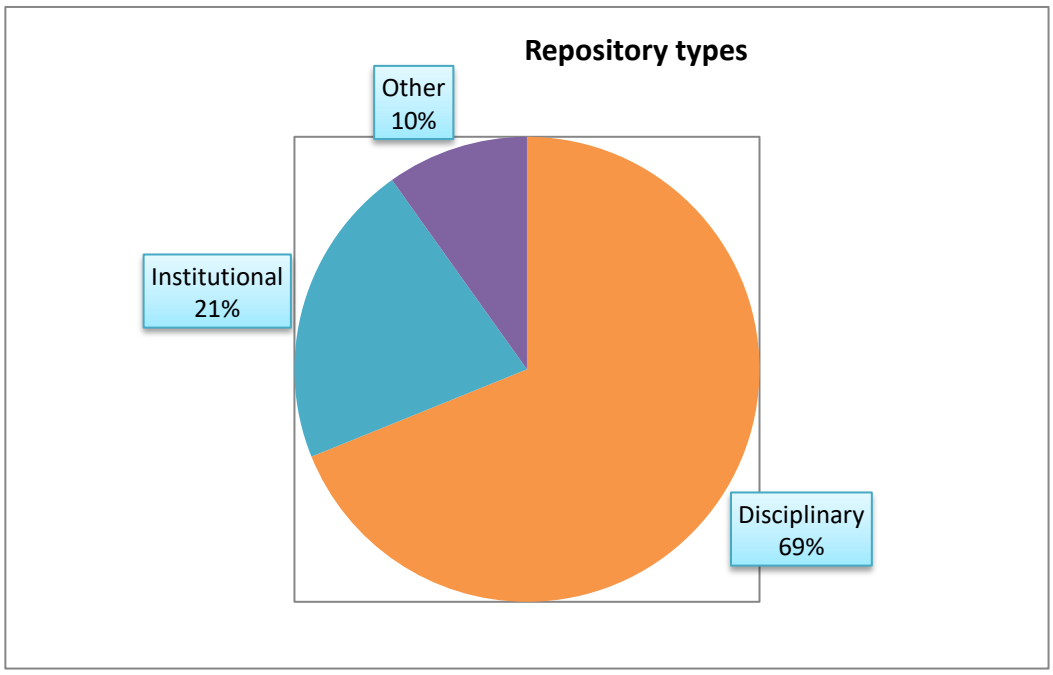


Figure 3.10: Repository Types

Stewardship and storage of research data content rely on the type of research data repository. In this context, if content of research data belongs to some specific subject so it would be manage into the discipline repository but if it belongs to a particular institution so it would be preserve into the institutional repository.

Hence, every data should mange into its category-specific repository. In the present case, the share of other and institutional repositories is fewer than the discipline-specific repository.

3.7.9 Country Types:

Seventy-nine countries are committed to the exchange of their research data on Re3data platform through registered repositories.

The United States with 36%, Germany (14%) and the United Kingdom (9%) ranked highest, while Egypt, Fiji, Iceland and Tunisia rated the least (1%) because of the differences in knowledge and comprehension.

There was still a RDM gap between developed countries and developing ones.

Table 3.11: Country Types

Ranking	Country	Repositories	Percentage
1	USA	1060	36%
2	Germany	403	14%
3	UK	281	9%
4	European Union	264	9%
5	Canada	255	9%
6	International	236	8%
7	France	103	4%
8	Australia	90	3%
9	Switzerland	69	2%
10	Japan	58	2%
11	Netherlands	56	2%
12	India	51	2%

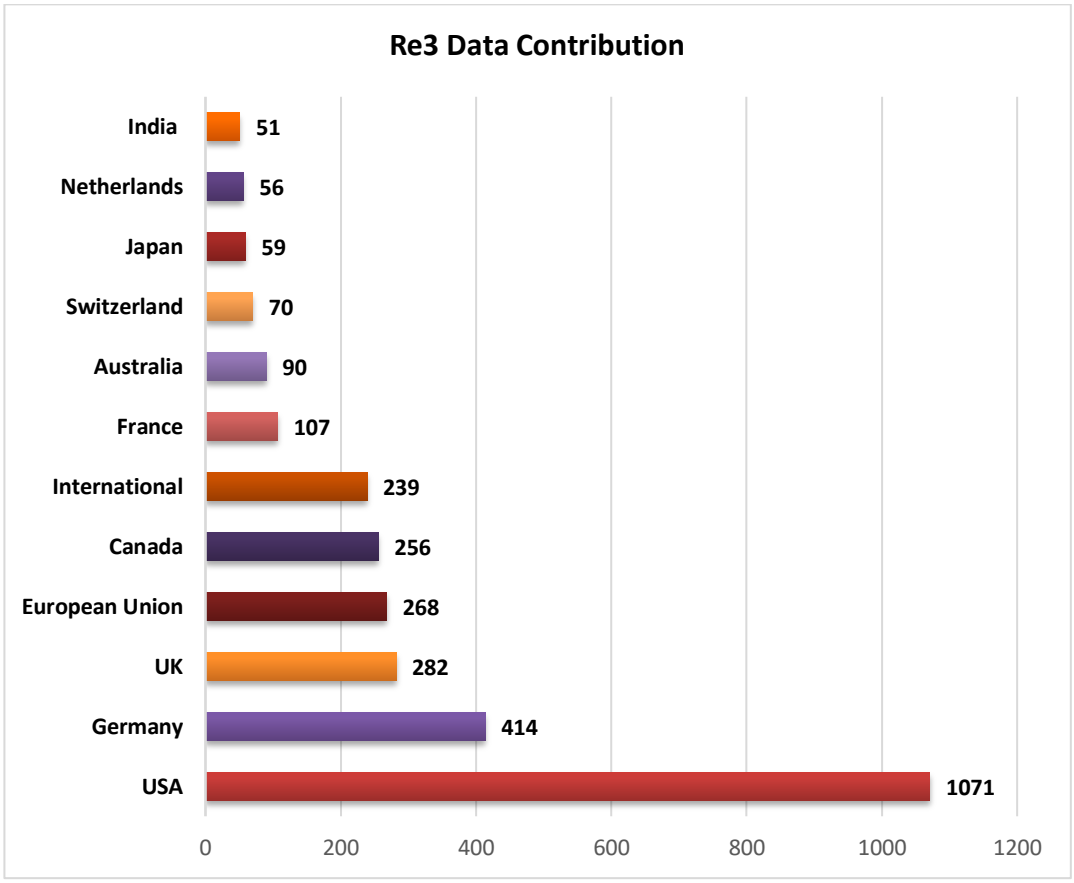


Figure 3.11: Country Types

Investment in Research data management can translate into national development. Hence, each country's primary and ultimate obligation is to handle the research data across all disciplines. In present findings, India's contribution, as opposed to the USA, is very small in the present findings.

3.8 Discussion:

Evidence from the Re3 database investigation discussed in this study suggests that developing countries are inactive to support RDM on the Re3 website. The research improves the standard of demonstrating to librarians and other stakeholders the complexities of RDM activities. Study shows that developing countries fall behind due to unawareness and lack of knowledge. The results addressed librarians and other stakeholders to handle their data with Dublin's core metadata requirements, scientific and statistical data formats, Discipline archives, and to enhance overall consistency in the English language. Ultimately, the results will fill the current gaps by providing data management activities for vogue research. The results cannot prove the best RDM software in all countries due to the lack of available data. Future studies should consider updated research data repositories criteria not only on the Re3 website but also on behalf of the institution's policy.

3.9 Conclusions and Recommendations:

The study shows that the Re3data platform played an important role in improving and organizing research data. In particular, it identifies how research data is organized in the Re3data platform in terms of contribution from subject type, content type, keyword type, metadata standard type, quality management type, language type, software type, repository, and country type.

The study concludes that maximum research data is organized in scientific and statistical format and the USA leads to highly research data being shared with 1060 repositories form the American continent. Europe contributes as much as possible to the exchange and organization of its research data across all the repositories of which Germany is the most relevant of all countries. Japan, from Asia, has highly organized research data, but a huge gap between Japan and the USA. Up to 8% of all research data details are structured in English language, which is also one of the international declared languages.

Disciplinary repository type especially Life Sciences manages the maximum data within 1336 repositories. Dublin core metadata standard is mostly used to define the entity of research data, while maximum software is unknown to processing data. 56% Research Data repositories are certain to support quality management and 11% use multidisciplinary keywords. On the basis of the research findings, the study recommends the following measures to strengthen and develop RDM practices in a sustainable manner:

a. In order to bridge the divide between Science, engineering and social science in particular, study data needs to be exchanged and coordinated across all disciplines.
b. Asian, African countries need to focus more on preserving, organizing, and sharing their research data individually and on the Re3 website to overcome the gap between developed and developing countries.
c. It is necessary to formulate national level data preservation policy and guidelines.
d. Study academics, librarians and other stakeholders need to be aware of RDM.
e. It is needed to develop research data repositories on institutions as well as on the center level.

3.10 References:

1. Angus, W., & Jonathan, T. (2011). Making the Case for Research Data Management. A Digital Curation Centre Briefing Paper, 1–8. https://www.researchgate.net/publication/252931138
2. Australian Research Council. (2018, June 14). Research Data Management. Www.Arc.Gov.Au. https://www.arc.gov.au/policies-strategies/strategy/research-data-management
3. Chakravarty, R. (2015). Research Data Management (RDM): A Systematic Approach to Big Data Challenge in R&D and Higher Education. Transforming Dimension of IPR: Challenges for New Age Libraries, 481–491.
4. Eynden, VEERLE VAN DEN. (2013). DATA LIFE CYCLE & DATA MANAGEMENT PLANNING. UD Digital Archive. 24-25. https://www.ukdataservice.ac.uk/media/187718/dmplanningdm24apr2013.pdf

5. Jonathan, R., & Angus, W. (2017). Using RISE the Research Infrastructure Self-Evaluation Framework. 1–19. https://www.dcc.ac.uk/sites/default/files/documents/publications/UsingRISE_v1_1.pdf
6. Karlsruhe Institute of Technology, GFZ German Research Centre for Geosciences, Berlin School of Library and Information Science. "Re3data.Org REGISTRY OF RESEARCH DATA REPOSITORY." Re3data.Org, 2012, www.re3data.org/. Accessed 2 June 2020.
7. Lang, L., Wilson, T., Wilson, K., & Kirkpatrick, A. (2018). Research Support at the Crossroads: Capability, Capacity, and Collaboration. New Review of Academic Librarianship, 24(3–4), 326–336. https://doi.org/10.1080/13614533.2018.1460727
8. Pennock, M. (2007). Digital Curation: A Life-Cycle Approach to Managing and Preserving Usable Digital Information. Library & Archives Journal, 1–3. http://www.ukoln.ac.uk/ukoln/staff/m.pennock/publications/docs/lib-arch_curation.pdf
9. Piracha, H. A., & Ameen, K. (2019). Policy and planning of research data management in university libraries of Pakistan. Collection and Curation, 38(2), 39–44. https://doi.org/10.1108/cc-08-2018-0019
10. Shelly, M., & Jackson, M. (2018). Research data management compliance: is there a bigger role for university libraries? Journal of the Australian Library and Information Association, 67(4), 394–410. https://doi.org/10.1080/24750158.2018.1536690
11. Thielen, J., & Hess, A. N. (2017). Advancing Research Data Management in the Social Sciences: Implementing Instruction for Education Graduate Students into a Doctoral Curriculum. Behavioral & Social Sciences Librarian, 36(1), 16–30. https://doi.org/10.1080/01639269.2017.1387739
12. University of Leeds. (n.d). Research Data Management Explained. FOSTER FACILITATE OPEN SCIENCE TRAINING FOR EUROPEAN RESEARCH. Retrieved June 7, 2020, from https://www.fosteropenscience.eu/node/2132.
13. Zhou, Q. (2018). Academic Libraries in Research Data Management Service: Perceptions and Practices. OALib, 05(06), 1–4. https://doi.org/10.4236/oalib.1104693