



Research Data Services in European Academic Research Libraries

Carol Tenopir

University of Tennessee

ctenopir@utk.edu, orcid.org/0000-0002-9056-8251

Sanna Talja

University of Tampere

Sanna.K.Talja@uta.fi

Wolfram Horstmann

University of Gottingen

horstmann@sub.uni-goettingen.de

Elina Late

University of Tampere

elina.late@uta.fi

Dane Hughes

University of Tennessee

tmc752@utk.edu

Danielle Pollock

University of Tennessee

dpolloc2@vols.utk.edu, orcid.org/0000-0003-3542-149X

Birgit Schmidt

University of Gottingen

bschmidt@sub.uni-goettingen.de, orcid.org/0000-0001-8036-5859

Lynn Baird

University of Idaho

lbaird@uidaho.edu

Robert J. Sandusky

University of Illinois at Chicago

sandusky@uic.edu, orcid.org/0000-0002-2917-6822

Suzie Allard

University of Tennessee

sallard@utk.edu, orcid.org/0000-0001-9421-3848

Abstract

Research data is an essential part of the scholarly record, and management of research data is increasingly seen as an important role for academic libraries. This article presents the results of a survey of directors of the Association of European Research Libraries (LIBER) academic member libraries to discover what types of research data services (RDS) are being offered by European academic research libraries and what services are planned for the future. Overall, the survey found that library directors strongly agree on the importance of RDS. As was found in earlier studies of academic libraries in North America, more European libraries are currently offering or are planning to offer consultative or reference RDS than technical or hands-on RDS. The majority of libraries provide support for training in skills related to RDS for their staff members. Almost all libraries collaborate with other organizations inside their institutions or with outside institutions in order

to offer or develop policy related to RDS. We discuss the implications of the current state of RDS in European academic research libraries, and offer directions for future research.

Key Words: research data services; data management; academic libraries

1. Introduction

Advances in technology now allow for the collection, storage, analysis, and communication of increasing amounts of scientific data on a global scale (Hey, Tansley, & Tolle, 2009; Open Data Charter, 2015; Royal Society, 2012). In this environment, good research data management becomes essential to ensure transparency of scientific research, preserve data, enable reuse and reanalysis of data, and advance knowledge (Borgman, 2015; Kim, 2013; Research Councils U.K., 2015). In addition, governments, funding agencies, and publishers around the world are requiring researchers to develop data management plans and, in many cases, to make the data resulting from their research openly available (Coates, 2015; Digital Curation Center, n.d.; National Science Foundation, n.d.; European Commission, 2016a,b; Office of Science and Technology Policy, 2013; Shearer, 2015; Wellcome Trust, 2010). As a result of all of these forces, research data is increasingly seen as an essential part of the scholarly record. Because academic libraries traditionally have a role in providing access to the scholarly record in many forms, it is not surprising that the management of research data is a global issue for academic libraries (Brown, Wolski, & Richardson, 2015; Chiware & Mathe, 2015; Corral, Kennan, & Afzal, 2013; Cox & Pinfield, 2014; Diekema, Wesolek, & Walters, 2014; Kim, 2013; Si, Xing, Zhuang, Hua, & Zhou, 2015; Tenopir, Birch, & Allard, 2012; Tenopir et al., 2015b).

Management of research data can take many forms, and there are a wide range of possible research data services that libraries offer, from merely helping researchers locate resources about data management planning or metadata standards in their disciplines to the creation and maintenance of full digital data repositories. To discover what types of research data services (RDS) are being offered by European academic research libraries and what services are planned for the future, an international research team funded by LIBER (Ligue des Bibliothèques Européennes de Recherche—Association of

European Research Libraries) and DataONE (Data Observation Network for Earth) conducted a survey of LIBER academic members in the spring of 2016.

The LIBER-DataONE survey, reported here, builds on earlier DataONE surveys of academic libraries in the United States and Canada (hereinafter referred to as North American) that are members of the Association of College & Research Libraries (ACRL) (Tenopir et al., 2012, 2015b). The 2011 baseline survey found that most libraries in the sample did not yet offer RDS, but more were planning on doing so in the future (Tenopir et al., 2012; Tenopir, Birch, & Allard, 2017). The follow-up survey conducted in 2014 with this same population found very little change in the percentage of libraries offering RDS (Tenopir et al., 2015b, 2016), despite the facts that many more had planned to offer services and that a majority of survey respondents agreed that losing data jeopardizes the future of scholarship and librarians should be stewards of all types of scholarship, including data sets.

Follow-up interviews with library directors who participated in the 2014 survey suggest that many factors may contribute to the level of library involvement in RDS remaining static, including lack of time, shortage of trained personnel, and absence of top-level institutional support for these activities (Tenopir et al., 2015b). Both North American surveys found that a greater percentage of larger institutions, defined by student enrollment, offered various types of RDS. Among those institutions that offered any RDS, informational and consultative services, such as providing support for finding and citing data, were more commonly offered than technical services, such as preparing data for deposit into a repository (Tenopir et al., 2012, 2015b). While the North American survey results cannot be directly compared to the results of the present study due to the passage of time and due to differences in the types of academic libraries included in the survey populations, those studies did inform the survey instrument and research questions for the current study.

Because many of the European countries have been among the first to require data management plans and provision of open data, we can expect that European libraries will be leaders in RDS. This survey examines current practice and future plans for providing RDS in European academic research libraries. Research questions that drove this study were:

- Are informational/consultative RDS offered by more European libraries than technological RDS, as in North American libraries?

- Are more European libraries planning to offer RDS in the future than currently offering RDS, as in North American libraries?
- Are there differences in RDS offered by libraries in different regions within Europe?
- How are European libraries developing staff capacity for RDS?
- What types of data are supported by European libraries which offer RDS?

Who are European libraries collaborating with on RDS? What are the attitudes towards RDS among European library directors?

2. Related Work

International surveys of researchers have found that even if researchers are willing to share data, many lack the time, expertise, and resources to fully comply with institutional or funders' mandates for depositing data. They may require assistance with activities such as creating metadata, locating datasets, and finding appropriate places to store their data (Aydinoglu, Suomela, & Malone, 2014; Enke et al., 2012; Kratz & Strasser, 2015; Schmidt, Gemeinholzer, & Treloar, 2016; Specht et al., 2015; Tenopir et al., 2011, 2015a). Earlier surveys of researchers suggest roles for research libraries in providing support for research data management, an extension of the library's traditional role in providing research and reference services (Si et al., 2015; Tenopir et al., 2012, 2015b; Vlaeminck, 2013).

Research data services (RDS) provided by libraries vary and may include: creation and management of institutional data repositories, providing tools for data mining and visualization, training for researchers on data management activities, guidance on institutional policies, help with creating data management plans and metadata for data sets, and assistance with intellectual property and privacy issues surrounding research data, and other services (Flores, Brodeur, Daniels, Nichalls, & Turnator, 2015; Koltay, 2016; Linde, Noorman, Wessels, & Sveinsdottir, 2014; Tenopir et al., 2012, 2015b; Vlaeminck, 2013).

Providing RDS in libraries takes skilled professionals as well as resources and time. Libraries vary in how well they are able to support RDS and what range of services they offer (Corrall, Kennan, & Afzal, 2013; Cox & Pinfield, 2014; Si et al., 2015). Rittel and Weber (1973) coined the term "wicked problem" to

describe a complex societal problem that is difficult to solve due to a number of factors. These factors include the understanding that such problems are unique; there is no “stopping rule” or criteria to determine whether the problem has been solved; and there is neither a definitive formulation of the problem itself nor a definitive list of possible solutions, meaning that various stakeholders may have different views on each of these. The problem of research data management has been characterized as a “wicked” one, due to the sheer scale and complexity of both data and data management activities, the number of stakeholders, heterogeneity of data types to be managed, and lack of clarity on appropriate roles for stakeholders, including libraries, as well as what support services to offer (Awre et al., 2015; Cox, Pinfield, & Smith, 2016).

3. Methodology

With assistance from the LIBER Board of Directors, the survey instrument from earlier DataONE surveys of academic libraries was revised and pilot tested by several European academic library directors. Based on feedback, the demographic section was shortened to better fit the European context and questions were added about type of data and subject disciplines served. Questions include demographics (size of student body population and country); RDS currently offered; RDS planned; staffing considerations; policies and procedures; disciplines served and types of data processed; collaborations; and opinions. The unit of analysis is the academic library; participants were asked to respond on behalf of their institution, with only one response per library. The survey instrument and full data set can be downloaded from the LIBER Quarterly Dataverse at <http://dx.doi.org/10.7910/DVN/SKNGGW>.

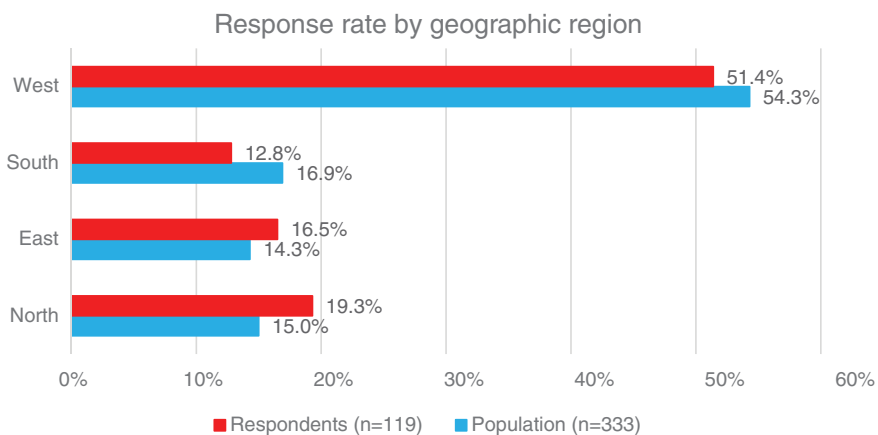
The research protocol was approved by the University of Tennessee Institutional Review Board (IRB) for Human Subjects with a letter of support from the University of Tampere. The survey instrument was built using the Qualtrics software and was hosted by the University of Tennessee. All analysis was done using Excel, SPSS, or R software at the University of Tennessee, University of Tampere, and University of Göttingen. The survey instrument was distributed via email by LIBER to its member institutions in February 2016. A follow-up reminder was sent two weeks after the initial email and

the survey was open for approximately 6 weeks. A total of 333 of the LIBER members were identified as European university libraries; 119 responded to at least one question beyond the demographic questions, for a response rate of 35.7%. Responses are representative of the population (See Figure 1).

Limitations include that libraries offering RDS or planning to do so may be more likely to have responded to the survey. Also, in accordance with IRB regulations, respondents were allowed to skip any question and leave the survey at any time, so each question may have a different number of responses and only a few questions have the total of 119 respondents. The survey instrument was only in English, perhaps limiting responses in some countries.

In total, libraries from 22 countries participated to the survey. Data does not include responses from European LIBER member libraries from Croatia, Cyprus, France, Hungary, Luxembourg, Malta, Portugal, Romania, Serbia, Slovakia, and Turkey. Countries were categorized into four regions; West, East, North, and South in order to study regional differences in RDS provision. Categorization is based on regions used in the OpenAIRE project¹ that aims to promote open scholarship by improving discoverability and reusability of research publications and data. East and North regions are somewhat overrepresented in our data. West and South regions are underrepresented, notably due to the lack of responses from France (See Figure 1).

Fig. 1: Response rate categorized by geographic region.

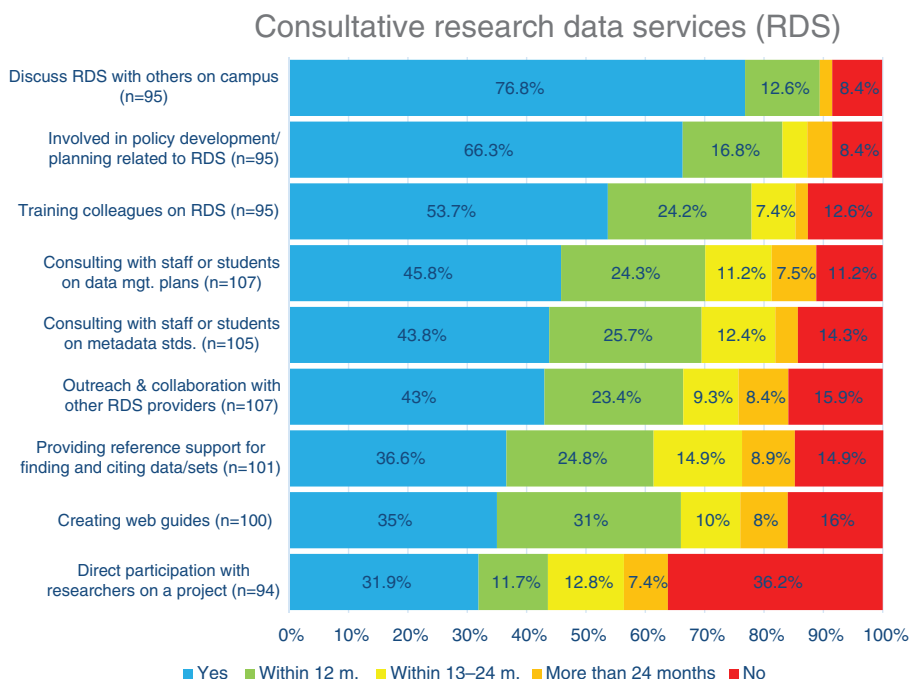


4. Results

4.1. Types of Services Offered and Planned

As was found in previous surveys conducted with libraries in North America, European academic research libraries (henceforth referred to as “libraries”) are more likely to offer consultative-type RDS services than hands-on/ technological services. Consultative services frequently involve a personal client-librarian relationship and inform the client (often a student or faculty member) about such things as how to find information on data management plans, metadata standards, or data citation practices. These informational services align with traditional reference or instructional services long offered by libraries. Consultative services can also include collaboration with others on planning, projects, or training (See Figure 2).

Fig. 2: Consultative RDS (labels not shown for values of <5%).



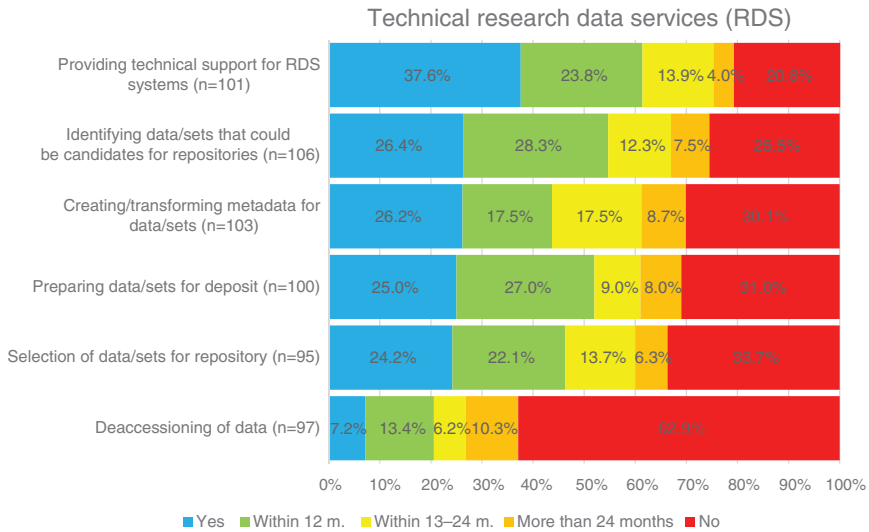
The activities currently conducted by the greatest number of libraries (76.8%) are “discussing RDS with others on campus” and involvement in “policy development/planning related to RDS” (66.3%), which may indicate that many libraries are still in the planning stages or that RDS requires intense ongoing discussion and policy-making. However, less than half (40.9%) of libraries say they currently have policies relating to RDS. A majority of libraries (53.7%) also answered that they provide training for colleagues on RDS.

For all but three services—creating web guides, direct participation with researchers on a project, and providing reference support for finding and citing data/sets—the number of libraries reporting they currently offer the service exceeds the number of libraries who plan to offer it in the future, though almost all libraries currently offer or plan within two years to offer most types of consultative RDS listed. The one exception is that currently less than a third of the libraries have services that involve direct participation with researchers on a project, while another third have no plans to offer such services in the future. Directly working with researchers might be considered more of a hands-on activity and may require more intense and time-consuming commitments by library staff than just helping researchers locate information.

Technical/hands-on RDS are currently offered by fewer libraries, although with the exception of “deaccessioning”, a majority of libraries currently offer or plan to offer some sort of technical RDS. As was found in North American surveys, more European libraries are planning to offer than are currently offering various types of technical RDS. The lower and slower up-take of technical services compared to consultative services may reflect the fact that these services require a substantial investment in time, resources, and new technical knowledge (See Figure 3). In the earlier North American surveys, few libraries said they offered many technical services.

An exception in European libraries however, is managing or participating in managing technology infrastructure that supports RDS. When asked this question separately, almost two-thirds (63.8%) of libraries say they currently manage or participate in managing technology infrastructure that supports RDS. When asked a follow-up question about what types of management they provide, over three-quarters (78.3%) of those say they are providing data storage. Other types of infrastructure support are offered by fewer of these libraries and include tools for data analysis (23.3%), virtual community support (31.7%), and other (23.3%). The more than one-third (36.2%) of those libraries that do not manage or participate in managing technology

Fig. 3: Technical RDS.



infrastructure supporting RDS say they rely upon other academic institutions, national/disciplinary data services, or other services.

4.2. Differences Based on Geography

Analyses show clear differences between regions in offering RDS. Libraries in the West region are offering RDS more often compared to other regions. There are also differences between regions in the types of RDS offered (See Appendix 1—Table 3).

Regarding consultative RDS, a higher share of West region libraries are creating web guides and providing support for finding and citing data. West and South region libraries are the most active in consulting with academic staff or students about data management plans and data and metadata standards—more than half of the libraries that responded in the West region and approximately half of South region libraries are offering these services.

Compared to other regions, libraries in the West and North are more active in collaborating with other research data service providers, discussing RDS

with other professionals, training colleagues in their library on RDS, and in policy development or strategic planning related to RDS. The majority of West and North region libraries are currently offering these services. Direct participation in a research project is not very typical in any region, but it is more common in West and North region libraries.

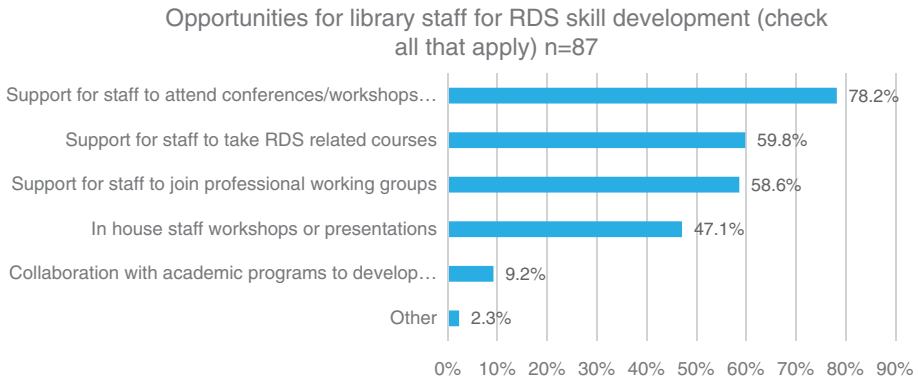
Libraries in the West region are also most active when it comes to technical RDS (See Appendix 1—Table 4). For example, compared to other regions, a higher share of West region libraries are providing technical support for RDS systems, are preparing data for deposit into a repository, and are creating or transforming metadata. Some West region libraries are participating in deselection of data for removal from repositories, however, the majority of libraries do not have this service and are not planning to offer it in the future. Perhaps libraries, no matter where they are located, have not yet solved the problem of attracting and preserving research data to repositories to the extent that any data needs to be removed.

Libraries in the South region stand out as being most active in participating in identifying data that could be candidates for repositories. Selecting data or data sets for repositories is also most common in West and South region libraries—one third of libraries offers this service.

4.3. Staff Capacity and Types of Data Supported

For a library to be successful in providing RDS to patrons, the library needs to have staff who are skilled in RDS. To develop staff capacity for RDS, 33 libraries (27.7%) reported they had hired staff specifically to support RDS, and 17 (14.3%) reported they were planning on doing so. More libraries reported they had or are planning to reassign existing staff to provide these services; 54 (45.4%) had reassigned existing staff, and 26 (21.8%) were planning on doing so. Library staff supporting RDS must have the requisite skills, and many libraries are providing opportunities for current staff to develop these skills. Nearly 84% of libraries who responded to a question on whether they provided any opportunities for staff to develop RDS skills responded “yes” they have provided opportunities for library staff to develop skills related to RDS. These development opportunities take many forms, as can be seen in Figure 4.

Fig. 4: Opportunities for library staff for RDS skill development.



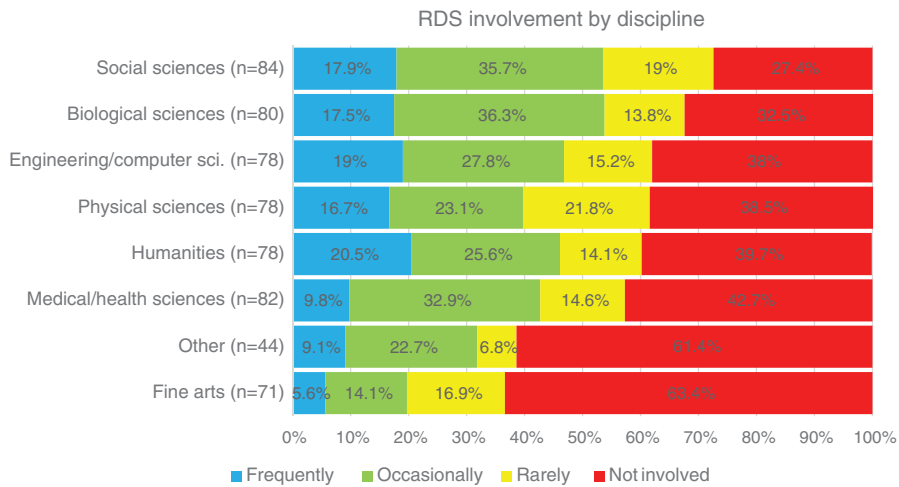
The survey asked libraries about the types of data in their research data archives. Although 42% of the 91 libraries that responded to the question do not maintain research data archives, two-thirds (66%) of the remaining libraries archive both qualitative and quantitative data (See Table 1).

Libraries offer RDS to staff or students from a variety of disciplines, but over 45% of libraries are involved occasionally or frequently with staff or students from humanities, social sciences, biological sciences, or engineering/computer sciences (See Figure 5). Perhaps surprisingly, libraries in the survey are less frequently involved with medical/health sciences and physical sciences than with humanities and social sciences. One explanation may be that medical sciences and physical sciences are employing their own data specialists to manage their research data, another explanation may be that medical/health sciences libraries are underrepresented in our responses. Our survey

Table 1: Types of research data supported.

	Frequency ("None" excluded)	Percent (n=53)
Both qualitative and quantitative	35	66%
Quantitative	6	11.3%
Qualitative	5	9.4%
Don't know	7	13.2%
Total	53	100%

Fig. 5: RDS involvement by discipline.



did not ask respondents to indicate which specific types of RDS were utilized or requested by faculty and students in which disciplines. All in all, there is a need for more research on the needs of different disciplines when it comes to RDS.

4.4. Collaboration

Collaboration is essential when offering RDS. Almost all (90.7%) libraries who answered a yes/no question on whether they collaborate say they collaborate with other units or offices within their institutions regarding RDS. The IT Center and Office of Research are the most frequent collaborators; libraries also collaborate with various subject departments. “Other” collaborators include university archives, legal offices, and research support units (See Figure 6).

Libraries also responded that they collaborate with other institutions regarding RDS (76.7%). Other universities are the most common collaborators. “Other” answers included national and multi-national data and infrastructure services, and data repositories (See Figure 7).

Fig. 6: Libraries that collaborate with other units or offices within their institution on RDS.

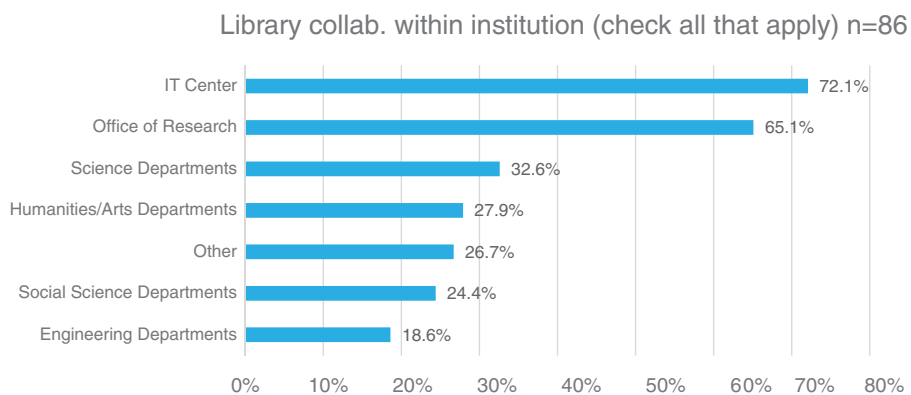
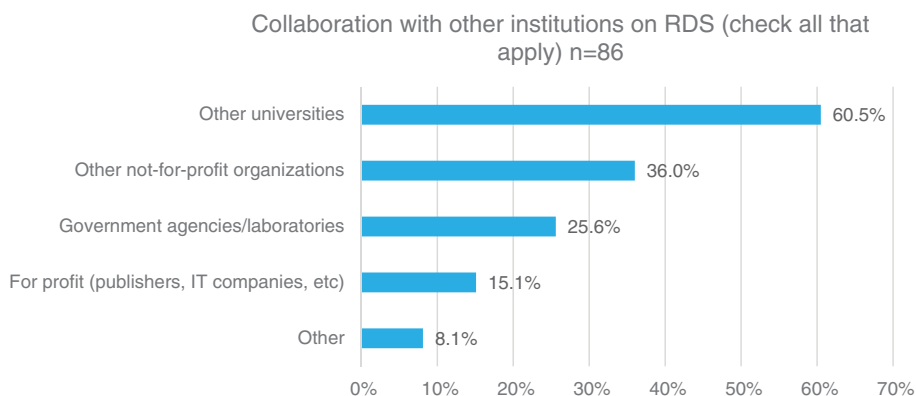


Fig. 7: Collaboration with other institutions on RDS.



4.5. Library Director Opinions

Library directors, whether or not their library offers RDS, strongly agree that research data stewardship is important, losing data jeopardizes future scholarship, and the library needs to offer RDS to remain relevant (See Table 2). These high levels of agreement on the importance of research data and RDS are the strongest observed in recent studies (Tenopir et al., 2012, 2015b).

Table 2: Library director opinions on library involvement in RDS.

	Mean* ("Don't Know" excluded)	Median* ("Don't Know" excluded)	SD
Library needs to offer RDS to remain relevant (n=87)	4.51	5	0.822
Library may see decreased funding if not offering RDS (n=88)	3.14	3	1.167
Losing data/sets jeopardizes future scholarship (n=87)	4.52	5	0.627
Librarians should be stewards of all types of scholarship, including data sets (n=87)	4.58	5	0.677
Researchers will be at a disadvantage for funds if library does not offer RDS (n=87)	4.06	4	1.016

*Level of agreement from 1=Strongly disagree to 5=Strongly agree.

5. Conclusions

Academic research libraries in Europe are offering or plan to offer a range of research data services. The range of RDS seems to be stabilizing into distinct categories of services. While, as noted earlier, direct comparisons cannot be made due to the passage of time and differences in the survey populations, we do find that as in North America, European libraries are more likely to offer consultative/reference type services, such as helping clients find information about data management plans, metadata, and data standards, rather than technical RDS such as identifying data for inclusion into a library repository. Also, as was found in the earlier North American surveys, fewer libraries are currently offering technical RDS than are planning on doing so in the future, though this was not the case for European libraries when it comes to most types of consultative RDS. In Europe, RDS activities undertaken by the most libraries include discussing RDS and planning or developing policies. Since less than half currently have data policies, this is clearly in the relatively early stages as yet. Hardly any libraries plan to start deaccessioning data, perhaps because libraries are still at the early stages of building data repositories and are not yet concerned about preserving too much data. Libraries in Europe differ by region in the types of RDS they offer, with libraries in the West region more active in offering RDS compared to other regions. The factors contributing to these regional differences and whether such differences

will remain if more libraries begin offering more types of RDS are potential questions for future research to explore.

European libraries are supporting RDS for various types of data, with the majority of those that maintain research data archives archiving both qualitative and quantitative data. European libraries also reported differences in their level of involvement in providing RDS to staff and students from various of disciplines. The specific sources of these differences, potentially including how the RDS needs of researchers from various disciplines differ and to what extent those needs are being met by sources other than the library for researchers in European universities are questions for future research.

Research data services require library staff who are knowledgeable and have the opportunity to learn new skills. Many libraries are providing opportunities for staff to learn more about RDS, while some are hiring new staff for these duties. If libraries reassign staff or hire new staff for RDS, an unanswered question for future research is what library services are being eliminated to accommodate new RDS?

Library directors realize they cannot solve the “wicked” problem of research data by themselves; libraries collaborate with many internal and external partners. Collaboration across campus and with other institutions is vital as many European libraries are working on developing policies or discussing how to offer the best range of RDS. These discussions will be ongoing as more libraries plan to collaborate and develop RDS in the future.

A majority of European library directors recognize the growing importance of research data and are looking for solutions that fit their institutional needs and priorities. Some libraries are further along in providing and planning research data services and will likely take leading roles in ongoing discussions. The academic library is by its nature a critical stakeholder in research data preservation and management now and into the future (Cox & Pinfield, 2014; Koltay, 2016). Future research will show if and how libraries expand their RDS over the next few years, how they will reshape their services to add these new RDS responsibilities, how they customize services to meet the needs of different subject disciplines, and whether technical RDS expands as a typical offering. The future will bring new opportunities and challenges related to RDS and libraries.

Acknowledgements

This article is based on a report commissioned by the LIBER Board. We wish to thank the LIBER Board, Kristiina Hormia-Poutanen, President, for their support and assistance at all stages of the project. This study could not have been done without the assistance of DataONE (NSF #0830944, William Michener, Principal Investigator) and the members of the DataONE Usability & Assessment Working Group.

References

- Awre, C., Baxter, J., Clifford, B., Colclough, J., Cox, A., Dods, N., ..., Zawadzki, M. (2015). Research data management as a “wicked problem”. *Library Review*, 64, 356–371. Retrieved December 15, 2016, from <https://doi.org/10.1108/LR-04-2015-0043>.
- Aydinoglu, A. U., Suomela, T., & Malone, J. (2014). Data management in astrobiology: Challenges and opportunities for an interdisciplinary community. *Astrobiology*, 14, 451–461. <https://doi.org/10.1089/ast.2013.1127>.
- Borgman, C.L. (2015). *Big data, little data, no data: Scholarship in the networked world*. Cambridge, MA: MIT Press.
- Brown, R.A., Wolski, M., & Richardson, J. (2015). Developing new skills for research support librarians. *Australian Library Journal*, 64, 224–234. <https://doi.org/10.1080/00049670.2015.1041215>.
- Chiwane, E., & Mathe, Z. (2015). Academic libraries’ role in research data management services: A South African perspective. *South African Journal of Libraries and Information Science*, 81(2), 1-10. <https://doi.org/10.7553/81-2-1563>.
- Coates, H. (2015). *Publisher policies*. Retrieved December 15, 2016, from https://www.ulib.iupui.edu/digitalscholarship/datasupport/publisher_policies.
- Corrall, S., Kennan, M.A., & Afzal, W. (2013). Bibliometrics and research data management services: Emerging trends in library support for research. *Library Trends*, 61, 636–674. <https://doi.org/10.1353/lib.2013.0005>.
- Cox, A.M., & Pinfield, S. (2014). Research data management and libraries: Current activities and future priorities. *Journal of Librarianship and Information Science*, 46, 299–316. <https://doi.org/10.1177/0961000613492542>.
- Cox, A.M., Pinfield, S., & Smith, J. (2016). Moving a brick building: UK libraries coping with research data management as a ‘wicked’ problem. *Journal of Librarianship and Information Science*, 48, 3–17. <https://doi.org/10.1177/0961000614533717>.

Diekema, A.R., Wesolek, A., & Walters, C.D. (2014). The NSF/NIH Effect: Surveying the effect of data management requirements on faculty, sponsored programs, and institutional repositories. *Journal of Academic Librarianship*, 40(3–4), 322–331. <https://doi.org/10.1016/j.acalib.2014.04.010>.

Digital Curation Center. (n.d.) *Overview of funders' data policies*. Retrieved December 15, 2016, from <http://www.dcc.ac.uk/resources/policy-and-legal/overview-funders-data-policies>.

Enke, N., Thessen, A., Bach, K., Bendix, J., Seeger, B., & Gemeinholzer, B. (2012). The user's view on biodiversity data sharing: Investigating facts of acceptance and requirements to realize a sustainable use of research data. *Ecological Informatics*, 11, 25–33. <https://doi.org/10.1016/j.ecoinf.2012.03.004>.

European Commission. (2016a). *Guidelines on open access to publications and research data in Horizon 2020*. Version 3.1, 25 August 2016. Retrieved December 15, 2016, from http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf.

European Commission. (2016b). *Guidelines on FAIR data management in Horizon 2020*. Version 3.0, 26 July 2016. Retrieved December 15, 2016, from http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-data-mgt_en.pdf, <https://doi.org/10.1016/j.ecoinf.2012.03.004>.

Flores, J.R., Brodeur, J.J., Daniels, M.G., Nicholls, N., & Turnator, E. (2015). Libraries and the research data management landscape. In J.C. Maclachlan, E.A. Waraksa, & C. Williford (Eds), *The process of discovery: The CLIR postdoctoral fellowship program and the future of the academy* (pp. 82–102). Washington, DC: Council on Library and Information Resources.

Hey, T., Tansley, S., & Tolle, K. (2009). *The fourth paradigm. Data-intensive scientific discovery*. Redmond, WA: Microsoft Research.

Kim, J. (2013). Data sharing and its implications for academic libraries. *New Library World*, 114, 494–506. <https://doi.org/10.1108/NLW-06-2013-0051>.

Koltay, T. (2016). Are you ready?: Tasks and roles for academic libraries in supporting Research 2.0. *New Library World*, 117, 94–104. <https://doi.org/10.1108/NLW-09-2015-0062>.

Kratz, J. E., & Strasser, C. (2015). Researcher perspectives on publication and peer review of data. *PLoS ONE*, 10(2): e0117619, n.d. Retrieved December 15, 2016, from <https://doi.org/10.1371/journal.pone.0117619>.

Linde, P., Noorman, M., Wessels, B., & Sveinsdottir, T. (2014). How can libraries and other academic stakeholders engage in making data open? *Information Services & Use* 34(3/4), 211–219. Retrieved December 15, 2016, from <http://dx.doi.org/10.3233/ISU-140741>.

- National Science Foundation. (n.d.). *Dissemination and sharing of research results*. Retrieved December 15, 2016, from <http://www.nsf.gov/bfa/dias/policy/dmp.jsp>.
- Office of Science and Technology Policy (OSTP). (2013, 22 February). *Increasing access to the results of federally funded scientific research*. Retrieved December 15, 2016, from https://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf.
- Open Data Charter. (2015, September). *International open data charter*. Retrieved December 15, 2016 from http://opendatacharter.net/wp-content/uploads/2015/10/opendatacharter-charter_F.pdf.
- Research Councils U.K. (2015). *Guidance on best practice in the management of research data*. Retrieved December 15, 2016, from <http://www.rcuk.ac.uk/documents/documents/rcukcommonprinciplesondatapolicy-pdf/>.
- Rittel, H.W.J., & Webber, M.M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4, 155–169. <https://doi.org/10.1007/BF01405730>.
- Royal Society. (2012). *Science as an open enterprise*. Retrieved December 15, 2016 from https://royalsociety.org/~media/Royal_Society_Content/policy/projects/sape/2012-06-20-SAOE.pdf.
- Schmidt, B., Gemeinholzer, B., & Treloar, A. (2016). Open data in global environmental research: The Belmont Forum’s open data survey. *PLoS ONE*, 11(1), e0146695, 1–29. Retrieved December 15, 2016, from <https://doi.org/10.1371/journal.pone.0146695>.
- Shearer, K. (2015). *Comprehensive brief on research data management policies*. Retrieved December 15, 2016, from: http://www.science.gc.ca/default.asp?lang=En&n=1E116DB8-1#_ftn3.
- Si, L., Xing, W.M., Zhuang, X.Z., Hua, X.Q., & Zhou, L.M. (2015). Investigation and analysis of research data services in university libraries. *Electronic Library*, 33, 417–449. <https://doi.org/10.1108/EL-07-2013-0130>.
- Specht, A., Guru, S., Houghton, L., Keniger, L., Driver, P., Ritchie, E. G., ..., Treloar, A. (2015). Data management challenges in analysis and synthesis in the ecosystem sciences. *Science of the Total Environment*, 534, 144–158. <https://doi.org/10.1016/j.scitotenv.2015.03.092>.
- Tenopir, C., Allard, S., Douglass, K., Aydinoglu, A.U., Wu, L., Read, E., ... , Frame, M. (2011). Data sharing by scientists: practices and perceptions. *PloS ONE*, 6(6), e201101, 1–21. Retrieved December 15, 2016, from <https://doi.org/10.1371/journal.pone.0021101>.
- Tenopir, C., Birch, B., & Allard, S. (2012). *Academic libraries and research data services: Current practices and plans for the future* [White paper]. Association of College and Research Libraries. Retrieved December 15, 2016, from http://www.ala.org/acrl/sites/ala.org.acrl/files/content/publications/whitepapers/Tenopir_Birch_Allard.pdf.

Tenopir C., Dalton, E.D., Allard, S., Frame, M., Pjesivac, I., Birch, B., ..., Dorsett, K. (2015a). Changes in data sharing and data reuse practices and perceptions among scientists worldwide. *PLoS ONE*, 10(8), e0134826, 1–24. Retrieved December 15, 2016, from <https://doi.org/10.1371/journal.pone.0134826>.

Tenopir, C., Hughes, D., Allard, S., Frame, M., Birch, B., Baird, L., ..., Lundeen, A. (2015b). Research data services in academic libraries: Data intensive roles for the future? *Journal of eScience Librarianship*, 4(2), art. 4, 1–21. Retrieved December 15, 2016, from <https://doi.org/10.7191/jeslib.2015.1085>.

Tenopir, C., Hughes, D., Allard, S., Frame, M., Birch, B., Baird, L., ..., Lundeen, A. (2016). *Academic Libraries Follow-Up Dataset* [Data set]. Oneshare. <http://dx.doi.org/10.15146/R39G6F>.

Tenopir, C., Birch, B., & Allard, S. (2017). *Academic libraries and research data services dataset* [Data set]. Oneshare. <http://dx.doi.org/10.15146/R3FG6P>.

Vlaeminck, S. (2013). Data management in scholarly journals and possible roles for libraries – Some insights from EDaWaX. *LIBER Quarterly*, 23, 48–79. Retrieved December 15, 2016, from <https://doi.org/10.18352/lq.8082>.

Wellcome Trust. (2010). *Policy on data management and sharing*. Retrieved December 15, 2016, from <http://www.wellcome.ac.uk/About-us/Policy/Policy-and-position-statements/WTX035043.htm>.

Note

¹ For lists of countries by OpenAIRE region, see <https://www.openaire.eu/regional-offices>.

Appendix 1

Table 3: Consultative RDS based on region.

Consultative RDS	Region	Yes	No, but plan to	No
Consulting with academic staff or students on DMPs	West	34 (60.7%)	19 (33.9%)	3 (5.4%)
	East	5 (27.8%)	8 (44.4%)	5 (27.8%)
	North	4 (19%)	13 (61.9%)	4 (19%)
	South	6 (50%)	6 (50%)	0 (0%)
Consulting with academic staff or students on meta/data stds.	West	31 (56.4%)	20 (36.4%)	4 (7.3%)
	East	6 (33.3%)	6 (33.3%)	6 (33.3%)
	North	4 (19%)	12 (57.1%)	5 (23.8%)
	South	5 (45.5%)	6 (54.5%)	0 (0%)
Outreach and collaboration with other research RDS providers	West	30 (55.6%)	19 (35.2%)	5 (9.3%)
	East	2 (11.1%)	7 (38.9%)	9 (50%)
	North	11 (52.4%)	9 (42.9%)	1 (4.8%)
	South	3 (25%)	8 (66.7%)	1 (8.3%)
Creating web guides/aids for data/sets	West	25 (49%)	18 (35.3%)	8 (15.7%)
	East	3 (17.6%)	8 (47.1%)	6 (35.3%)
	North	5 (25%)	14 (70%)	1 (5%)
	South	2 (16.7%)	9 (75%)	1 (8.3%)
Directly participating with researchers on a project	West	20 (40%)	13 (26%)	17 (34%)
	East	3 (21.4%)	5 (35.7%)	6 (42.9%)
	North	6 (30%)	6 (30%)	8 (40%)
	South	1 (10%)	6 (60%)	3 (30%)
Providing support for finding and citing data/data sets	West	25 (47.2%)	23 (43.4%)	5 (9.4%)
	East	5 (29.4%)	7 (41.2%)	5 (29.4%)
	North	4 (20%)	12 (60%)	4 (20%)
	South	3 (27.3%)	7 (63.6%)	1 (9.1%)
Discussing research data services RDS with others	West	43 (86%)	5 (10%)	2 (4%)
	East	7 (50%)	3 (21.4%)	4 (28.6%)
	North	18 (90%)	1 (5%)	1 (5%)
	South	5 (45.5%)	5 (45.5%)	1 (9.1%)
Training colleagues on RDS	West	30 (60%)	15 (30%)	5 (10%)
	East	4 (28.6%)	6 (42.9%)	4 (28.6%)
	North	13 (65%)	5 (25%)	2 (10%)
	South	4 (36.4%)	6 (54.5%)	1 (9.1%)
Involved in policy development related to RDS	West	40 (80%)	8 (16%)	2 (4%)
	East	4 (28.6%)	6 (42.9%)	4 (28.6%)
	North	14 (73.7%)	3 (15.8%)	2 (10.5%)
	South	4 (36.4%)	7 (63.6%)	0 (0%)

Table 4: Technical RDS based on region.

Technical RDS	Region	Yes	No, but plan to	No
Providing technical support for RDS	West	24 (45.3%)	25 (47.2%)	4 (7.5%)
	East	5 (29.4%)	3 (17.6%)	9 (52.9%)
	North	5 (25%)	7 (35%)	8 (40%)
	South	4 (36.4%)	7 (63.6%)	0 (0%)
Deaccessioning / deselection of data/sets	West	7 (13.7%)	18 (35.3%)	26 (51%)
	East	0 (0%)	3 (20%)	12 (80%)
	North	0 (0%)	4 (20%)	16 (80%)
	South	0 (0%)	4 (36.4%)	7 (63.6%)
Preparing data/sets for deposit	West	19 (36.5%)	21 (40.4%)	12 (23.1%)
	East	3 (18.8%)	4 (25%)	9 (56.3%)
	North	1 (5%)	12 (60%)	7 (35%)
	South	2 (18.2%)	7 (63.6%)	2 (18.2%)
Creating or transforming meta/ data for data/sets	West	19 (35.8%)	21 (39.6%)	13 (24.5%)
	East	3 (16.7%)	7 (38.9%)	8 (44.4%)
	North	3 (14.3%)	10 (47.6%)	8 (38.1%)
	South	2 (18.2%)	7 (63.6%)	2 (18.2%)
Identifying data/sets	West	18 (33.3%)	24 (44.4%)	12 (22.2%)
	East	4 (22.2%)	7 (38.9%)	7 (38.9%)
	North	1 (4.8%)	14 (66.7%)	6 (28.6%)
	South	5 (45.5%)	6 (54.5%)	0 (0%)
Selection of data/sets	West	16 (32%)	18 (36%)	16 (32%)
	East	2 (14.3%)	5 (35.7%)	7 (50%)
	North	1 (5%)	10 (50%)	9 (45%)
	South	3 (30%)	7 (70%)	0 (0%)