EUROPE'S RESEARCH LIBRARY NETWORK

LIBER Open Science Roadmap

Table of Contents

EXECUTIVE SUMMARY

Embracing Open Science is critical if we are to make science more collaborative, reproducible, transparent and impactful. Open Science undoubtedly has the power to positively influence society, but its implementation is not yet universal.

A revolution is required: one which opens up research processes and changes mindsets in favour of a world where policies, tools and infrastructures universally support the growth and sharing of knowledge.

Research libraries are well placed to make that revolution happen. This Roadmap outlines the specific actions libraries can take to champion Open Science, both within and beyond their own institutions.

As we explain in detail throughout this document, libraries need to advocate for Open Science locally and internationally, to support Open Science through tools and services and to expand the impact of their work through collaboration and partnerships.

LIBER has shaped its 2018-2022 Strategy[1] to support and enable Open Science and it is our hope that this Roadmap will help Europe's research libraries to do the same.

This document was written during spring 2018, when the Open Science Policy Platform (OSPP) produced integrated advice for the EC and key stakeholders.[2] People from across the LIBER community translated the OSPP recommendations for libraries and combined them with suggestions drawn from their own expertise and experiences.

[1] https://libereurope.eu/strategy

[2] *Integrated advice of the Open Science Policy Platform Recommendations, 2018. Available at https://ec.europa.eu/research/openscience/pdf/integrated_advice_opspp_recommendations.pdf*

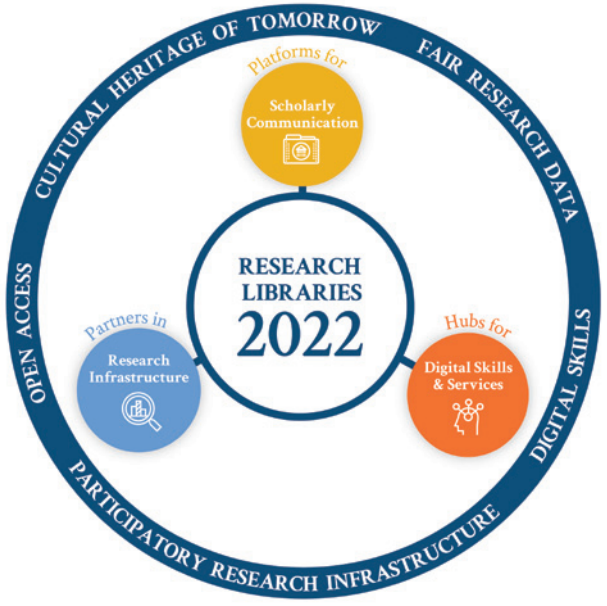
About LIBER

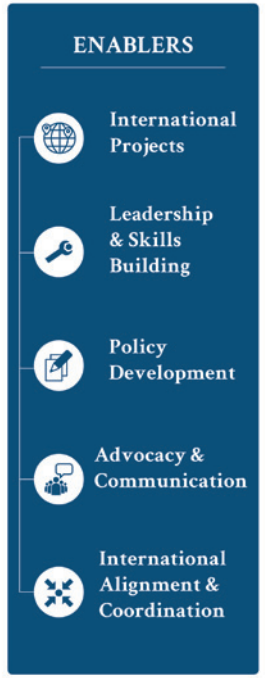
LIBER *(Ligue des Bibliothèques Européennes de Recherche – Association of European Research Libraries)* represents 430 university, national and special libraries in 40 countries, making us Europe's largest research library network.

Our 2018-2022 Strategy, Powering Sustainable Knowledge in the Digital Age, outlines how libraries can prepare themselves for coming changes in the research landscape. It is based on three key focus areas: Innovative Scholarly Publishing, Digital Skills and Services, and Research Infrastructures.

By 2022, we envision a world where:

- Open Access is the predominant form of publishing;
- Research Data is Findable, Accessible, Interoperable and Reusable (FAIR);
- Digital Skills underpin a more open and transparent research life cycle;
- Research Infrastructure is participatory, tailored and scaled to the needs of the diverse disciplines;
- The cultural heritage of tomorrow is built on today's digital information.





Introduction

Open science is the practice of making everything in the discovery process fully and openly available, creating transparency and driving further discovery by allowing others to build on existing work. When I read such definitions, I think 'but isn't that just science? [3]

Open Science is here to stay — and with good reason. It makes scientific outputs publicly available so that anyone can read, share and build upon the results. This, in turn, drives collaboration and innovation, and maximizes the potential to solve global challenges such as climate change and disease.

Because of its immense power, supporting Open Science is increasingly being adopted as a key strategic aim of organisations big and small, from the European Commission and Member states to universities and other research performing organisations, research funders and infrastructures, Citizen Science organisations and libraries. It is being implemented through policies, funding, the development of infrastructures, projects, the sharing of best practices, the development of skills and awareness raising.

This is encouraging but there is still considerable work to be done. Mindsets need to change and profound shifts in working methods need to take place. From the conduct and funding of science to methodological and ethical issues, openness affects all processes and it is important to identify specific actions which can help drive the shift to Open Science.

The development of new Open Science infrastructures and other tools, the sharing of best practices, awareness raising and provision of training are all important contributions. Above all, we need pioneers and champions to show how the research cycle can happen in an open way.

Libraries are in an excellent position to be those pioneers and champions. This roadmap describes how and why they should do so, and gives concrete examples of how all libraries can actively contribute to the development of Open Science by raising awareness, provide training, opening up research collections to innovative research methods and developing supportive policies and infrastructures.

[3] *Watson, M. (2015). When will 'open science' become simply 'science'?. Genome Biology. Available at https://genomebiology.biomedcentral.com/articles/10.1186/s13059-015-0669-2*

The actions they can undertake are numerous and diverse but one theme emerges repeatedly: collaboration. Coordinating with colleagues both within the library's own institution and on a bigger scale — by establishing regional Open Science programmes to efficiently share best practices and resources and engaging in international projects and policy development — is key.

Exactly how much work needs to be done varies greatly between disciplines, countries and institutions. In some countries Open Science is recognized in the government agenda and awareness is high. In others, the concept of Open Science and its development is still at a preliminary stage. There is a considerable geographical split, with initiatives in western and northern Europe broadly more advanced than southern and eastern Europe.

Not all libraries will have the resources to do as much as they might like with Open Science but all libraries can do something and any step — no matter how small — is a step in the right direction. It is no longer a question of if but how. Libraries must take an active role in Open Science because it is the right thing to do: for the library, its users and society as a whole.

No matter where your library lies on the Open Science continuum, it is LIBER's hope that this document will provide guidance to further drive the shift to Open Science, providing invaluable support to your researchers and institution and — at the same time — making a significant contribution to future discoveries and innovation.

THREE KEY PRINCIPLES

1. TRANSPARENCY
The whole research cycle should be as transparent as possible including publishing cost information, open peer review, open metrics. Libraries should support transparency by, for example, sharing licensing information, raising awareness of next generation metrics, communicating Open Access requirements and mandates as well as Open Access publishing possibilities to researchers.

2. SUSTAINABILITY
Research outputs, infrastructures and funding should all be sustainable. Libraries should support sustainability in providing standardised metadata services including persistent identifiers and long term preservation solutions.

3. COLLABORATION
The spirit of collaboration on a local, European and global level is deeply embedded in libraries and across research communities. Libraries can use this to foster Open Science, through the sharing of best practices and case studies and by developing common standards and services.

LIBRARIES SUPPORT THE ENTIRE RESEARCH PROCESS

1. PLANNING

- Develop Data Management Plans and support researchers in their implementation
- Develop and provide tools for FAIR data management
- Help researchers to manage their personal identifiers (ORCID, ISNI)
- Provide information about research funding possibilities

2. SUPPORTING

- Support access to information through portals and databases
- Ensure your library is a one-stop-shop to support researchers in all questions related to Open Science
- Turn the library into a working environment especially for students and citizen scientists

3. MANAGING

- Ensure research outputs are interoperable by supporting researchers in the use of identifiers, metadata and vocabularies
- Provide training in managing data sets, in programming languages, support in statistics and in using high computing power
- Develop infrastructures: Institutional Repositories for publications and data, ontologies and other tools to describe content

4. PUBLISHING

- Encourage researchers and students to use Institutional Repositories for publishing
- Provide training in Open Access publishing and the requirements of publishers

5. ASSESSING

- Participate in projects and pilots to learn about next-generation metrics
- Advance the adoption of next-generation metrics

6. REUSING

- Raise awareness and provide training about reuse requirements
- Promote reuse with copyright and contract management, and through the use of Creative Commons licenses

Cultural Change

The openness I am advocating would be a giant cultural shift in how science is done, a second open science revolution extending and completing the first open science revolution, of the 17th and 18th centuries.[4]

The development of new infrastructures and other tools, the sharing of best practices, and provision of training can all help to encourage Open Science. To be truly effective, however, libraries must also strive to change the culture which underpins scientific practice and knowledge creation.

Cultural change is a slow process but it can be accelerated by:

Using training and advocacy to foster a common understanding. Everyone, from researchers and library staff to professors, university directors and politicians, needs to understand the importance of Open Science.

Ensuring that your institution has an Open Science policy. This policy should be informed by the insights and needs of your library and users.

Reflecting a commitment to Open Science across all services. Provide a certified repository. Create a data catalogue. Publish content with a machine-readable license. Use open APIs to provide access to library services. Develop intelligent tools to automate metadata production and support FAIR data management during the entire data life-cycle. Ensure that contracts with publishers are transparent.

Sharing inspiring examples. Highlight your own library's successes and those of Open Science champions from across the community.

[4] *Bartling, S., & Friesike, S. (2014). Towards Another Scientific Revolution. Available at http://dx.doi.org/10.1007/978-3-319-00026-8_1*

Main Priorities

ENCOURAGE

the development of Open Science and Open Access policies and strategies at your university or research performing organisation. Ensure that these policies support the move towards Open Science and that they are informed by the insights and needs of libraries and their users.

ENGAGE

in the development of national and European legislation and policies which impact on Open Science. When topics such as copyright, text and data mining, data protection and FAIR data are discussed, reinforce the importance of Open Science and the need to adopt frameworks which give maximum access to knowledge and resources.

STRIVE

to make everyone in your community, from students and researchers to staff and partners, an Open Science advocate. Key to this is ensuring that the principles of Open Science and FAIR Data are prominently and publicly reflected in your library's work.

SUPPORT

promote and participate in international Open Science initiatives. These include the European Open Science Cloud (EOSC),[5] Open Access Publishing Platform projects and declarations such as the Declaration on Research Assessment (DORA),[6] the Hague Declaration[7] and the Leiden Manifesto.[8]

DEVELOP

training programmes and guidelines which support the entire Open Science ecosystem and cover key concepts such as Open Access, FAIR Data, metadata and data management and Citizen Science. Libraries can also help researchers learn how to responsibly conduct research by teaching the legal and ethical aspects of scholarly communication, copyright and data management.

ADOPT

technology and provide services which support Open Science. Provide a certified repository. Create a data catalogue. Publish content with a machine-readable license. Use open APIs to provide access to library services. Develop intelligent tools to automate metadata production and support FAIR data management during the entire data life-cycle.

COLLABORATE

nationally and internationally to develop best practices which support Open Science, and to ensure that solutions are appropriately scaled to support the international research community. This can be done with other libraries and research organisations, through LIBER's Working Groups[9] and by participating in European projects.

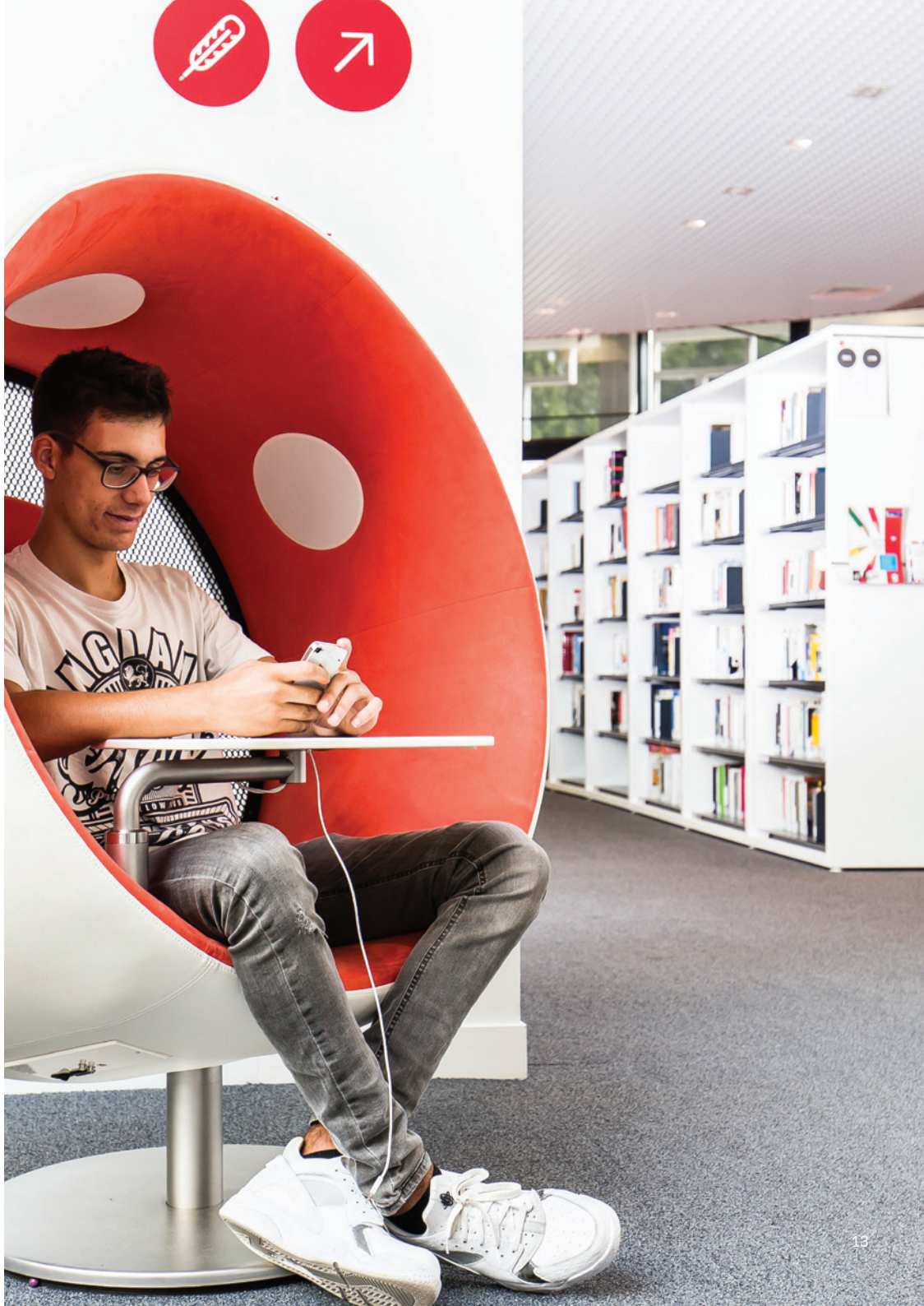
[5] https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud
[6] https://sfdora.org
[7] https://thehaguedeclaration.com
[8] http://www.leidenmanifesto.org
[9] http://libereurope.eu/working-groups

SEVEN FOCUS AREAS

Our Seven Focus Areas reflect the priorities highlighted by the Open Science Policy Platform (OSPP), in its integrated advice for the European Commission and key stakeholders. Libraries need to work across all of these areas if they want to fully support Open Science.

In the following section, we elaborate on the opportunities and challenges related to each of these areas and make specific recommendations for libraries who want to go further.

- Scholarly Publishing
- FAIR Data
- Research Infrastructure & the EOSC
- Metrics & Rewards
- Open Science Skills
- Research Integrity
- Citizen Science



1. Scholarly Publishing

Research-led universities have, for centuries, shared a common goal to publish the results of research and to share these results widely. Open Science now allows new approaches to the publication of research and educational outputs which were previously unthinkable. Libraries have a unique opportunity to take the lead in this space.

OPPORTUNITIES & CHALLENGES

The core aim of Open Science is to open up the research and educational process, and the outputs which are produced as a result. Open Access is key component of this transition. However, it is still far from the the default publishing model and the European Commission's goal of full Open Access for all publicly-funded scientific publications by 2020 seems ambitious.

LIBER's Open Access Working Group[10] has identified critical ways in which this gap can be addressed, including five principles which aim to guide libraries and consortia as they shift from a reader — pays model (subscription licensing) to an author — pays model based on Article Processing Charges (APC).[11] The principles emphasize transparency in negotiations, encourage model flipping and aim to sustain the scholarly communication landscape for the benefit of research and academia.

More generally, libraries should ensure that they are advocates for Open Science and Open Access, and that certain foundations are in place at their own institutions. An Open Access mandate is essential to supporting a transformational move to Open Science dissemination and libraries can lead its creation. In addition, libraries should insist that such mandates form part of a wider institutional policy and strategy on Open Science.

Libraries can also become direct facilitators of knowledge creation, rather than simply curating it for access and long-term preservation. University presses such as Stockholm University Press[12] and UCL Press[13] are two examples of how this can be done. They champion rigorous peer review, Open Access and global dissemination, and they are based in university libraries.

By making themselves pivotal players in the publishing landscape, libraries can help the academic community embrace Open Science principles and directly support Open Science through the transition to Open Access.

[10] http://libereurope.eu/strategy/innovative-scholarly-communication/openaccess

[11] van Otegem, M., Wennström, S., & Hormia-Poutanen, K. (2018). Five principles to navigate a bumpy golden road towards open access . Insights , 31, 16 . DOI: http://doi.org/10.1629/uksg.403

[12] https://www.stockholmuniversitypress.se

[13] http://www.ucl.ac.uk/ucl-press

FIVE PRINCIPLES FOR OPEN ACCESS NEGOTIATIONS WITH PUBLISHERS

1. LICENSING AND OPEN ACCESS GO HAND-IN-HAND
The world of subscription deals and APC-deals are closely linked. Nobody should pay for subscriptions and pay APCs at the same time ('double dipping'). Each new license agreed on should therefore contain conditions about both sides of the coin. Increased spending on APCs should result in proportionately lower spending on subscription fees.

2. NO OPEN ACCESS, NO PRICE INCREASE
There is enough money in the system already. Libraries have paid annual price increases of up to 8% for years, supposedly to allow publishers to innovate. A key feature of innovation for the research community is that research outputs are freely available. Therefore if an agreement with publishers on Open Access cannot be reached in our contracts, future price increases should not be accepted.

3. TRANSPARENCY FOR LICENSING DEALS: NO NON-DISCLOSURE
The practices of libraries should fully reflect their commitment to Open Access. Licensing agreements should therefore be openly available. Society will not accept confidential agreements paid for with public money in the form of non-disclosure agreements, as recent developments have shown.

4. KEEP ACCESS SUSTAINABLE
To avoid putting more money in the system, and to strengthen Open Access, some libraries have given up their rights to perpetual access in license agreement. Perpetual access is, however, critical in a quickly-changing publishing environment. Libraries must secure sustainable access to content.

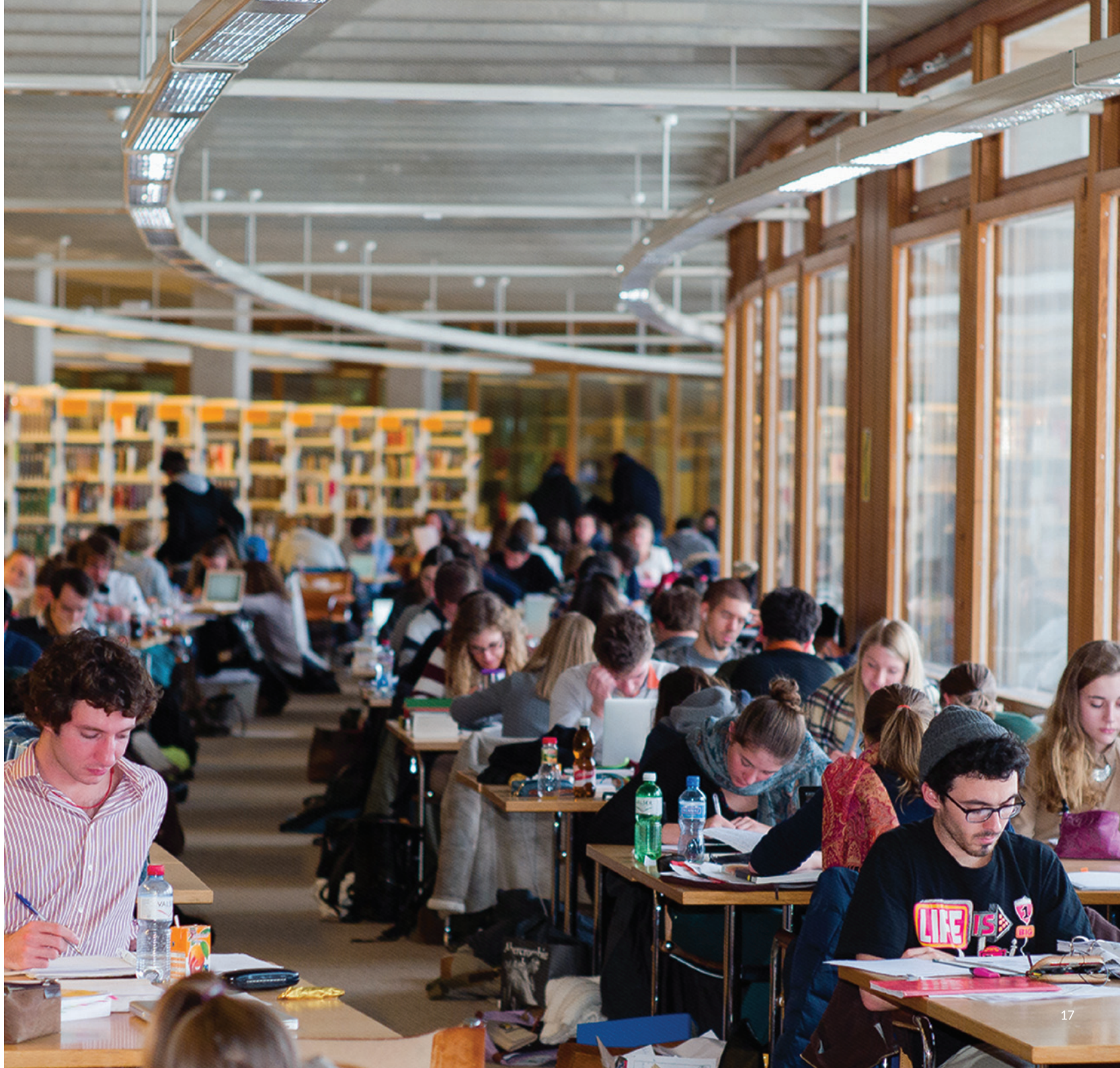
5. USAGE REPORTS SHOULD INCLUDE OPEN ACCESS
Although APC-buyouts are becoming more common, reporting about Open Access is still rare. Just as libraries receive reports about downloads and usage in the subscription world, they should also receive reports on Open Access publications. It is normal to receive insight into what we pay for.

RECOMMENDATIONS

1. Ensure an Open Science policy or Open Access mandate is in place at your institution, which requires researchers to make their publications digital, online without delays, free of charge, and free of most restrictions to reuse.
2. Directly champion Open Science by embracing a new role as a direct publisher of information.
3. Commit to following LIBER's licensing principles for Open Access negotiations[14] when negotiating with publishers.
4. Examine new models for journal delivery such as mega journals, a format popular with research funders. They are interdisciplinary and fully open. The Wellcome Open Research platform[15] is one example. The European Commission is also actively working in this space.

[14] https://libereurope.eu/blog/2017/09/07/open-access-five-principles-for-negotiations-with-publishers

[15] https://wellcomeopenresearch.org



2. FAIR Data

Open Science is underpinned by research data being Findable, Accessible, Interoperable and Reusable (FAIR). Transitioning to FAIR Data requires more awareness among the scientific community, new tools and training – not to mention a significant change in research data culture. Libraries can play an important supporting role in all of these areas, and they are backed up in this work by the European Commission which is strongly committed to FAIR Data as an essential element of Open Science.

OPPORTUNITIES & CHALLENGES

Libraries are enablers of Open Science. They facilitate communication and exchange of data between researchers, IT service providers and research offices, and they are ideally placed to bridge the gap between researchers within an institution and Open Science initiatives from the wider national and international environment.

Libraries can use this unique position to kickstart an academic culture change which favours FAIR data and makes it the default for research data.

Providing training and support to researchers and students is one obvious step. Libraries can also work with technical staff and the broader community to develop the infrastructures and components needed to support the FAIR Data ecosystem, such as certified repositories, identifiers, metadata standards, vocabularies and ontologies.

WHAT IS FAIR?

Findable.
Accessible.
Interoperable.
Reusable.

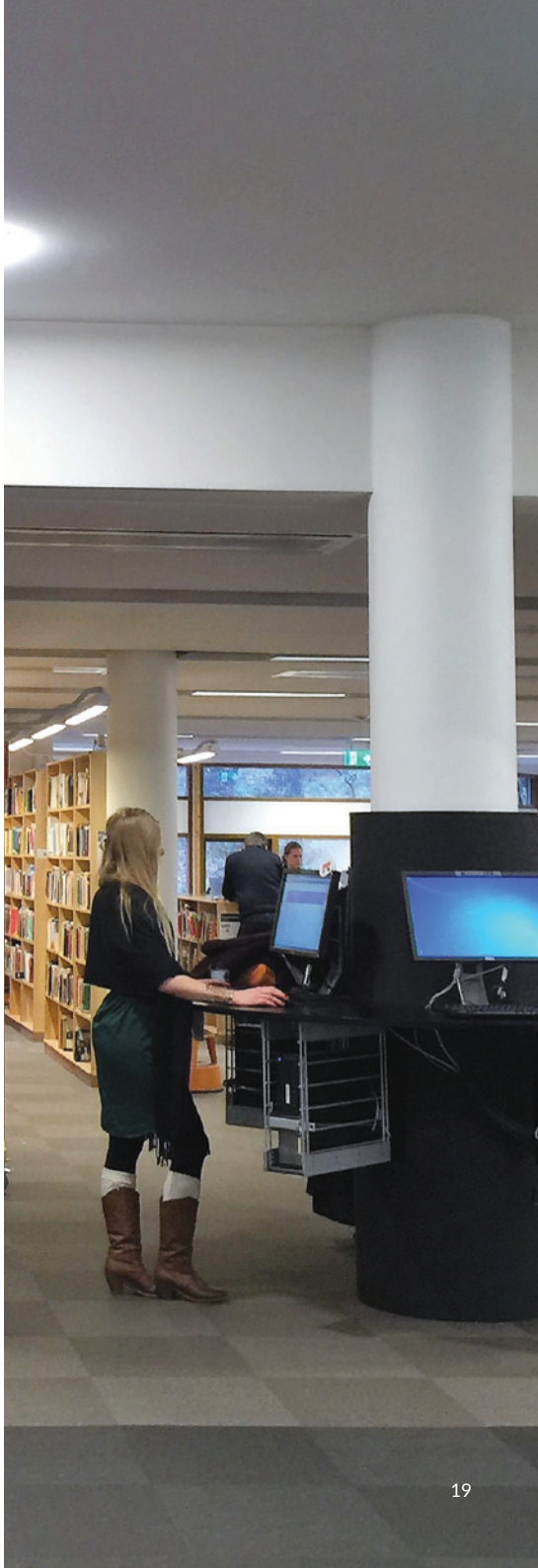
Together they make FAIR: a guiding principle to facilitate knowledge discovery by assisting humans and machines in their discovery of, access to, integration and analysis of scientific data and their associated algorithms and workflows. The FAIR concept also embraces trust and sustainability.

FAIR data is not always open but it should be as open as possible, or as closed as necessary. Even data which must be restricted for reasons such as privacy can, and should, adhere to the FAIR principles.

RECOMMENDATIONS

1. Invest in staff with good data skills and train personnel to promote FAIR principles to your organisation's researchers, students and technical staff.
2. Work with your institution, research infrastructures and funders to make the use of FAIR-compliant Output and Data Management Plans (OMPs/DMPs) mandatory. DMPs should be machine actionable and support automated evaluation of project plans.
3. Develop and provide certified repositories and intelligent tools for researchers to support FAIR data management during the entire data life-cycle, from planning the research to data preservation and re-use.
4. Automate as much as possible the metadata production and data management during the data life-cycle, and incorporate the FAIR principles in your own digital preservation practices and policies.
5. Advocate for copyright legislation which supports FAIR data and encourages techniques dependent on it, such as text and data mining.
6. Share best practices and case studies in the implementation of FAIR principles during the data life cycle, and advocate at your institution for guidelines such as those in LIBER's FAIR Data Factsheet.[16]

[16] *Implementing FAIR Data Principles: The Role of Libraries. Available at https://libereurope.eu/wp-content/uploads/2017/12/LIBER-FAIR-Data.pdf*



3. Research Infrastructure & the EOSC

The European Open Science Cloud (EOSC) is an initiative of the European Commission to build the infrastructure required to support Open Science. The EOSC is still being shaped. Stakeholders from all quarters and two High Level Expert Groups (HLEG) have provided their views. Projects such as EOSCpilot,[17] EOSC-Hub,[18] FREYA,[19] and OpenAIRE-Advance[20] are elements of the EOSC Roadmap[21] which has been endorsed by EU ministers. Research libraries have an important role to play in the EOSC because of their connections to researchers and EOSC stakeholders.

OPPORTUNITIES & CHALLENGES

The EOSC will provide a one-stop-shop for finding, accessing and using research data and services from multiple disciplines and platforms. It will be a major contribution to Europe's Open Science efforts and libraries should engage with it. Many LIBER libraries are already doing so.

Questions of how it will be governed and which services it will offer are currently being defined. Nevertheless, guiding statements can be found in the EOSC Declaration[22]— a document which provides the basis for stakeholder engagement in the EOSC.

LIBER's endorsement of the Declaration in 2017[23] outlines numerous areas through which research libraries can align their activities with the EOSC. Many, such as a commitment to data culture and stewardship and Open Access as a default form of publication, relate to well-established principles of Open Science and are already being actively pursued by libraries. Libraries will certainly have a critical role to play in supporting the EOSC and, because they mediate between researchers and EOSC service providers, they need to be represented in the advisory layer of the EOSC Governance Framework.

17 https://eoscpilot.eu
18 https://www.eosc-hub.eu
19 https://www.project-freya.eu
20 https://www.openaire.eu/advance
21 https://ec.europa.eu/research/openscience/pdf/swd_2018_83_f1_staff_working_paper_en.pdf
22 https://ec.europa.eu/research/openscience/pdf/eosc_declaration.pdf
23 https://libereurope.eu/wp-content/uploads/2017/09/EOSC-Declaration.pdf

RECOMMENDATIONS

1. Link your institution's strategies and policies to the EOSC in order to maintain the highest possible standard of data infrastructures offered at the institutional level.
2. Promote the EOSC to students, researchers and other staff members as both a source of information and a place to publish research outputs, in addition to institutional and national repositories.
3. Advocate for your institution to embed infrastructure training into the curricula of students and doctoral students.
4. Contribute to the ongoing development of the EOSC by offering feedback, either directly or through LIBER, and by sharing best practices which support Open Science.

4. Metrics & Rewards

Traditional methods of assessing the outputs of scientific research must change if Open Science is to thrive. Research should be assessed on its own merits, rather than the influence of the journal in which it is published, and researchers should be evaluated on a broader set of scholarly practices. Libraries can help by participating in the development and implementation of open scholarly metrics, and of indicators that embody Open Science values and account for Open Science practices, so that researchers are encouraged to embrace Open Science as a research paradigm.

OPPORTUNITIES & CHALLENGES

There is currently a bias towards the use of quantitative metrics, often based on inaccurate data and arbitrary indicators (e.g., h-index and Impact Factor). This significantly affects the career of researchers and is one of the strongest barriers towards the adoption of Open Science. Traditional metrics such as these do not encourage researchers to practice Open Science or to cultivate more open scholarly practices, nor do they allow researchers to reveal more about the Open Science principles they might embrace and the role those principles played in their research.

Openness and transparency should be the default drivers for scholarly metrics, and for the development of related services and tools. This is backed by the European Commission's Expert Group on Altmetrics,[24] which concluded that 'next generation metrics should be underpinned by an open, transparent and linked data infrastructure'.

Working with research communities, libraries should support the cause for open responsible metrics that facilitate the transition to Open Science within their institutions, nationally and internationally. Practical advice for doing this is offered by LIBER's Innovative Metrics Working Group.[25] It has published two documents.

[24] *European Commission Expert Group on Altmetrics. Next-generation metrics: Responsible metrics and evaluation for Open Science. Luxembourg: Publications Office of the European Union, 2017. Available at https://ec.europa.eu/research/openscience/pdf/report.pdf*

[25] *https://libereurope.eu/strategy/innovative-scholarly-communication/metrics*

The first, Deciphering the Trees in the Forest: Recommendations for Research Libraries in the Field of Scholarly Metrics,[26] lists prioritized actions that libraries can take. A second paper provides a critical view of the Leiden Manifesto for Research Metrics[27] and gives advice for libraries who want to implement its principles. Both documents underline the fact that open scholarly metrics is an arduous task that requires increased awareness, new cultural approaches and skills development, both from researchers and librarians.

Also, of interest is the report of the OSPP Working Group on Rewards.[28] The report recognizes that researchers are the key agent of change toward Open Science and calls for harmonization practices between the recognition and reward systems with the basic aims of Open Science. According to the report, 'science must go back to cooperative rather than competitive processes'. One proposal of the group is the Open Science Career Assessment Matrix (OS-CAM) that develops a comprehensive approach to evaluating researchers. It both enhances the range of metrics used to assess research output and research behaviour in relation to Open Science and offers a sophisticated evaluation system which provides insight and direction to more appropriate rewards.

[26] *LIBER Innovative Metrics Working Group. Deciphering The Trees in the Forest: Recommendations for Research Libraries in the Field of Scholarly Metrics. 2018. Available at DOI: 10.5281/zenodo.1289831*

[27] *Coombs, S. K., & Peters, I. (2017). The Leiden Manifesto Under Review: What Libraries Can Learn From It. Digital Library Perspectives. Available at https://libereurope.eu/wp-content/uploads/2017/03/DLP-Paper.pdf*

[28] *Working Group on Rewards under Open Science. Evaluation of Research Careers fully acknowledging Open Science Practices; Rewards, incentives and/or recognition for researchers practicing Open Science. Luxembourg: Publications Office of the European Union, 2017. Available at https://ec.europa.eu/research/openscience/pdf/os_rewards_wgreport_final.pdf*

RECOMMENDATIONS

1. Endorse the San Francisco Declaration on Research Assessment (DORA) and the Leiden Manifesto.
2. Collaborate with stakeholders to develop next-generation metrics which focus on evidence-based quantitative and qualitative indicators for Open Science.
3. Work with funding bodies and institutional HR departments to develop new methods of assessing and rewarding researchers in their careers, in a way which supports Open Science.
4. Retain high standards, both ethical and technical, when reporting metrics and indicators for individual researchers.

5. Open Science Skills

For Open Science to become the de-facto mode of conducting research and scholarship in Europe, researchers need disciplinary — specific skills and broader cross — disciplinary capabilities. It is therefore crucial to integrate Open Science training in curricula for students, starting at the bachelor level, and libraries should play a key role in this.

OPPORTUNITIES & CHALLENGES

Research Libraries have a long track record of offering training, both to individual researchers and scholars and in collaboration with departments and labs across their institutions. Open Science is an opportunity to strengthen that role as researchers search for guidance on new ways of working and techniques.

The Report from the European Commission's Open Science Skills Working Group[29] suggests four areas on which to focus:

1. Skills and expertise necessary for **open access publishing**. Library and research information skills (technical/library research support); open publication literacy skills (research user level).
2. Skills and expertise regarding **research data and open access**, data production, management, analysis/use/reuse, dissemination and a change of paradigm from 'protected data by default' to 'open data by default'. Technical skills, in particular, data engineering, data science and data management skills.
3. Skills and expertise to act in and beyond their own **scholarly and disciplinary community**. Open Science skills enabling professional research conduct which include research management skills; research integrity and ethics skills; legal skills.
4. Skills and expertise resulting from a general and broad concept of **Citizen Science**, where researchers interact with the general public to enhance the impact of science and research.

It is not only researchers who need help coping with topics such as electronic resource management and text and data mining. Library staff also need training in these areas so that they can better meet the needs of library users. LIBER's working group on Digital Skills for Library Staff & Researchers[30] is developing an educational programme to help with this.

[29] *Open Science Skills Working Group Report. Providing researchers with the skills and competencies they need to practise Open Science. Luxembourg: Publications Office of the European Union, 2017. Available at https://ec.europa.eu/research/openscience/pdf/os_skills_wgreport_final.pdf*

[30] *https://libereurope.eu/strategy/digital-skills-services/digitalskills*

In addition, libraries should look to partner with European projects such as FOSTER[31] to share best practices and content on an international scale, and should consult the outputs of former projects such as LEARN.[32] There may also be opportunities to participate in more local efforts, such as train-the-trainer workshops.

[31] *https://www.fosteropenscience.eu*

[32] *http://learn-rdm.eu*

RECOMMENDATIONS

1. Coordinate with other partners to provide a multidisciplinary one-stop-shop for researchers to support them in Open Science workflows in every stage of the research process.
2. Incorporate Open Science skills in the academic training programmes of students.
3. Provide innovative digital training materials and courses to support (and monitor) skills development.
4. Build on your library's expertise in areas such as metadata catalogues, persistent identifiers and ontologies to organise relevant new skills, expertise and competencies in the different areas of Open Science in order to develop the optimal Open Science support infrastructure.

6. Research integrity

Continued public trust in science is fundamental to securing unhindered support to publicly funded research, as well as to a broader appreciation of science and ultimately to support the prosperity of modern democracy. High standards of research integrity, ethics and conduct are therefore essential aspects of practicing research in general and hence of practicing Open Science.

OPPORTUNITIES & CHALLENGES

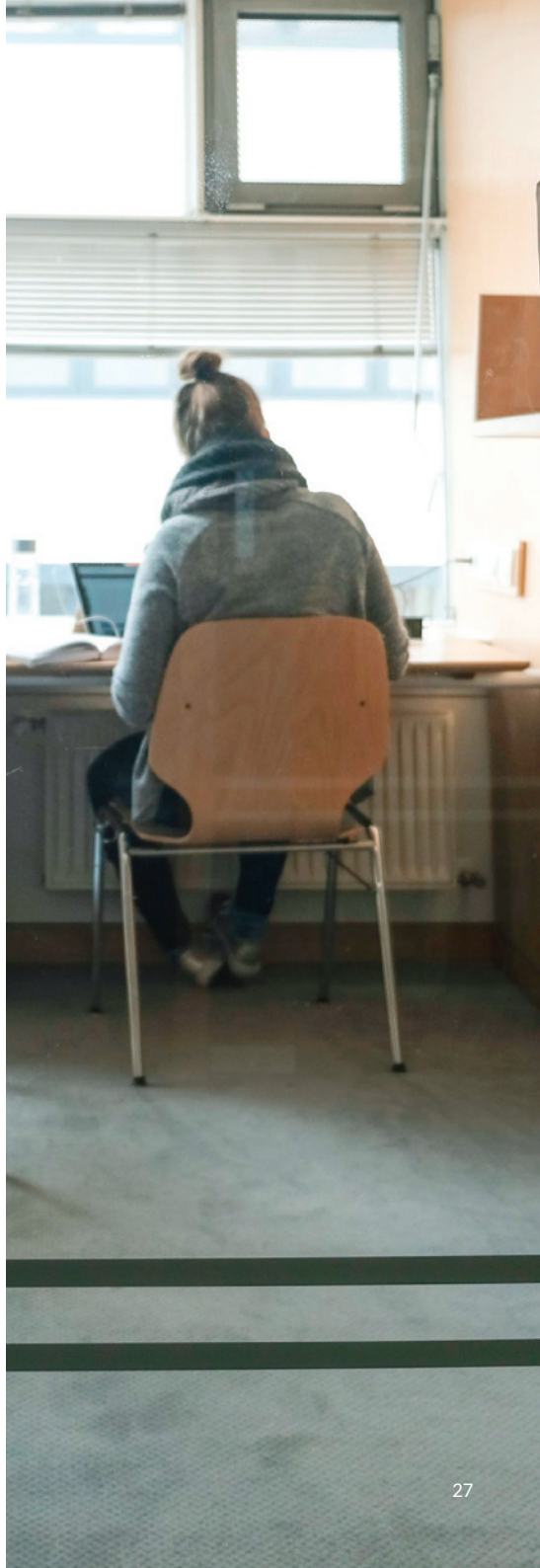
Increased focus on the societal impact of research, as well as high profile cases in the media focusing on malpractice, fraud, plagiarism and misconduct, have led to the development of national and international codes of conduct to further research integrity. However, details and tradition in research practices differ across disciplines. Generic codes and policies related to research integrity can lose impact when applied to a more specific daily practice or problem.

Libraries have a key role in supporting research integrity. They can fight against fake and predatory publishers. They can ensure that their institution has appropriate policies in place, and they can provide services related to copyright and IPR. They can investigate plagiarism and they can offer training: facilitating, guiding and educating young researchers about the rules and tools needed to conduct research according to the highest standards.

Libraries are ethically, legally and competently well positioned to do all of these things, in tight collaboration with relevant research communities. Additionally, libraries can provide the technical infrastructures to support research integrity in terms of systems for keeping, accessing and publishing research outputs.

RECOMMENDATIONS

1. Participate in establishing Codes of Conduct for Research Integrity within your institution. These codes should align with core principles of Open Science, such as openness, transparency and accountability in all aspects of research.
2. Train researchers about the legal and ethical aspects of scholarly communication, scholarly publishing, information competencies, copyright, data management and Open Science.
3. Provide services to counter malpractice and questionable conduct of research, such as counter-plagiarism services and publication strategy tools.



7. Citizen Science

Citizen Science, or the participation of the general public in the scientific research process, is an important element in establishing new links between science and society. It is thus essential to implementing Open Science, can contribute to innovation tailored to the needs of society, lead to reciprocal learning and foster a scientific culture across society as a whole.

OPPORTUNITIES & CHALLENGES

Citizen Science is booming around the world but the degree to which it is open varies greatly, as does formal support for Citizen Science across disciplines, organizations and countries.

Since both Open Science and Citizen Science facilitate and encourage broad participation in science and research, they are mutually beneficial.

As champions of Open Science, it is therefore relevant and necessary that national and research libraries assist if not lead in lifting the potential of Citizen Science. The possibilities for libraries to do this are seemingly endless.

They relate to the handling and keeping of research data and metadata, as well as the facilitation, organisation and documentation, skills and outreach needed for Citizen Science.

Citizen Science is an integrated part of the European Commission's Open Science Strategy, to be implemented through the Open Science Policy Platform and the European Open Science Cloud.

RECOMMENDATIONS

1. Promote the library as an active partner in Citizen Science and develop the necessary infrastructure to effectively support public researchers in their work.
2. Use the library's role as an organising and managing body to ensure that responsible conduct and good scholarly practice are respected when participating in Citizen Science.
3. Develop a set of guidelines including methodologies and policies for Citizen Science activities involving the library.
4. Develop the necessary skills to be a strong and active partner in Citizen Science, including skills in the areas of scientific communication, information technologies and project management. These skills should be attained not only internally in libraries but in collaboration with researchers and the public.

LOOKING FORWARD

With this Open Science Roadmap, LIBER aims to emphasise the importance of Open Science for the research library community, and to outline the areas and ways in which libraries can make a difference.

LIBER's work does not, however, end with this Roadmap. Libraries who want to do more with Open Science can rely on LIBER for support.

Our Working Groups are actively advancing Open Science. Staff in LIBER libraries are invited to follow the progress of these groups and to get involved. Participating in a Working Group is a wonderful way to exchange experiences and challenges with your professional peers, while at the same time making a valuable contribution to the wider research library community.

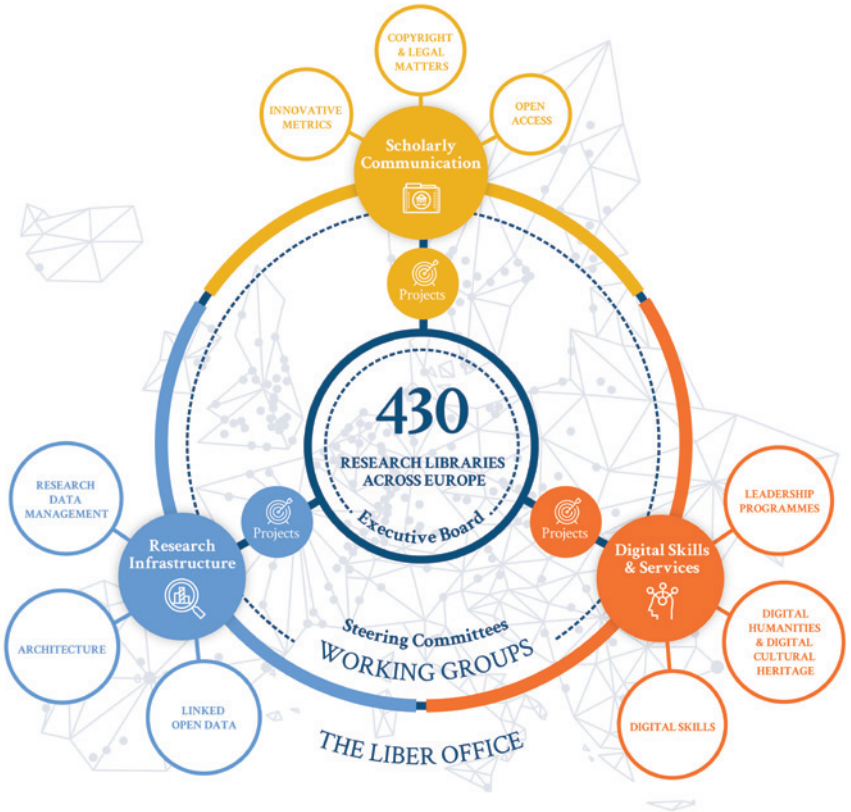
LIBER's office and Executive Board will also continue to work Open Science into all of LIBER's activities, and will collaborate with other research organisations to advance Open Science. If you have an idea, suggestion or question, please share it with us.

WHO TO CONTACT

LIBER Office
liber@kb.nl
EU Open Science Projects Officer
Valentino Cavalli *valentino.cavalli@kb.nl*

Working Groups
Architecture
Sylvia van Peteghem
sylvia.vanpeteghem@ugent.be
Copyright & Legal Matters
Friedel Grant *friedel.grant@kb.nl*
Digital Humanities & Digital Cultural Heritage
Lotte Wilms *lotte.wilms@kb.nl*
Dr Andreas Degkwitz

Digital Skills for Library Staff & Researchers
Susanne Dalsgaard Krag *sudk@kb.dk*
Cécile Swiatek *cecile.swiatek@gmail.com*
Innovative Metrics
Giannis Tsakonas *gtsak@upatras.gr*
Leadership
Hilde van Kiel *hilde.vankiel@kuleuven.be*
Linked Open Data
Matias Frosterus *matias.frosterus@helsinki.fi*
Open Access
Matthijs van Otegem *matthijs.vanotegem@eur.nl*
Lluís Anglada *lluis.anglada@csuc.cat*
Research Data Management
Birgit Schmidt *bschmidt@sub.uni-goettingen.de*
Rob Grim *rob.grim@eur.nl*



OPEN SCIENCE CHAMPIONS

Many LIBER libraries are already actively promoting Open Science and integrating it in their services and strategies. While writing this Roadmap, LIBER invited its libraries to expand on their Open Science activities and experiences. The following libraries volunteered to share their story.

- Karlsruhe Institute of Technology
- National Library of Finland
- Ruđer Bošković Institute Library
- Spanish National Research Council
- Svetozar Markovic University Library
- University of Barcelona
- University College London
- University Library of Southern Denmark

Karlsruhe Institute of Technology

Karlsruhe, Germany — kit.edu

Open Science in the sense of 'open as default or as open as possible' is the leading paradigm of science. Karlsruhe Institute of Technology (KIT) Library follows this paradigm by offering information infrastructure and comprehensive services to support both the research and publication process for all scientists at the KIT.

KIT takes a multifaceted but complementary strategy to Open Science and KIT Library has long supported Open Access to publications as an essential part of that strategy. We not only have an institutional Open Access policy but have also signed the Berlin Declaration[33] and in 2011 we were the first German academic institution to sign the Compact for Open Access Publishing Equity (COPE).[34] KIT has been running a central publication fund since then. KIT is one of the first signatories of the Hague Declaration[35] and has been instrumental in publishing the Open Access policy of the Helmholtz Association,[36] one of the large research organizations in Germany.

KIT Library has operated an institutional repository for publications since 1997. A repository for audio and video files followed in 2000. Together with the computing center and the research office at KIT, KIT Library forms the service team for research data management.[37]

The service team helps researchers at KIT with their data management plans, provides advice on suitable data repositories (re3data[38]) and offers institutional services to store and share research data.

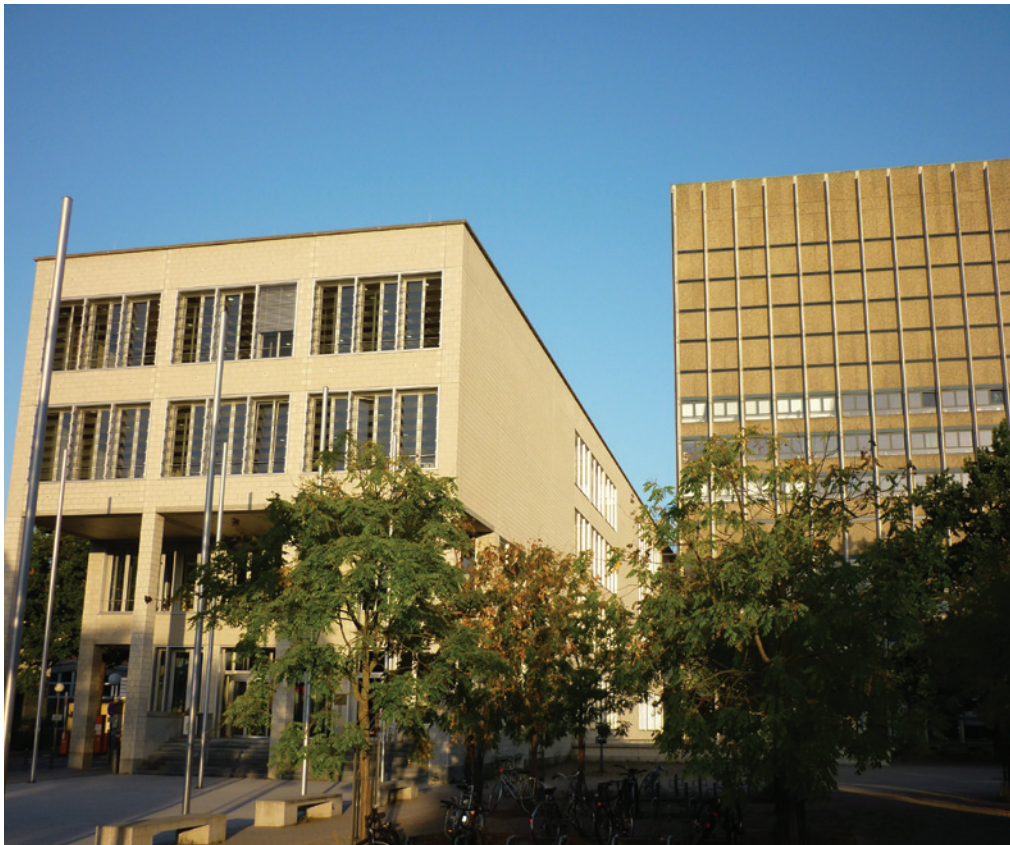
Together with the House of Competence at KIT, KIT Library offers a wide variety of training courses, lectures and seminars to all aspects of Open Access, publishing, research data management or good scientific practice. KIT Library is currently preparing a project proposal to enhance online and hybrid courses on data literacy.

It is one of the strategic concepts of KIT library to work in internal and external collaborations in the field of Open Science. It is sometimes challenging to convince possible partners of the mutual benefits of this collaboration. It can help to be the first mover and to be the first to give something without demanding an immediate equivalent.

[33] https://openaccess.mpg.de/Berlin-Declaration
[34] http://www.oacompact.org
[35] https://thehaguedeclaration.com
[36] https://www.helmholtz.de
[37] https://www.rdm.kit.edu
[38] https://www.re3data.org

Although cooperation can be challenging, it is the key to success. Make sure that you are working together with all the units, offices and departments at your institution. In addition, it is important to create an internal willingness inside your library to support the whole publication and research process at your institution.

Frank Scholze, Director of Library Services,
frank.scholze@kit.edu



National Library of Finland

Helsinki, Finland — nationallibrary.fi

Finland wants to be one of the leading countries in openness of science and research. As the National Library, we want to contribute to that aim.

Our strategy focuses on digital and open services, and on developing digital research environments. This forms a good foundation from which to advocate for and implement Open Science services. We believe openness builds trust, boosts collaboration and enables integration of platforms, services and people.

Much of our work revolves around the development of services for researchers, especially in the humanities and social sciences fields. Digital Humanities is a key focus for us and we have carried out several projects in this area, together with researchers. These have increased our knowledge regarding the needs of researchers as well as what kind of skills are needed at the library.

The National Library of Finland is also a national service provider for higher education institutions and other public sector organisations. We have integrated openness into the services we provide and develop. These include national licensing (FinELib[39]), a discovery service (Finna[40]), and the development of metadata and standards, ontology and interoperability services as well as institutional repository services.

Metadata, persistent identifiers, development of standards and ontologies form an important basis for FAIR Data and Open Science services as a whole. In addition to FAIR, sustainability is also crucial. Metadata plays an important role in long term preservation. Our library has been a key player in developing services, practices and providing training in this field.

Open services and platforms provide a good basis for further development. Implementing machine learning and artificial intelligence into the services to develop automated processes, automated indexing and intelligent search possibilities are currently on our agenda

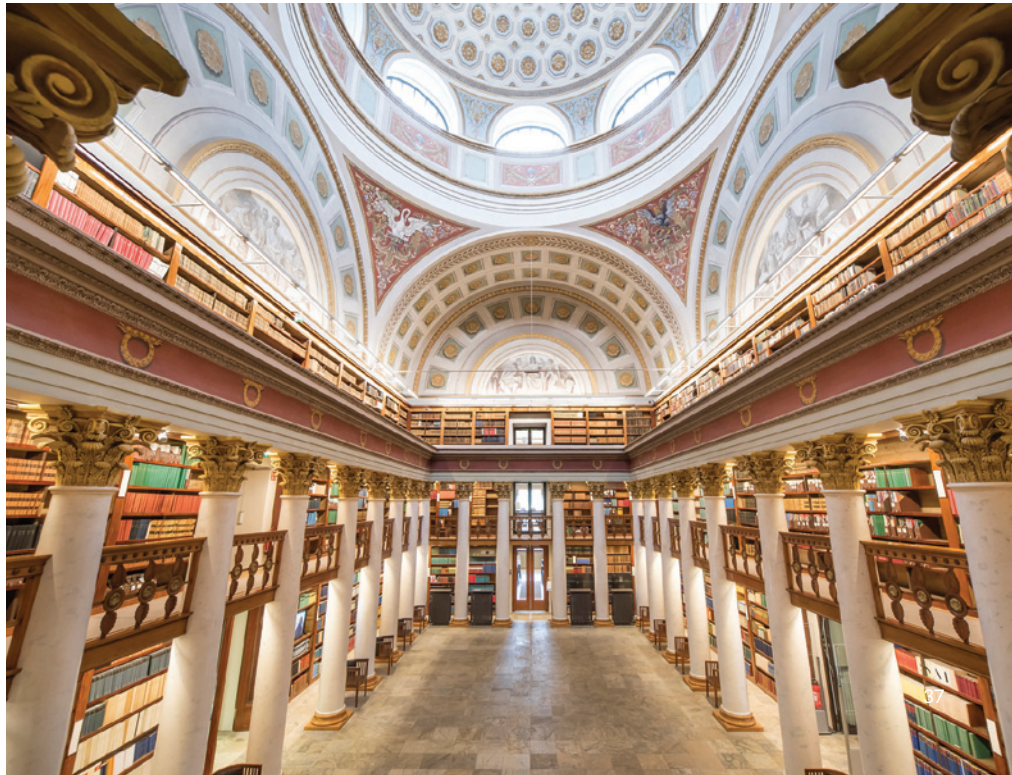
The possibilities to get involved with Open Science are endless and every library can contribute to its development. A good way to get started is by sharing case studies and best practices with colleagues. At our library, a key step was to hold brainstorming sessions with colleagues from different professional backgrounds. Some are experts in collections or digital humanities, others in metadata or IT issues.

[39] *https://www.kansalliskirjasto.fi/en/services/licensing-services/finelib*

[40] *https://www.finna.fi*

Be patient as you develop new services. Openness is about culture change which always takes time. Before we could open the metadata (CC0) of our catalogues, for example, we had to discuss extensively with the memory organisations in the country and with vendors. This took a couple of years. Openness can also mean loss in income. A clear strategy or policy helps to overcome the barriers.

Kristiina Hormia-Poutanen, Director
of National Library Network Services,
kristiina.hormia@helsinki.fi



Ruđer Bošković Institute Library

Zagreb, Croatia — lib.irb.hr

According John Wilbanks, the opposite of open isn't closed. The opposite of open is broken. We agree that 'closed science' is 'broken science'. As the biggest research library in Croatia (nine librarians and three IT specialists), it's our duty to support researchers: at our Institute and nationally. That's why we have been working hard on the Open Science agenda for over 20 years. Limited resources have helped us to see that the main role of the library shouldn't be the acquisition of (very expensive) resources but rather the collection, organisation and storage of knowledge created in our environment. This knowledge must be open to the world, and collaboration has been key to making this happen.

Our first collaborative project in the mid 1990s was a joint effort with more than 120 Croatian academic and research libraries to open their collections and services. In 1997 we created the Croatian Scientific Bibliography (CROSBI[41]), which serves as a national repository and contains data on 520,000 publications, many of which are accompanied by Open Access full-texts.

We also worked with the University of Zagreb Computing Centre (SRCE) to launch HRČAK,[42] the repository of Croatian scientific journals including more than 450 Open Access journals, and we helped create a common national infrastructure for institutional repositories which now supports more than 120 repositories. These are but a few of the many ways in which we've worked to make research in Croatia as transparent as possible.

The most important message I can share is that lack of resources should never be an excuse to avoid working on and promoting openness at all levels and all stages of the research process. We are still struggling with limited human and other resources in our library, lack of Government support and poor awareness in the research community but despite this we believe that together we can make Open Science the reality.

If this is your situation, reach out on a national and international scale. We bring the Open Science community in Croatia together with foreign colleagues every year by organizing the PUBMET Conference on scholarly publishing in the context of Open Science,[43] and we joined the EU-funded OpenAIRE project. This was a huge encouragement for us.

[41] *https://www.bib.irb.hr*
[42] *https://hrcak.srce.hr*
[43] *http://pubmet.unizd.hr*

Ultimately, openness is not an option. It goes to the heart of every academic and research library. Raising awareness of the importance of Open Science is sometimes not easy but Open Science is the best possible direction and, I believe, the only possible direction.

Jadranka Stojanovski, Research Librarian,
jadranka.stojanovski@irb.hr

Spanish National Research Council

Madrid, Spain — csic.es

Research libraries and their staff have traditionally played a fundamental role in enabling access to research resources. They have a wealth of experience related to managing large volumes of scientific information and building research infrastructures, developing bibliometric services, and about international scientific publishing, business models and work 'behind the scenes'.

Sitting on this legacy, research libraries are well positioned to play a leading role in current transformations and it's a great opportunity for them to remain relevant in the eyes of institutional policymakers and scientists.

For all these reasons, Open Access — and increasingly Open Science — has become a main pillar on the agenda of CSIC libraries. Our Unit of Information Resources for Research (URICI) delivers training to a whole community of institutional libraries and our Open Access repository DIGITAL.CSIC[44] has more than 155,000 items.

Our repository doesn't simply enable Open Access. It also features tools to help researchers comply with Open Access mandates and promote Open Data.

We have huge demand for data-related services so we offer training for researchers and technical staff, DOI minting, support to manage research data throughout the cycle and help complying with the Open Data policies of journals and funders.

Last but not least, we're testing innovative services such as Open Peer Review. We feel that the very concept of 'Open Peer Review' is much more known and accepted today than 2-3 years ago and that open peer review practices may go well beyond traditional research outputs.

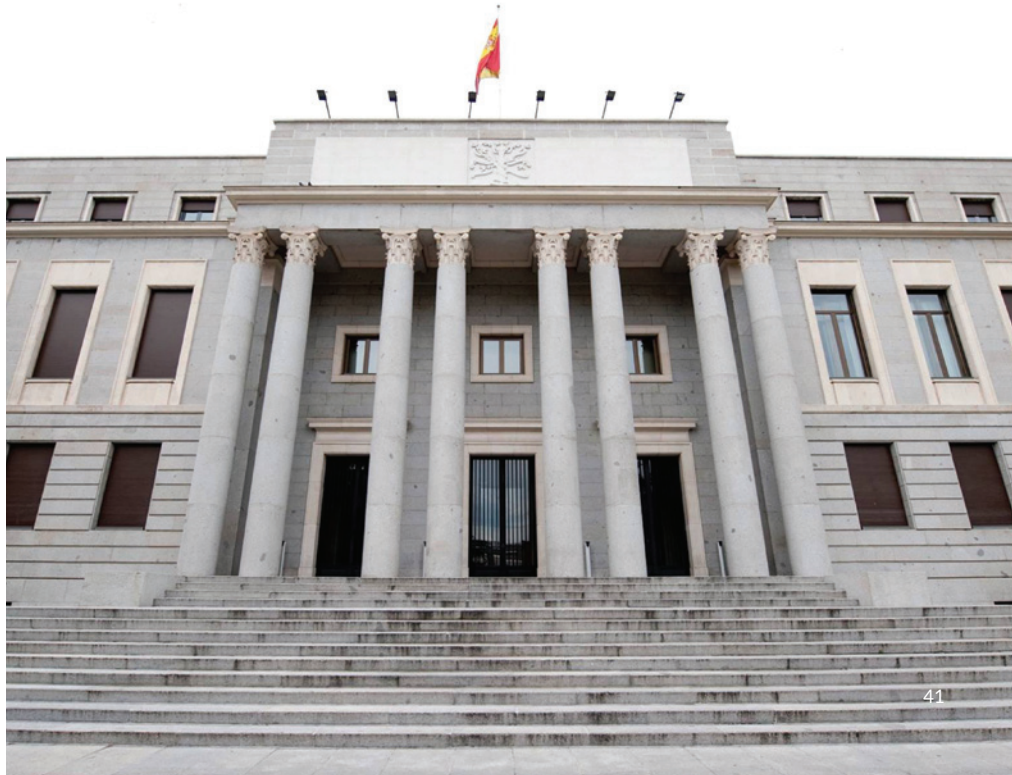
Evolving is essential if we are to remain meaningful and continue adding value in the eyes of the institutional community. Equally, it's important to remember that it takes time to consolidate new services and get new messages across. The scholarly communication landscape is full of hot debates, resources, players, business models, tools and infrastructures, and of course vested interests. It's easy to get sidetracked.

Every time we open a new service on the repository, it sparks a significant learning curve. Upgrading skills in an innovative and diverse field like this is not trivial, especially considering that libraries often suffer staff shortages.

[44] *https://digital.csic.es*

No matter how challenging it is to set up new services, in the end it always pays back. There is a real need among researchers to focus on these new services that, let's not forget, at the end of the day deal with managing and enabling access to information — the very task of libraries.

Isabel Bernal, Manager of the DIGITAL.CSIC repository, *isabel.bernal@bib.csic.es*



Svetozar Markovic University Library

Belgrade, Serbia — unilib.rs

We are investing in Open Science because it is the right thing to do in the post-truth world in which we live. Openness is based on accountability and transparency so that anyone can see, in an efficient and effective way, how the truth has been established by scientific method.

If there is no truth, libraries (and science) are no longer needed, so investing in Open Science is the top priority. This is not just for development of academic libraries today but for their very existence and, in the long run, for the existence of concepts close to the hearts of librarians such as human rights, equal opportunities and freedom of speech.

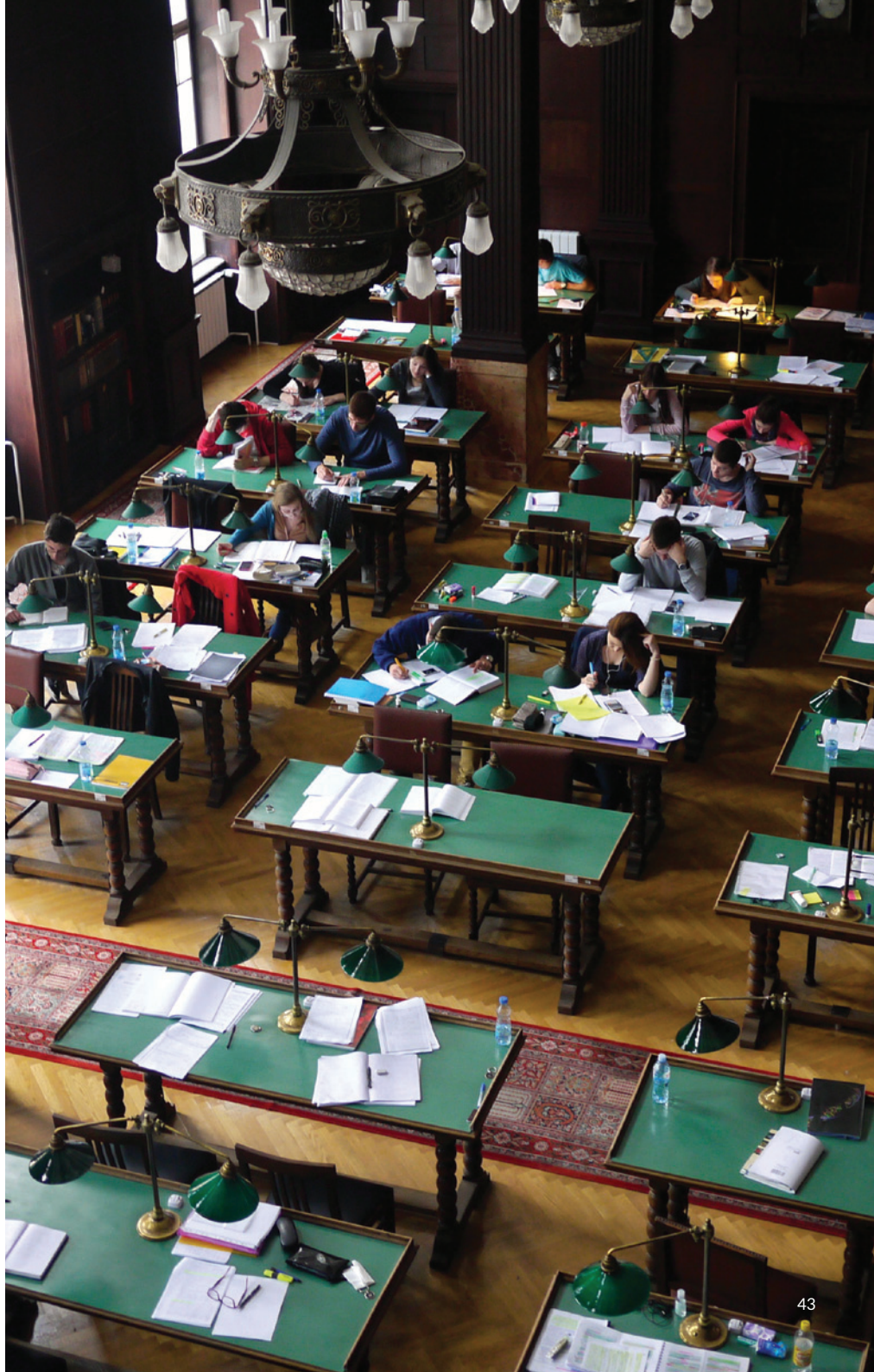
At our library we have a two prong approach to enabling Open Science. We have very limited resources but we use them to make available as many tools and platforms as possible to give researchers options to publish in Open Access. At the same time, we try to influence the academic community and Serbian society to adopt the ideology of Open Science. With their support, we can hopefully gain more resources to be invested in the implementation of tools, platforms and training for Open Science.

One of our most important actions has been to provide concrete tools for Open Access publishing. If this is not available, there is no basis to build on. These tools may be custom built, such as the organizational repository which we launched in 2012, or they may be public ones as Zenodo.[45] That said, these tools are useless if there is no desire or obligation for the academic community to use them. The adoption of an official university policy regarding Open Access and Open Science has therefore been equally important, as has advocacy and lobbying to engage librarians, researchers and other interested parties.

Anyone who wants to do more with Open Science first needs to understand why they are doing it. If you realize that it is your job, your institution and your world that is at stake in the long run, you will probably do a good job of fostering Open Science in your community. Once this is established, look for opportunities to work with like-minded people around you. Technology today is amazing and many resources are free to use so it is simply a matter of deciding to make the step. If you need additional inspiration and ideas in this area, please contact LIBER members that are already engaged and doing great things with Open Science.

Adam Sofronijevic, Deputy Director,
sofronijevic@unilib.rs

[45] *https://zenodo.org*



University of Barcelona

Barcelona, Spain — ub.edu

Soon Open Science will be simply known as science, research or scholarship. We have always supported researchers in their activities and therefore it's logical that we support Open Science.

At the University of Barcelona, we implement Open Science in different ways. We have been supporting Open Access for many years by managing the institutional repository and dealing with publishing policies and copyright issues. We are also managing a fund for Open Access publications aimed at supporting our own researchers when they choose this road. Moreover, the library manages a portal of institutional journals giving advice on publishing and on open access topics. We help researchers with their data management plans, provide a repository to share their data and develop training sessions at all levels so that we can raise Open Science awareness across the community. Finally, we are leading the creation of a committee devoted to implementing Open Science practices and principles across the university.

Of all our activities, our regular training sessions dedicated to research are especially appreciated. We engage young researchers by means of dedicated seminars and show them how to use tools like unpaywall.[46] This helps researchers to understand that a few minutes dedicated to uploading a paper could increase significantly its visibility.

Policies requiring openness have also become a driving force to change researcher behaviour. Now researchers are chasing librarians to get their papers in the repository instead of being chased by us.

My advice to other libraries is to make sure that you are working together with all the units, offices and departments that provide support to researchers. The change to Open Access cannot be carried out by the library alone. A second tip is to design a plan which acknowledges what has already been done, identifies future working areas with priorities and sets indicators to measure success.

Ignasi Labastida, Head of the Research Support Unit, CRAI Library, University of Barcelona, *ilabastida@ub.edu*

[46] *https://unpaywall.org*

University College London

London, United Kingdom — ucl.ac.uk

For University College London (UCL), Open Science represents a culture change in the way research, teaching and learning are done and how universities share their outputs with an engaged society outside academia. At UCL Library Services, we support our institution's Mission and Vision and we're including explicit Open Science actions in our new library strategy.

As head of service at UCL Library Services, I work at an institutional level to introduce Open Science practices across the organization and I chair our Open Science Policy Platform, which oversees work in all eight pillars of the Commission's Open Science agenda.

We have a particularly strong offering in Open Access options, including UCL Press which is the UK's first fully Open Access University Press. There is a new Research Data Management Team in the Library, which supports RDM activity and training across the institution. At a policy level, the Library has successfully had openness recognized as a core criterion for promotion in the new UCL academic promotions framework. We've also written the new UCL Bibliometrics Policy based on Open Science principles.

For libraries who want to strengthen Open Science in their institutions, it's good to start by looking at Open Access to publications. First, does the Library run an institutional Open Access repository? How much of the University's research output is deposited there? Do researchers understand the enhanced visibility and citation advantage that Open Access delivers?

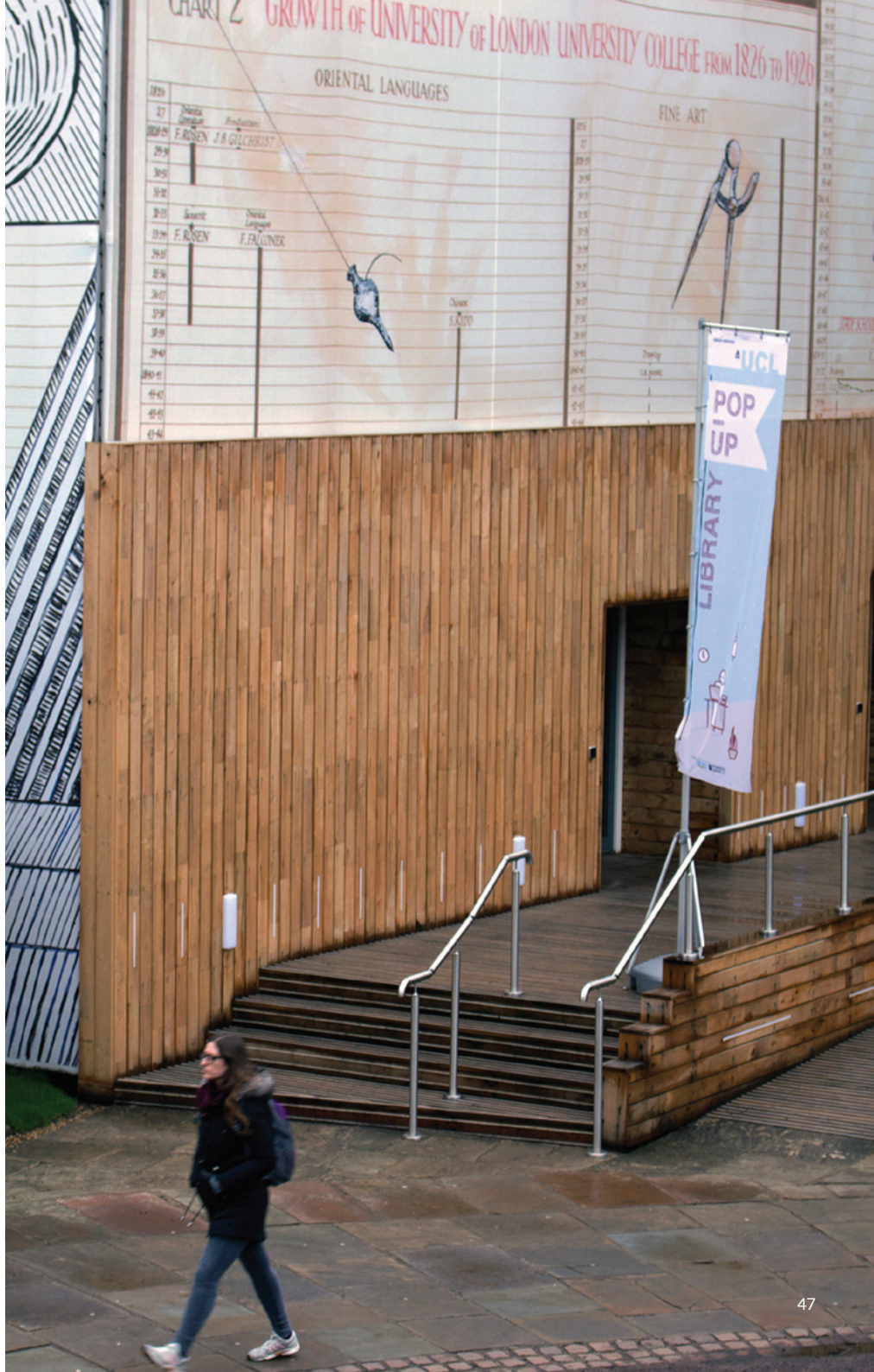
Second, the Library can offer training and advocacy for research data management. The outputs of the EU-funded LEARN project[47] offer a good starting point for policy development, best practice case studies and monitoring for the uptake of RDM activity across the institution.

Of course, there are a number of challenges in developing Open Science approaches at institutional level. Cost is one of them. Establishing new systems or platforms, and equipping staff with new skill sets, comes at a price. UCL has tackled this by building strategic initiatives into annual budget cycles and by using existing funding to deliver new approaches. Perhaps the most demanding challenge is the need for cultural change. The Open Science Roadmap produced by LERU (League of European Research Universities)[48] suggests that cultural change is a key element in the move to Open Science and that such change is needed amongst all stakeholders to deliver Open Science solutions. It is a compelling vision.

Paul Ayris, Pro-Vice-Provost
p.ayris@ucl.ac.uk

[47] *http://learn-rdm.eu*

[48] *Open Science and its role in universities: a roadmap for cultural change, 2018. Available at https://www.leru.org/publications/open-science-and-its-role-in-universities-a-roadmap-for-cultural-change*



University Library of Southern Denmark

Odense, Denmark — sdu.dk

Our library is actively pursuing the Open Science agenda. Every library needs to continually develop and there is increasing demand for Open Science related services and support from researchers, research management and other university research support units that need to demonstrate societal impact and comply with national and funding policies.

Due to our research information and management competencies, and our strategic position as a bridge between administration and Research & Development, the library is ideally suited to host several research support services related to Open Science. We are positioned at arm's length from both legal and political perspectives. At the same time, we are recognized by both administration and research environments as a trustworthy and competent partner.

Our activities are numerous. We helped create an Open Science policy for the university and we offer many Open Science services. Training is a major focus. We offer support for Research Data Management planning through a central unit and give PhD students in all faculties training on responsible conduct of research including data management and open access.

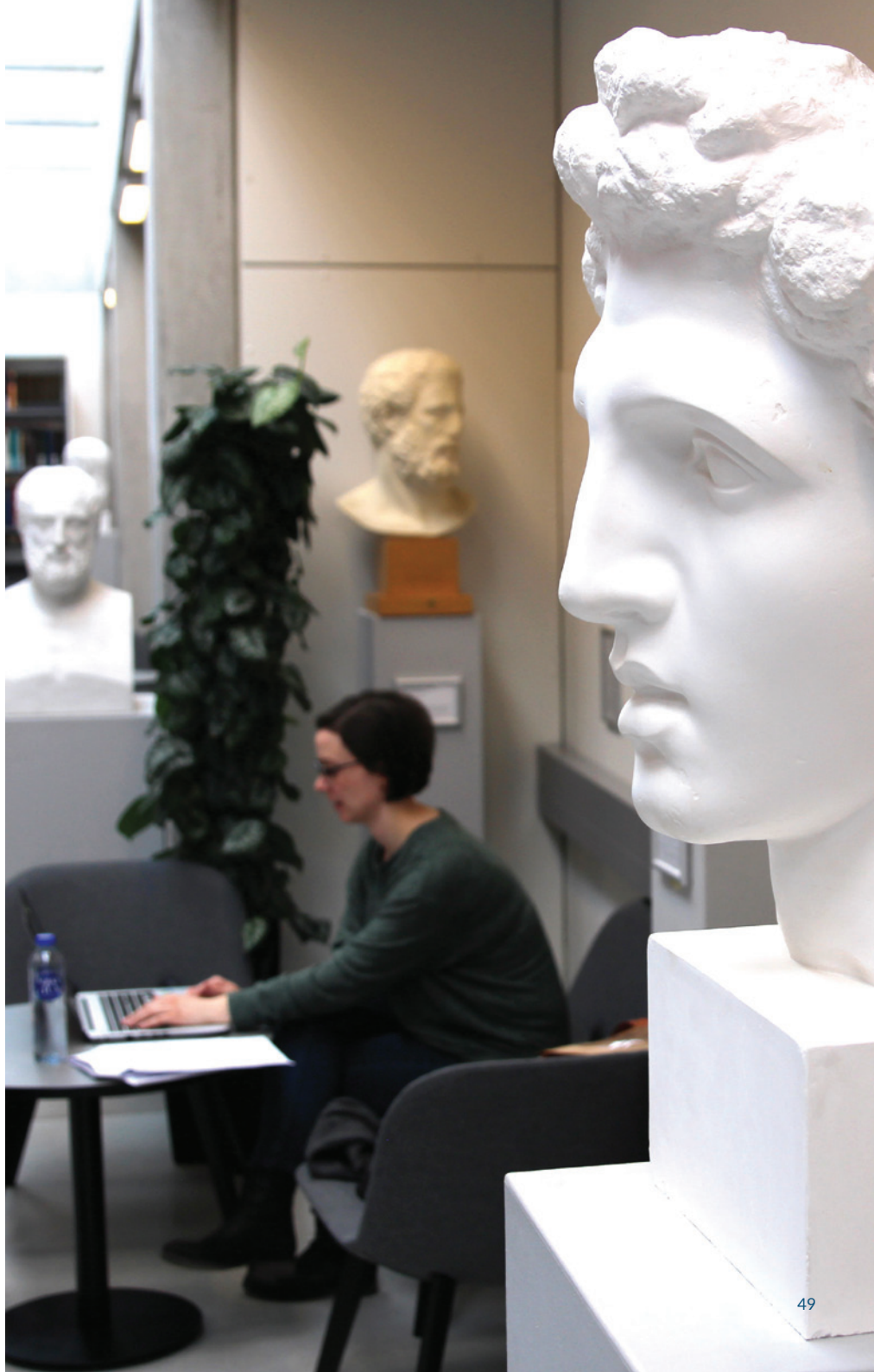
In addition, we run a central research registration unit. It populates the university repository with Open Access full text documents. We operate an Open Access APC fund and maintain institutional agreements with Open Access publishers. For citizen scientists, we facilitate and support research projects in collaboration with faculties, university administration and external media partners.

Beside the services, the library runs the Open Science implementation project on all faculties on behalf of the university.

Beyond the needs of our own institution, we have been strongly motivated by the Open Access and Open Science requirements of funders, Denmark's national government and the European Union. The universities' steps towards implementing the EU General Data Protection Act have also driven us to act. Open Science advocates among researchers are also influential. Researchers are core users of the libraries services and it goes without saying that we need to respond to their needs.

I would advise other libraries to engage with researchers, research communities and seek external partnerships. The library can work together with researchers to draft local policies and guidelines for individual research areas. It's also critical to develop and tailor library research support services in collaboration with legal, IT and faculty partners. These services should allow the implementation of local policies and guidelines, and support changing practices and new possibilities.

Bertil Dorch, Library Director,
bfd@bib.sdu.dk



Acknowledgements

This Open Science Roadmap is the result of contributions from across the LIBER community.

Thank you to everyone who took the time to help with its development.

Paul Ayris
Isabel Bernal
Valentino Cavalli
Bertil Dorch
Jeannette Frey
Friedel Grant
Martin Hallik
Kristiina Hormia-Poutanen
Ignasi Labastida
Iryna Kuchma
John MacColl
Agnès Ponsati Obiols
Simone Sacchi
Frank Scholze
Birgit Schmidt
Anja Smit
Adam Sofronijevic
Jadranka Stojanovski
Martin Svoboda
Giannis Tsakonas
Matthijs van Otegem
Astrid Verheusen
Andris Vilks
Wilhelm Widmark
Wolfram Horstmann

Credits

P. 2, 13, 30, 48, 50 — LILLIAD Learning Centre Innovation, Atmosphère Photo
P. 17, 21 — Cantonal and University Library of Lausanne
P. 19 — Lilian Fernández Hall
P. 27, 33 — Göttingen State and University Library
P. 29 — University of Tartu Library
P. 35 — David M.
P. 37 — National Library of Finland
P. 39 — Ruder Bošković Institute
P. 41 — Spanish National Research Council
P. 43 — Friedel Grant
P. 45 — University of Barcelona Library
P. 47 — UCL Library Services
P. 49 — University of Southern Denmark