



EU CONEXUS
Research for Society



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EU-CONEXUS Research for Society

"WHITE PAPER ON OPEN SCIENCE
PRACTICE AND BARRIERS"

2022

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Introduction

The White Paper on Open Science Practices and Barriers focuses mainly on the best Open Science practices of EU-CONEXUS partners, as well as common barriers to Open Science implementation at EU, national and institutional levels. The collected data was analyzed from the perspective of international recommendations and practices on Open Science based on recent scientific works and official documents. For example, European Commission, Directorate-General for Research and Innovation has clearly stated that *the challenge is for Europe to embrace open science as the modus operandi for all researchers* (European Commission, Directorate-General for Research and Innovation, 2021).

It is clear that Open science is a policy priority for the European Commission and the standard method of working under its research and innovation funding **programmes as it improves the quality, efficiency and responsiveness of research** (European Commission, 2019).

However, practices and barriers to Open Science are often the subject of scientific discussions at interdisciplinary level. There are many open questions about Open Science as well as suggestions for the best answers on the topic.

1. What is Open Science?

Although the concept of "science should be open" is not new, the scientific community is still trying to create the conditions to achieve this goal. The scientific community is trying to consolidate and accept the principles, guidelines and policies of open science and create the infrastructure for implementation. To explain and define the terms and concepts of open science, we use FOSTER taxonomy, developed within FOSTER Plus project¹ (FOSTER, n.d.), definition from various initiative and declarations in support of Open Access.

Open Science is often defined as an umbrella term encompassing various movements aimed at removing barriers to sharing any kind of results, resources, methods, or tools at any stage of the research process. Thus, open access to publications, open research data, open source software, open collaboration, open peer review, open notebooks, open educational resources, open monographs, citizen science, or research crowdfunding fall within the boundaries of Open Science (Bueno de la Fuente, n.d.). According to OECD (2015), *open science encompasses unfettered access to scientific articles, access to data from public research, and collaborative research enabled by ICT tools and incentives*. It is the practice of doing science in a way that enables researchers to collaborate and contribute, with research data, laboratory notes, and other research processes freely available under conditions that enable the reuse, sharing, and reproduction of research and its fundamental data and methods.

Open Access refers to online, free of cost access to peer reviewed scientific content with limited copyright and licensing restrictions. Statements that established Open Access as a movement: Budapest Open Access Initiative (2002), Bethesda Statement on Open Access Publishing (2003) and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (2003), IFLA Statement on open access (2011), Open Science for the 21st century (2012), Declaration on Research Assessment (DORA) (2012), The Lyon Declaration on Access to Information and Development (2014), Amsterdam Call for Action on Open Science (2016), EOSC Declaration (2017), Sorbonne Declaration on Research Data Rights (2020). There

¹ FOSTER Plus (Fostering the practical implementation of Open Science in Horizon 2020 and beyond) (2017 – 2019), EU-funded project, with 11 partners within 6 countries. "The primary aim is to contribute to a real and lasting shift in the behaviour of European researchers to ensure that Open Science (OS) becomes the norm" (FOSTER, n.d.).

are two routes to open access: (1) the open access journals and (2) the open access repositories or open archives.

The Green route to open access is delivered via self-archiving (depositing) an output into a repository. There are two types of repositories – institutional and subject repositories. The Gold route to open access is delivered via publishing an article in a journal (FOSTER, n.d.) *Published work is made available in Open Access mode by the publisher immediately upon publication. The most common business model is based on one-off payments by authors* (Bezjak et al., 2018). According to Amsterdam Call for Action on Open Science (2016) *open science has impact and has the potential to increase the quality and benefits of science by making it faster, more responsive to societal challenges, more inclusive and more accessible to new users.*

Open data is data accessible online and free of charge that can be used, reused, and shared, provided the source of the data is indicated and equally released. Open Big Data is huge amounts of data that can sometimes be cumbersome to process. Open data standards should be applied to tool configuration of tools, formats, and protocols related to open data, as well as to online and free data that comes with conditions that allow reuse and redistribution, such as online government data. Open Data journals publish peer-reviewed articles describing openly available datasets for future reuse (FOSTER, n.d.). Open Data Charter (2015) defines *open data as digital data that is made available with the technical and legal characteristics necessary for it to be freely used, reused, and redistributed by anyone, anytime, anywhere.*

Open Reproducible Research is an act of open science and the provision of free access to experimental elements for reproducing research. This term includes Open Lab/Notebooks, Open Science Workflows, Open Source in Open Science, Reproducibility Guidelines, and Irreproducibility Studies. Open Lab/Notebooks are laboratory research records, diaries, journals, workbooks, etc., offered online for free with terms that allow reuse and redistribution of the recorded material. Open Science Workflows are a sequence of processes that scientists undertake to manage and disseminate complicated scientific research, offered online and for free, with terms that allow reuse of the material. Research should follow reproducibility guidelines (FOSTER, n.d.). Wilkinson et al. (2016) intended to provide guidelines to improve the findability, accessibility, interoperability, and reuse of digital assets in paper The FAIR Guiding Principles for scientific data management and stewardship. *The*

principles emphasise machine-actionability (i.e., the capacity of computational systems to find, access, interoperate, and reuse data with none or minimal human intervention) because humans increasingly rely on computational support to deal with data as a result of the increase in volume, complexity, and creation speed of data (FAIR Principles, n.d.)

Open Science Evaluation is an open assessment of research results, not limited to peer-reviewers, but requiring the community's contribution. An alternative to traditional impact metrics systems, open metrics have developed new way of evaluating the impact of the scholarly outputs: Altmetrics, Bibliometrics, Semantometrics and Webometrics. Altmetrics is project that produces article level metrics of scholarly articles from information collected from the Internet, such as social media sites, newspapers, and other sources. Bibliometrics include citation and content analysis. As opposed to existing Bibliometrics, Webometrics, Altmetrics, etc., Semantometrics are not based on measuring the number of interactions in the scholarly communication network but exploit primarily the full-text of manuscripts to assess the value of a publication (FOSTER, n.d.).

Open peer review is an umbrella term for several overlapping ways that peer review models can be adapted in line with the aims of Open Science, including making reviewer and author identities open, publishing review reports and enabling greater participation in the peer review process. Ross-Hellauer (2017) offer full list of traits:

1. Open identities: Authors and reviewers know each other's identities
2. Open reports: Review reports are published together with the corresponding article.
3. Open participation: The public can participate in the review process.
4. Open interaction: Direct two-way discussions between author(s) and reviewer(s), and/or between reviewers, are allowed and encouraged.
5. Open pre-review manuscripts: Manuscripts are made immediately available (e.g., via pre-print servers such as arXiv) in advance of any formal peer review procedures.
6. Open final- version commenting: Review or comment on publications in the final "version of record".
7. Open platforms ("decoupled review"): Review is supported by a different organizational entity than the venue of publication.

Open Science Policies implies best practice guidelines for applying Open Science and achieving its fundamental goals. *The initial policies were aimed at requiring an open*

dissemination of the research results based on the idea that results achieved from publicly funded research should be available to the public without any restriction (Bezjak et al., 2018).

Open Science Policies are organisational mandates which are written endorsements by organisations on specific matters. Organisational mandates can be: funder policies (courses of actions adopted from organisations that supply money to researchers and research projects), governmental policies (courses of actions adopted from governments) and institutional policies (courses of actions adopted by an academic establishment or foundation). Also, there is subject policies (actions on a specific branch of knowledge) which join actions relating to the online, free of cost access to peer reviewed scientific content with limited copyright and licensing restrictions (Open Data Access) and accessible data that can be used, reused and distributed provided that the data source is attributed and shared alike (Open Data Policies) (FOSTER, n.d.).

Citizen science is also a part of Open Science. The distinctive feature is that such scientific projects involve *millions of individuals - many of whom are not trained as scientists - in collecting, categorizing, transcribing, or analyzing scientific data* (Bonney et al., 2014). ESCA (2020) describes citizen science as an *emerging field of research and practice, despite different scientific discipline, with evolving standards based on which various stakeholders develop methods, theories, and techniques.*

2. Barriers for Open science

According to newest researches on topic, the open science implementation is unstoppable process, more and more discussed and actively promoted worldwide on the institutional level (UNESCO, 2022). The question about open science barriers is actual worldwide scientific issue discussed among the researchers. Many of them offer some solutions and opportunities considering specific circumstances in certain geographic areas (Mwelwa et al, 2020).

There is a lack of political commitment in government, suggesting that this new paradigm is yet to be fully understood. Most researchers and innovators have little trust in the open science approach, particularly with regard to the ownership of results, the intellectual property that might arise from technological developments and the importance of publications and prime authorship, issues that are regarded as important for career progression. There is a lack of adequate human and infrastructural capacity in ICT to handle the complexity of open science and the institutionalisation of open science. There is a lack of research data bases and journals dedicated to open science. There is a general lack of policies at national and institutional levels to set a legal and regulatory framework for open science and for the coordination of relevant research efforts. The demand by funders, universities and research institutions for researchers to publish their result in „high impact journals“, which are rarely open-access journals, compounds the problem of open science in Africa, where access to published scientific works, let alone access to the Internet, are inhibited by prohibitive costs (Mwelwa et al., 2020, p. 7).

Interestingly, side-by-side comparison of open science barriers in Europe with the up-mentioned barriers in Africa brings approximately similar results. The main barriers such as *lack of credit or acknowledgment, concerns about being outcompeted, (uncertainty about) legal constraints (for instance copyright law, licensing restrictions et cetera), cost and time of sharing data or of engaging with a broad spectrum of stakeholders, concerns about misuse of data, lack of skills (for instance data stewardship), privacy issues, uncertainty about socio-economic benefits of open science* have been emphasized in latest research (Hessels et al., 2021, p. 11). The results of the survey conducted among the EU-CONEXUS partner institutions correspond in large measure with the above-mentioned barriers (Table 1.).

Table 1. Open science types of barriers according to the conducted survey among the EU-CONEXUS partner institutions (2021).

KU	AUA	LRU	UCV	UTCB	UNIZD
Lack of initiative of researchers	Lack of financial support	Evaluation and rating	Development of collaborative projects	Costs	Lack of financial support for publishing in open access
Researchers feel lack of data management knowledge	Lack of knowledge	Low exposure of open access journals	Open data sharing	Lack of knowledge	Lack of awareness regarding open science
FAIR requires additional knowledge, skills and time		Lack of interest	Physical infrastructure for collaboration – open spaces	Career evaluation, rewards and incentives	
Competition between researchers		Biases about open access			
Data quality		Participatory practices: protocols too complex			
Enforcement of related (non-copyrighted rights)					
Data protection, trade secrets					

The survey has shown that open science barriers within EU-CONEXUS alliance are mainly pointed at **university level, researchers level and infrastructural level** among the partner institutions (Table 2.)

Table 2. Open science types of barriers explanation by EU-CONEXUS partner institutions perspective.

KU	AUA	LRU	UCV	UTCB	UNIZD
Competition between researchers as no credits are given for open-science journal.	Underfunding of the Universities	Research and researchers' evaluation is mostly based upon number of published papers and their impact and h factors	Coordination between groups can be difficult	Open Science is a costly process both in terms of OA publications and FAIR data	Lack of recognition of researchers who publish in Open access journals
Some of the researcher are not aware of data FAIR, data protection rules and requirements.	Lack of information on the available platforms and abilities	Publications of good quality, highly cited and disseminated articles are found in journals that are not open access	Lack of incentive to use open infrastructure	Lack of career benefits or on the contrary, disadvantages for researchers who promote Open Science	Advancing in carrier requires publishing in expensive journals
No career benefits for researchers who promote Open Science.		Protocols to follow may require a certain level of knowledge and experience	Political resistance from other university departments	Open Science literacy	Lack of capacity to develop infrastructure
Low motivation in sense of salary to researcher		Many researchers consider open access journals as low quality and low impact journals	Lack of capacity to develop infrastructure		
		Researchers do not feel concerned about open science	Ethical risks		

To overcome the specific obstacles, it is therefore crucial to understand the expectations (or better the benefits) of open science policies from the perspective of **researchers, educational/research institutions, governments, society, and funders**. This diversity of required approaches will certainly involve various difficulties, as it is necessary to consider the (im)possibility of common interests regarding open science by all subjects involved. It seems inevitable to first try to identify the common and undiscussable interests of all subjects involved in an open science policy to create a way to overcome the barriers to the implementation of open science.

Such an approach requires research institutions, funders, government agencies, libraries, and all other stakeholders to change their visions, policies, practices, and attitudes toward science. Following this approach, it seems useful to consider the possible targets within the EU-CONEXUS partner institutions in relation to the target group(s) for developing further steps towards an open mindset and acceptance of open science. According to the survey, nearly 50% of examinees within EU-CONEXUS alliance show awareness and openness on topic. That percentage consist mainly of the young researchers within EU-CONEXUS universities. Therefore, a recent idea that *early career researchers (ECRs) will play a key role in transitioning the scientific community to more widespread use of OS from pre-registration to publication* is also to consider within EU-CONEXUS alliance (Gownaris et al., 2021, p. 1). As it is well putted by Dr Kostas Glinos (2021) – *more action will be necessary to make Open Science the „new normal“*, as well to follow the guidelines established by European Commission for developing European Open Science Cloud (EOSC) (see: Table 3.).

Table 3. Source: European Commission, *European Research Area Policy Agenda. Overview of actions for the period 2022-2024*, p. 5.

European Open Science Cloud
The ambition of the European Open Science Cloud (EOSC) is to provide European researchers, innovators, companies and citizens with a federated and open multi-disciplinary environment where they can publish, find and re- use data, tools and services for research, innovation and educational purposes. The EOSC ultimately aims to develop a ‘Web of FAIR Data and services’ for science in Europe, upon which a wide range of value-added services

can be built. These range from visualisation and analytics to long-term information preservation or the monitoring of the uptake of open science practices.

The implementation of the EOSC is based on a long-term process of alignment and coordination pursued by the European Commission (EC) since 2015 with diverse stakeholders of the European research landscape. In the initial phase of implementation (2018-2020), the EC invested around EUR 250 million to prototype components of the EOSC through calls for projects under Horizon 2020. The EC also launched an interim EOSC Governance to prepare the strategic orientations for the EOSC implementation post-2020. The current phase of implementation (2021-2030), is taking place in the context of the EOSC European co-programmed partnership and according to a Strategic Research and Innovation Agenda (SRIA), which is co-developed with the entire EOSC community. EOSC is transitioning to a more stakeholder-driven approach with a shared vision, common objectives and complementary contributions at European, national and institutional levels. A concrete co-investment (in kind and in cash) by the European Union and non-EU partners of at least EUR 1 billion is foreseen for 2021-27.

Suggestions for overcoming open science barriers

There are many steps EU have already done, such as Open Science Policy Platform (2020). Its role was to advise the European Commission on how to develop its Open Science Policy. A role of the governments seems to be one of the crucial points for developing open science mentality. For example, the Maltese government commissioned a group of independent experts to provide recommendations on transitioning the science system in Malta to an *open by default* setting. The experts recommend a *phase-in* approach, with a timeline to 2025, to arrive at: *providing open access to scientific publications, making open and FAIR (findable, accessible, interoperable and re-usable) data „as open as possible, as closed as necessary“ and implementing related actions on awareness raising, skills, training and support, and career assessment* (European Commission, 2020).

The conducted survey among EU-CONEXUS partner institutions shows the same need on awareness raising, skills, training and support among the researchers regarding open access scientific publications (Table 3).

Table 3. Recommendation for the improvement by EU-CONEXUS partner institutions.

KU	AUA	LRU	UCV	UTCB	UNIZD
Change the recognition of open access journals comparing them with high impact factor journals.	Increase of funds towards Universities	Getting incentive to promote open access publication and make it as valuable as publications in high factor impact journals	Creation of clusters of expertise	Identifying the specific needs of the national context and engaging in transformative negotiations with major journals are essential, along with creating new mechanisms for collaboration and funding	Getting funds to promote open access publications
Change national and international science funding rules and grants to promote open access publications.	Organization of events related with open science in the Universities and Research Institutes	Promote and create open access journals of high quality managed by researchers themselves; contribute to the change of the system based on the evaluation by impact factor	Ensure that data is anonymised	Open Science can only become a reality through cultural change, strengthening dialogue among the stakeholders in the country and providing long-term opportunities for capacity building to support the systemic change	Give equal treatment and evaluation of publications with open access in carrier advancement
Develop EU Open access infrastructure for quality open access journals and other publications to be published.		Incentive regulation; stress the practical benefits of open science for their research activities	Creation of inter-university collaboration networks	Lack of career benefits or on the contrary, disadvantages for researchers who promote Open Science	Building strong partnership with partners who promote open access
Develop international and national funds for supporting OA journals, from development to support for infrastructure.		Raising the level of recognition of open access journals			Develop OA infrastructure, e. g. ensure development of repositories and quality open access journals and other publications
		Simplify as much as possible protocols and adapt the study's methodology			Support researchers involvement in open access initiatives

According to the EU-CONEXUS partner institutions data, the **increase of funds towards Universities** and **promotion of open access** are dominating recommendations for the improvement as well as **creating of inter-university collaboration network** as a mean of overcoming possible obstacles to an open by default mentality within the alliance.

3. Legal framework and regulations (EU-CONEXUS alliance)

European Commission document *European Research Area Policy Agenda. Overview of actions for the period 2022-2024* proposed an EU copyright and data legislative and regulatory framework fit for research. Document clearly shows a need for identification of existing and upcoming barriers and challenges in the EU legislative and regulatory framework to main objectives such as:

- *access and reuse of publicly funded R&I results, including open access;*
- *access and reuse of publications and data for research purposes;*
- *data services and infrastructures managed by/for the benefit of research stakeholders; and*
- *the seamless flow of research knowledge and data across the EU based on Article 179 TFEU and academic freedom.*

Based on the copyright and data legislation analysis, the action will explore possible legislative and non- legislative measures to ensure a framework fit for research.

- *Identify barriers and challenges to access and reuse of publicly funded R&I results and of publications and data for scientific purposes;*
- *Identify potential impacts on research, through an analysis of relevant provisions under EU copyright, data legislation and related regulatory frameworks, relevant institutional as well as national initiatives*
- *Propose legislative and non-legislative measures to improve the current EU copyright and data legislative and regulatory frameworks (European Commission, 2021)*

Several reports in a series of SPARC Europe and DCC analyses of national Open Science policies in Europe have been conducted in the period 2017-2021 (<https://sparceurope.org/what-we-do/open-data/sparc-europe-open-data-resources/>). The latest report, *An Analysis of Open Science Policies in Europe*, v7 from April 28th, 2021, has shown the following results on topic concerning the countries of EU-CONEXUS alliance partner institutions. In addition, the information from the data collected through the survey among the EU-CONEXUS partner

institutions about regulations, open science practices and barriers in their countries have been added (SPARC Europe, n.d.).

LITHUANIA (LT)

Policy specifics

Although Lithuania has a [Law on Higher Education and Research](#) (2009, revised 2015 and 2016) which covers Open Access and research data, stipulating that “the results of all research works carried out in state higher education and research institutions must be communicated to the public,” in practice the more relevant policy document is the Research Council of Lithuania’s [“Guidelines on Open Access to Scientific Publications and Data”](#) (2016). These guidelines likewise cover both publications and data. Skills are not addressed, but responsibilities for various aspects of Open Access and Open Data are covered in detail, indeed in more explicit detail than most of the other national policies. As with France, the only other EU country known to have enshrined OA and research data in law, the focus is more on rights than on obligations, and the inference is that universities will be responsible for developing their own policies, procedures, guidance and monitoring systems.

Additional information

Some research institutions in Lithuania, including Kaunas University of Technology Lithuanian University of Health Sciences, Mykolas Romeris University, Vytautas Magnus University, Lithuanian University of Educational Sciences and Vilnius Gediminas Technical University are understood to have adopted institutional policies aligned with the Research Council guidelines, the Horizon 2020 Open Access Mandate and Open Research Data Pilot, and the Guidelines on Data Management in Horizon 2020 (SPARC Europe, & Digital Curation Centre, 2021, p. 19).

Klaipeda University

Commission Recommendation (EU) 2018/790 of April 25th 2018 on access to and preservation of scientific information C2018/2375

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018H0790>

Plan S (launched by cOAlition S). This OpenAIRE Policy and Legal Task Force focuses on research visibility through author copyright retention, support for existing of future infrastructures, recognition of the importance of repositories, monitor compliance and sanction non-compliance.

<https://www.openaire.eu/plan-s-a-european-open-access-mandate>

National level:

The Law on Higher Education and Research of the Republic of Lithuania (2009, revised 2015 and 2016)

<https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/548a2a30ead611e59b76f36d7fa634f8?jfwid=-n0odowwru> (law)

Article 45. Communication of research activities to the public: *"In order to ensure the quality of research conducted with funds of the state budget, the transparency of the use of funds of the state budget, to enhance scientific progress, the results of all research works carried out in state higher education and research institutions must be announced publicly (in the Internet or any other way), to the extent this is in compliance with the legal acts regulating the protection of intellectual property, commercial or state and official secrets"*.

Guidelines on Open Access to scientific publications and data (Lithuanian Research Council, 2016) https://www.lmt.lt/data/public/uploads/2016/09/eng_atvira-prieiga-galutinis.pdf

Recommendation

eLABa (Lithuanian Academic Electronic Library) regulations <https://www.e-tar.lt/portal/lt/legalActEditions/TAR.402D8BE8D1D2?faces-redirect=true>

Law

A Working Group for developing a national Open Access / Open Science Policy was set up on the 16th of January 2020 by the Ministry of Education, Science and Sport.

Institutional level (documents available only in Lithuanian language)

- Regulations of Foundation of Research and Studies (Klaipėda University, 2020) <https://ku.lt/paraiskos/lt/nuostatai/>
- Guidelines for the uploading electronic documents of Klaipėda University to the information system of the Lithuanian Academic Electronic Library (eLABa, 2019, in revision now) <https://www.ku.lt/kub/wp-content/uploads/sites/15/2019/10/1-010.pdf>
- Guidelines for open access to scientific data and publications of Klaipėda University (2018) https://www.ku.lt/kub/wp-content/uploads/sites/15/2019/01/KU_atvirosios_prieigos_gaires.pdf
- Resolution on approval of the rules of intellectual property management and knowledge transfer of Klaipėda university (2017) <https://www.ku.lt/wp-content/uploads/2016/03/D%20KU-intelektin%20nuosavyb%20valdymo-ir-%20beini%20perdavimo-taisykli%20patvirtinimo-1.pdf>

GREECE (EL)

Law 4310/2014 supports open access to publicly funded research; however, Greece does not have a national Open Access/Open Science policy yet. On the 29 and 30 November 2018 OpenAIRE organised a Greek Open Science Symposium which aimed at understanding the current research ecosystem and prioritise actions towards the development of a National Open Science Strategy. Drawn from discussions during the 1st day, a proposal for the re-formulation of a National Open Science High Level Task Force under the auspices of the General Secretariat of Research and Technology (GSRT) was made (SPARC Europe, & Digital Curation Centre, 2021, p. 24).

Agricultural University of Athens

- DIRECTIVE (EU) 2019/1024 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019L1024&from=EN> (*Directive on open data and the re-use of public sector information*)
- Open Science Policy Platform <https://openscience.eu/open-science-policy-platform-final-report/> (*policy*)

National level

Laws:

- L.4310/2014 https://www.kodiko.gr/nomologia/download_fek?f=fek/2014/a/fek_a_258_2014.pdf&t=cc4c6dcf4499088fcfb5c094560e0603

- L.4485/2017
https://www.kodiko.gr/nomologia/download_fek?f=fek/2017/a/fek_a_114_2017.pdf&t=0e81b697b3fa709eda2cbc9f8d9d11bb

Policy:

- National Plan for Open Science
<https://zenodo.org/record/3908953#.YaYrOrrQDcc>
- 71st Hellenic Universities rector synod (30/11-1/12/2012 (*recommendation*))
- The Hellenic Universities rector synod adopts Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (*recommendation*)
 - 90th Hellenic Universities rector synod (13-16/3/2019)
http://www.synodos-aei.gr/documents/apofaseis_90is_synodou.pdf

FRANCE (FR)

The French approach is, together with Lithuania, the highest level of all: the “Law for a Digital Republic” (Loi n°2016-1321 pour une République numérique) passed by the French Parliament in 2016. Designed by the French government as a framework for the development of the entire national digital economy, this is also the most wide- ranging of all the policies examined in this study, covering a multitude of digital issues, including both Open Access publications and research data. Article 30 ensures the re-usability of open data deriving from public funding:

When data result from a research activity funded for at least half by the State, local authorities, or public institutions, by national agencies or by European Union grant are not protected by a specific right or a particular regulation and have been made public by the researcher, the institution or the research agency, their reuse is free. The publisher of a scientific publication [...] cannot limit the reuse of the research data made public in the publication.

The French law is unlike most of the other policies in that it focuses on rights, rather than obligations, such as the right to access research data and the right to deposit publications in an Open Access repository. In practical terms, it seems somewhat obvious to say that implementation and monitoring will not be the duty of the French parliament but rather

devolved to individual research organisations and publishers, although the ultimate arbiter of any disputes will be the French legal system. Being a law, it is very much a hard policy.

In July 2018, the Ministry of Higher Education, Research and Innovation adopted the ambitious National Plan for Open Science (https://cache.media.enseignementsup-recherche.gouv.fr/file/Recherche/50/1/SO_A4_2018_EN_01_leger_982501.pdf). The plan presents three broad commitments under the headings:

- 'Generalising Open Access to Publications'
- 'Structuring Research Data and Making it Available through Open Access'
- 'Be part of a sustainable European and international open science dynamic'

Each commitment is accompanied by a short Roadmap section, which outlines the stepping stones to meeting each commitment. The section on open data can be summarised in the following quote:

"Our ambition is to make sure that the data produced by French public research are gradually structured in accordance with FAIR principles (Easy to find, Accessible, Interoperable, Reusable), preserved and, when this is possible, open.

The Plan references the "Artificial Intelligence Strategy" which was launched in March 29, 2018, where the President announced the establishment of openness principles by default for all data published by projects funded by public funds. The plan furthermore recognizes the limitations placed on some data by law, professional secrecy, commercial limitations and IPR issues etc. Data processing will now be an eligible research expense in funded projects and researchers will be invited to submit their data to in certified data repositories. The plan also states that Data Management Plans will be generalized; a prize for research data will be set up to reward and highlight research teams who are excelling in this area and pledges the support of France to the RDA and software and technical solution development in this field.

The main national research funder (ANR) has also an Open Science policy, which specifically addresses open research data and is guided by the principle of "as open as possible, as closed as necessary". The agency draws their grantees attention to data management and all

projects funded from 2019 requires data management plans. Meanwhile, on July 2021 the Second French Plan for Open Science. Generalising Open Science in France 2021-2024 took place (https://www.ouvrirlascience.fr/wp-content/uploads/2021/10/Second_French_Plan-for-Open-Science_web.pdf) following the four paths:

- *Generalising open access to publications*
- *Structuring, sharing and opening up research data*
- *Opening up and promoting source code produced by research*
- *Transforming practices to make open science the default principle.*

Additional information

As a member of the G8, France joins Germany, Italy, and the United Kingdom in the G8 Science Ministers' Declaration issued in London on June 12, 2013. This statement “proposes to the G8 for consideration new areas for collaboration and agreement on global challenges, global research infrastructure, open scientific research data, and increasing access to the peer-reviewed, published results of scientific research.”

France is a member of The Open Government Partnership, and the OGP National Action Plan presents commitments to open science (SPARC Europe, & Digital Curation Centre, 2021, p. 16-18).

La Rochelle Université

- European Science Foundation for full open access <https://www.coalition-s.org/> (*recommendation*)

National level

Law:

- Loi n° 2016-1321 du 7 octobre 2016 pour une République numérique. Art . 30 and 31: Scientific papers issued from public research get released for open access publication <https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000033202746/> – *scientific papers published from public research (or at least with half public funding) may be reused and republished in open access 6 months after the first publication (12 months for arts and humanities), whatever copyright the first publisher may have*

Policy:

- Deuxième plan national pour la science ouverte
<https://www.ouvrirelascience.fr/deuxieme-plan-national-pour-la-science-ouverte/> – *national policy aiming 100% open access for scientific papers and data (including gold road)*
- National agreement with Elsevier for Science Direct Agreement – big deal including APC, copyright release for open access and deposit in the national open archive repository - Arrêté NOR MENS1611139A du 25 mai 2016
<https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000032587086>
Law – doctoral dissertations digital deposit and online publication

ROMANIA (RO)

Currently, Romania does not have a national Open Access/ Open Science policy although discussions are underway with various stakeholders with the view to develop one. Open Access is however mentioned in The National Plan for Research and Innovation 2015-2020. In 2019, the UEFISCDI (Executive Agency for Higher Education, Research, Development and Innovation Funding) in partnership with the Ministry of Education and Research have started a process of developing a national strategic framework for Open Science. The process is led by Open Science Hub Romania who is also the Romanian OpenAIRE NOAD. The OpenAIRE Romania NOAD will start implementing a project financed through European structural funds which includes a strong component dedicated to the elaboration of a proposal for an Open Science national strategy. In late 2018, the Romanian Government did approve the 2018-2020 National Action Plan. The Plan includes a commitment which aims to lead to the adoption of a national Open Access strategy to research results, by implementing pilot programs and substantiating Open Government Partnership research and public consultations. The institution in charge with this activity is the Romanian Ministry of Research and Innovation (SPARC Europe, & Digital Curation Centre, 2021, p. 24).

Technical University of Civil Engineering Bucharest

National level:

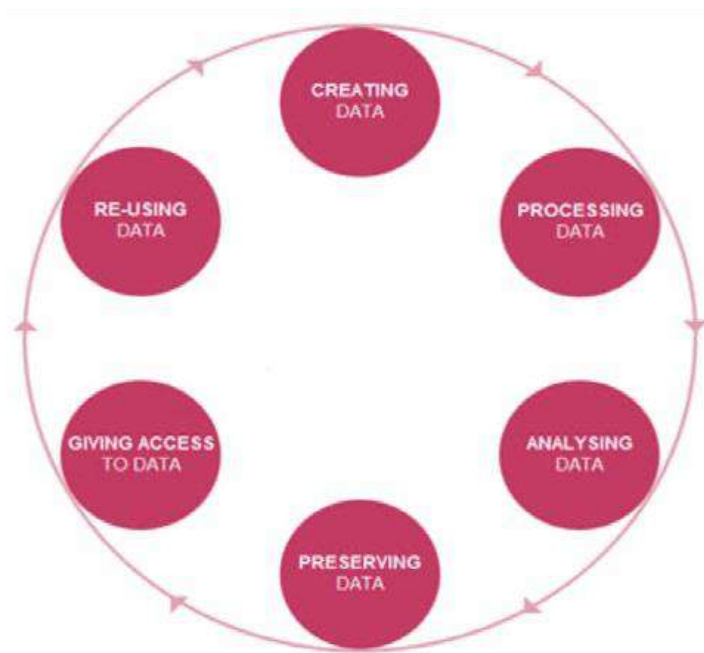
National project to develop and implement regulations on Open Science
uefiscdi.gov.ro :: [Development of the strategic framework for Open Science in Romania](#)

Project to develop regulations on Open Science
uefiscdi.gov.ro :: [Development of the strategic framework for Open Science in Romania](#)

CROATIA (HR)

No national policy is yet in place, but there is much on-going work in this area. National policies on access and preservation of scientific information (both publications and data) are under the responsibility of the Ministry of Science, Education and Sports. The Ministry strongly supports open access to scientific information to provide maximum impact from the research they support. The Croatian Research and Innovation Infrastructures Roadmap 2014-2020 addresses the promotion of open access to research data, “especially data funded from public sources” (SPARC Europe, & Digital Curation Centre, 2021, p. 23). As a result of the promotion of open access to research data recent initiative for establishing Croatian Open Science Cloud (furthermore: HR-OOZ) has been developed in Croatia during 2021. The main goal of this HR-OOZ initiative is to create a national cloud for open science including services and resources compatible and implementable within European Open Science Cloud (EOSC). The initiative implies an Open Science drafting proposal on national level as well as national Open Science legal framework and regulatory policy (SRCE, n.d.). This goal follows the guidelines of European Commission.

Graph 1. Source: <https://www.srce.unizg.hr/files/srce/docs/HR-OOZ/hr-ooz-inicijativa.pdf>



University of Zadar

National level

2006. Scientific and technological policy of the Republic of Croatia 2006. – 2010.

2012. Croatian declaration on open access

2013. Law (o izmjenama i dopunama Zakona o znanstvenoj djelatnosti i visokom obrazovanju)

2014. Strategy on education, science and technology

2015. Odluka o obavezi pohrane znanstvenih, stručnih i popularnih radova u Repozitorij Instituta Ruđer Bošković – FULIR

2021. Inicijativa za Hrvatski oblak za otvorenu znanost (HR-OOZ)

<https://www.srce.unizg.hr/hr-ooz>

Institutional level

2012. Declaration on the Application of Open Science Principles at the University of Zadar

[https://www.unizd.hr/Portals/0/doc/eng_web/Declaration on the Application of Open Science Principles 20200113.pdf](https://www.unizd.hr/Portals/0/doc/eng_web/Declaration_on_the_Application_of_Open_Science_Principles_20200113.pdf)

Since 2020. Core partner of OPERAS. OPERAS is the Research Infrastructure supporting open scholarly communication in the social sciences and humanities (SSH) in the European Research Area (OPERAS, n.d.).

2022. University of Zadar is a member of SPARC Europe.

SPAIN (ES)

The Spanish Government published the State Plan for Research, Development and Innovation 2017-2020 in January 2018. The plan includes a new focus on open access to scientific publications and research data. The State Plan is the main instrument of the State Government for developing and achieving those objectives set at the Spanish Strategy for Science and Technology and Innovation 2013-2020, and at the Europe 2020 Strategy. The state plan presents a new focus on research data with a voluntary mandate that data from research funded by public funds should be stored and made available through Open Access for purposes of replication and reproduction of research and analysis.

The plan outlines how funded research projects may include, as an option, a plan for the management of research data that will be deposited in national/institutional/international repositories after the end of the project. The plan also recognises that data must be protected and some may not be amenable to openness for reasons of security, confidentiality or commercial reasons. The plan recommends that evaluation of researchers should take into account work published in open repositories and this regards both publications as well as research data.

Furthermore, two HE consortia ("Consortio Madroño" in Madrid and CSUC in Catalonia) have developed RDM services to support their researchers. Work is currently underway to create guidance and policies for member institutions based on the LEARN model policy (SPARC Europe, & Digital Curation Centre, 2021, p. 23).

Useful links:

- Teresa Gomez-Diaz, Tomas Recio. Towards an Open Science definition as a political and legal frame- work: on the sharing and dissemination of research outputs. 2021. hal-02962399v2

Giske Ursin & Heidi Beate Bentzen (2021) Open science and sharing personal data widely – legally impossible for Europeans?, *Acta Oncologica*, 60:12, 1555-1556, DOI: [10.1080/0284186X.2021.1995894](https://doi.org/10.1080/0284186X.2021.1995894)

- <https://www.cesaer.org/news/scientific-knowledge-must-be-protected-to-ensure-a-europe-fit-for-the-digital-age-1081/>

4. Implementation of Open science and barriers according to the results of survey among partner institutions

When talking about 'best' open science practices among EU-Connexus alliance, all universities highlighted importance of participation in EU-projects which continued within sustainable activities such as OpenAIRE, i.e. OpenAIRE Noad (Romania and Croatia), OPERAS (Croatia), FOSTER Plus (Romania).

All partners reported raising awareness among researchers by organizing trainings, workshops, lectures, webinars, and other types of dissemination activities as most represented and important.

All partners have established open institutional repositories or archives for theses and for scientific papers from researchers, several reported practising FAIR and Open Data Management.

Participation to the European Open Science Cloud was reported as a good open science practice by Greece, Croatia. Support of the open access journals platforms (such as French episciences.org or Morepress in Croatia) for diamond journals is one of the good practices for all universities.

Participation in ERICs (European Research Infrastructure Consortium) such as DARIAH (The Digital Research Infrastructure for the Arts and Humanities) – Ireland, France, Romania, CLARIN (Common Language Resources and Technology Infrastructure) – Greece, Lithuania, Croatia; CESSDA (Consortium of European Social Science Data Archives) – France, Greece, Croatia, Ireland, and other infrastructural consortia is extremely important to help universities to fully participate in open science movement.

Several partners participate in organizing conferences and other events dealing with open science from the research point of view. One good example is yearly scholarly conference PUBMET organized by University of Zadar, Ruđer Bošković Institute, University of Zagreb, and Croatian Association for Scholarly Communication (CROASC), Zagreb from Croatia. PUBMET is an International Conference on Scholarly Communication in the Context of Open Science. Among other examples of good practices, collaborative projects on the institutional, national, or international levels are proven to be the most influential.

Learning from experience and spreading the word, meaning, raising awareness regarding open science is the most effective and efficient way to speed up onboarding to

these topics. Institutional and infrastructural support is something that all partners stressed as highly important and there is evidence that can be supported by openness from national and institutional level regarding further development of open science initiatives and topics.

As part of the study of individuals' participation in open science activities, a survey was conducted among the partners of the EU-CONEXUS Alliance. Two forms of questionnaires were designed - one for scientific staff and one for administrative staff.

The following is an analysis of the data collected, which provides answers to questions about the participation of individual groups in Open Science activities and the main advantages and disadvantages of using Open Science. Based on the data obtained, recommendations are made as to which activities should be increased.

Unfortunately, the responses of researchers and administrative staff at each institution were not suitable to statistically justify the comparison of the data obtained, and the data were analyzed at a descriptive level.

Table 3. The number of participants to survey from different EU-CONEXUS partner universities

	Researchers		Staff	
	Number	%	Number	%
Agricultural University of Athens, Athens	9	4,27	1	0,7
Klaipeda University, Lithuania	23	10,90	6	4,48
La Rochelle Université, France	5	2,37	6	4,48
La Universidad Católica de Valencia "San Vicente Mártir", Spain	12	5,69	3	2,24
Technical University of Civil Engineering Bucharest, Romania	33	15,64	3	2,24
University of Zadar, Croatia	99	46,92	110	82,09
Waterford Institute of Technology, Ireland	30	14,22	5	3,73
TOTAL	211		134	

Table 4. The number of participants to survey according to gender

	Researchers	Staff
Male	84	41
Female	124	90
Don't want to answer	3	3

Table 5. The average work experience of participants to survey

	Researchers				Staff			
	Mean	Min	Max	SD	Mean	Min	Max	SD
Your professional experience in general (number of years):	19,53	2,00	39,00	8,93	10,37	0,00	30,00	7,28
Your professional experience in your current institution (number of years):	13,56	1,00	36,00	8,19	16,70	0,00	36,00	8,47

Based on the collected data (Table 6), it is clear that the attitude of the respondents is mostly positive. The positive aspects of open science are highlighted, but it seems necessary to continue to emphasize these positive aspects and to point out the need for further development of open science in the SmUCS area.

Table 6. Answers which represent participants opinion on Open Science

	Researchers	Staff
	Number (%)	Number (%)
OS is an exciting opportunity for science, mostly with benefits	84 (39,81)	66 (49,25)
OS is an opportunity for science, with the benefits overcoming the drawbacks	57 (27,01)	49 (36,57)
OS is mostly positive for science, it has benefits but also important drawbacks	36 (17,06)	20 (14,93)
OS is a worrying new perspective for science	3 (1,42)	3 (2,24)
OS is a real threat to science	0	0
I do not know	10 (4,74)	11 (8,21)
Other:	0	2 (1,49)

Comments

It is important that the articles and books are accessible to students, researchers and practitioners in the field. I prefer cooperation in projects – (Staff, University of Zadar)

Responses (Table 7) indicate that they believe open science is aimed at a wide range of groups and individuals. Thus, the purpose of open science is not only for scientists, but also for broader social groups. This also provides an opportunity to introduce interdisciplinary research in SmUCS to broader groups, further promoting the activities of all Alliance members.

Table 7. Answers related to opinion about to whom should science be opened/available? (multiple answers were possible)

	Researchers	Staff
	Number (%)	Number (%)
Open to scientist from the same area / discipline	135 (63,98)	65 (48,51)
Open to scientist from other disciplines	133 (63,03)	77 (57,46)
Open to all citizens	128 (60,66)	93 (69,40)
Open to civil and social organizations	81 (38,39)	44 (32,84)
Open to specially concerned groups	73 (34,60)	32 (23,88)
Open to funders and policy makers	87 (41,23)	41 (30,60)
Open to industry and companies	79 (37,44)	49 (36,57)
It should not be open	0	1 (0,75)
Other	4 (1,90)	1 (0,75)

Comments (Table 7.):

- *Universities, as many universities cannot pay access to science direct for instance and students cannot access to papers for their thesis (Researcher, UCV)*
- *Open, but properly considering copyright and security issues. (Researcher, UTCB)*
- *I believe every human being should be allowed to access any scientific research results via the internet and for free (Researcher, UNIZD)*
- *Protection of sensitive data (e.g. due to privacy concerns) might occasionally be warranted (Researcher, UNIZD)*
- *In principle, science should be open and available to all but doing so should not imply that the scientist will debate the results. That is the purpose of the peer review process. (Researcher, WIT)*
- *Open to everyone but targeted and delivered in an understandable way (Researcher, WIT)*
- *general open to all citizens, but ideally open science should be user oriented for the highest impact (Staff, KU)*

It goes without saying that most scientists participate in activities involving various aspects of open science (Table 8.). We should certainly work on this (e.g., through various trainings and workshops) to ensure that awareness of the need to strengthen open science is additionally communicated to the scientific community, as well as to non-teaching staff at universities and the broader community.

Table 8. Participation in Open science

	Number	%	Number	%
Yes	156	73,93	71	52,99
I don't know	11	5,21	46	34,33
No	44	20,85	17	12,68

**Table 9. Answers to question “In which part of open science have you participated?”
(multiple answers possible)**

	Researchers	Staff
	Number of answers (%)	Number of answers (%)
Open access to research publications	155 (73,46)	68 (50,75)
Research data management	20 (9,48)	16 (11,94)
FAIR (Findable, Accessible, Interoperable, Re-usable) data	15 (7,11)	7 (5,22)
Data sharing	0	30 (22,39)
Open research protocols	0	8 (5,97)
Open source research software and code	0	6 (4,48)
Open education	36 (17,06)	23 (17,16)
Open evaluation	18 (8,53)	8 (5,97)
Citizen science	23 (10,90)	9 (6,72)
Science outreach and communication	45 (21,33)	11 (8,21)
Other	2 (0,95)	0

Participation in various open science activities indicates that the individual is most engaged in dissemination of scientific activities, education, and evaluation. It is notable that he does not participate in activities through which research data could be shared. This is a potential area where action is needed to facilitate data sharing and dissemination in collaborative research.

As can be seen from Table 10., most of the activities are related to the promotion of science. It is obvious that our participants see the positive aspects of using Open Science and we should continue to work on this in the future.

Table 10. Answers to question “What would be your motivation to participate in open science?”

	Researchers	Staff
	Number of answers (%)	Number of answers (%)
To promote science in general	165 (78,20)	96 (71,64)
To promote different aspects of scientific processes (research design, results etc.)	136 (64,45)	69 (51,49)
Because of the lack of funding opportunities for doing research and publishing	75 (35,55)	27 (20,15)
It is an obligatory precondition to improve your career	39 (18,48)	19 (14,18)
To network	77 (36,49)	50 (37,31)
Because of fear and uncertainties for career development	1 (0,47)	7 (5,22)
Other	6 (2,84)	7 (5,22)

Comments on why to use Open Science:

- *To ensure reproducibility of research results, and thus increase their credibility, 2) to increase the impact of my publications (also in terms of silly bibliometrics) (Researcher, LRU)*
- *For the meaning of findings (environmental problems, conservation in general). Many problems could be avoided if people knew about them and get information on mitigation measures ASAP (Researcher, KU)*
- *Work for the public, social benefit. (Researcher, UNIZD)*
- *To show the benefits of scientific results and a scientific method, but also to show the limits of science (Researcher, WIT)*
- *Because science should be accessible to all - science communication in less complex terms is an underdeveloped skill in many scientists; we should all be able to explain our research and why it is important and impactful to a non-specialist. (Researcher, WIT)*
- *to promote relations between science and other fields (art, different professions...) (Staff, UNIZD)*
- *To make results of research and/or their publications free and easily accessible. (Staff, UNIZD)*
- *I stand by open science on ethical grounds. The reasons we all aren't doing more open science is because it does not have the same value for our career development at the moment. (Staff, UNIZD)*
- *To promote data sharing regarding experiences and new solutions in education (Staff, UNIZD)*
- *publications are expensive to access and many universities do not have access (Staff, UCV)*
- *Sharing data and results between researchers (Staff, LRU)*
- *To combat misinformation (Staff, WIT)*

Table 11. Identifying the most important barriers for open science

	Researchers	Staff
	Number of answers (%)	Number of answers (%)
Limited awareness of the researchers of the benefits of open science	100 (47,39)	60 (44,78)
Limited awareness at the institutional level of the benefits of open science	61 (28,91)	39 (29,10)
Concerns over the legal framework (e.g. data privacy, copyright regulations etc.)	118 (55,92)	71 (52,99)
Absence of policies and guidelines at the national level	69 (32,70)	53 (39,55)
Absence of policies and guidelines at the institutional level	40 (18,96)	31 (23,13)
Technical complexity (e. g. lack of precise definitions, standards and procedures etc.)	47 (22,27)	29 (21,64)
Different disciplinary practices	47 (22,27)	24 (17,91)
Resistance to making data available or to sharing data	74 (35,07)	36 (26,87)
Misconceptions of open science from the part of seniority faculty or leadership of the institution	11 (5,21)	6 (4,48)
Concerns over increased costs	42 (19,91)	12 (8,96)
Lack of expertise and skilled staff of different areas of open science at the institutional level	30 (14,22)	22 (16,42)
Lack of coordination among the relevant actors within the university	15 (7,11)	13 (9,70)
Lack of support structures at institutional level for researcher interested in open science activities	16 (7,58)	12 (8,96)
Lack of awareness raising, including training opportunities, at the institutional level	13 (6,16)	7 (5,22)
Absence of incentives to promote open science activities (e.g. absence of impact of impact on academic career assessment and career progression)	29 (13,74)	6 (4,48)
Public's lack of understanding	21 (9,95)	15 (11,19)
Perceived risk to (traditional) fundamental research	19 (9,00)	6 (4,48)
Low quality	21 (9,95)	8 (5,97)
Danger and potential misuse	23 (10,90)	15 (11,19)
Unfairness	11 (5,21)	2 (1,49)
Authentic public engagement	2 (0,95)	3 (2,24)
Budget and funding constraints	36 (17,06)	9 (6,72)
Time constraints	18 (8,53)	3 (2,24)
Fears and uncertainties for career development	6 (2,84)	3 (2,24)
Other	3 (1,42)	2 (1,49)

It can be observed that the hottest obstacles to the use of Open Science are aspects of limited awareness of the benefits of Open Science. Clearly, further efforts need to be made to increase this awareness through future activities by all partners.

Comments on barriers to open science

- *Publishers and/or funders are against it (they want to earn profit from publications and/or research results). (Staff, UNIZD)*
- *The biggest barrier is ideological (Staff, UNIZD)*
- *It is complicated to put in place open science when you have collaborative research with private companies. (Staff, LRU)*

Even though open science training stands out as one of the ways through which institutions support the strengthening of open science (Table 12.), it seems that this number is not yet as significant and pronounced and is needed through additional activities and investments in workshops, education, and other activities. Work on raising awareness of the need for open science.

Table 12. Distribution of answers to question “What type of support does your institution provide to researchers to make their research publications available in open access? (multiple answers possible)”

	Researchers	Staff
	Number of answers (%)	Number of answers (%)
Training for researchers	71 (33,65)	39 (29,10)
Institutional website(s) on open access to research publications	88 (41,71)	33 (24,63)
Developing open research strategy and vision	47 (22,27)	23 (17,16)
Linkage to career evaluation and promotion within the institution	29 (13,74)	12 (8,96)
Facilitating administrative reporting of publications in projects	30 (14,22)	9 (6,72)
Funding for publishing in open access journals (APCs)	46 (21,80)	18 (13,43)
Guidelines providing clarification of legal issues related to linking, sharing and re-using Open Access content	8 (3,79)	4 (2,99)
Establishment of specific services (helpdesks) for researchers	12 (5,69)	9 (6,72)
Legal support	16 (7,58)	9 (6,72)
Other	2 (0,95)	1 (0,75)

Comments

- *we provide a pre-print open access platform for open access that is mandated for all research outputs. (Researcher, WIT)*
- *Very limited funding for publishing of few selected underrepresented topics in open access journals (APCs) per year (with a high risk for authors do not get expenses back...)(Researcher, KU)*
- *I have to write disclaimer for these answers because I am not aware of all what is provided by our University.(Researcher, UNIZD)*

Table 13 also shows that most responses are along the lines that researchers and staff have not had the opportunity to participate in open science training. This should certainly be seen as a sign of the need to organize training in this area.

Table 13. Distribution of answers to question “Do you receive training from your institution related to Open Science such as (multiple answers possible)”

	Researchers	Staff
	Number of answers (%)	Number of answers (%)
research and data management	30 (14,22)	14 (10,45)
research integrity	41 (19,43)	12 (8,96)
research publishing and dissemination	52 (26,44)	22 (16,42)
collaborating and networking	32 (15,17)	18 (13,43)
communicating science to the general public	22 (10,43)	8 (5,97)
involving the general public in research	12 (5,69)	2 (1,49)
evaluation of research projects and researchers	22 (10,43)	11 (8,21)
assessment of the impact of initiatives in public	6 (2,84)	1 (0,75)
I do not receive any training	83 (39,34)	53 (39,55)
I do not know	40 (18,96)	42 (31,34)
Other	2 (0,95)	0

Comments

- *More information should be made freely available (Researcher, WIT)*
- *We had one workshop this week to introduce us to Open Science. 15 people participated (out of 150 invited) (Researcher, UNIZD)*

The most frequently cited barriers across the Open Science lifecycle were limited awareness of the researchers of the benefits of open science, concerns over the legal framework, lack of awareness and training, excessive time commitment, and lack of specific services (helpdesks) for researchers. Open Science practices are highly fragmented, and awareness of Open Science practices is particularly low, potentially leading to 'path dependencies' that reduce the likelihood of Open Science practices in later stages. When asked about barriers, they cited institutional policies that discourage open data publishing and the fact that the practice is generally uncommon in some disciplines (e.g., humanities/social sciences).

Open processes represent a major departure from current practice and carry a mix of promise and risk. Benefits include accessibility of information prior to peer-reviewed publication, more efficient use of resources and knowledge, and the ability to reproduce

detailed protocols. However, developing fully reproducible workflows is challenging, and it is still unclear whether open notebooks or other documented processes are read and used. Other barriers to adopting open processes include disagreements among staff or other restrictions on sharing data and ideas, time constraints, and language barriers for non-native speakers.

Training is low-hanging fruit for promoting Open Science practices, but there remains a lack of training on most Open Science topics. Even knowledge of open access, the best known aspect of Open Science, was limited to a subset of open access study (i.e., 'author pays' models). There are free introductory courses on reproducible and transparent research that have proven successful in promoting Open Science practices, but they need to be more formally integrated into undergraduate and/or graduate education, and possibly required. For example, a course on Open Science could lead students to adopt Open Science practices or plan to adopt these practices soon.

Reducing barriers to the use of Open Science requires efforts at multiple levels: individual, departmental, institutional, and EU-CONEXUS alliance. Once researchers themselves are trained in these practices, they can help promote Open Science by engaging in low-effort seminars, journal clubs, or discussions with colleagues. Researchers who use Open Science in their teaching and research are likely to encourage the use of these practices among their trainees, whether explicitly (e.g., by requiring graduate students to pre-register their theses) or not (by setting an example for their students). Efforts to train researchers and collaborators in Open Science and to incentivize these practices will therefore lead to knock-on effects that will eventually lead to widespread adoption of Open Science by future generations of scientists.

The new ways of presenting scientific information should be understood and used as an opportunity to actively improve, shape, and change scientific communication. This redesign will only work if participants assume their role as active designers while preserving the freedoms of the scientific system. Important areas for future evaluation include privacy and research misuse. There is also a need for a joint negotiation process between science, politics, and society. Another starting point for research efforts arises from the shift in the publication system from the sale of content to reimbursement of the cost of publishing

scientific findings by the public sector. Developments in citizen science also need to be considered.

Through open processing, every step of a scientific project can be comprehensively documented with a timestamp and meta-information and thus made traceable. Open Science is becoming an increasingly necessary and accepted *modus operandi* in the scientific environment, but actual implementation lags the widely shared vision. Together, we make science more open, for the benefit of science and society.

5. Conclusion

The implementation of Open Science is an unstoppable process, both at international and EU level. Therefore, for a better implementation of Open Science practices within the EU-CONEXUS partner institutions, it is necessary to consolidate and accept the principles, guidelines and policies of Open Science and to create the infrastructure for implementation.

A survey of partner institutions has shown that the barriers to Open Science within the EU-CONEXUS Alliance are mainly at **university level, researcher, and infrastructure levels**.

Therefore, in order to overcome the specific barriers, it is crucial to understand the expectations (or better the benefits) of Open Science policies from the perspective of all stakeholders involved (**researchers, educational/research institutions, governments, society and funders**). To achieve this goal, existing and future obstacles and challenges in the EU legal and regulatory framework need to be identified with respect to the main objectives, and best examples of Open Science practices need to be developed and shared within the EU-CONEXUS Alliance, such as: participation to the European Open Science Cloud, support of the open access journals platforms for diamond journals, participation in ERICs (European Research Infrastructure Consortium) such as DARIAH (The Digital Research Infrastructure for the Arts and Humanities), CLARIN (Common Language Resources and Technology Infrastructure) – Greece, Lithuania, Croatia; CESSDA (Consortium of European Social Science Data Archives).

Several partners participate in organizing conferences and other events dealing with open science from the research point of view.

Among other examples of good practices, collaborative projects on the institutional, national, or international levels are proven to be the most influential. Learning from experience and spreading the word, meaning, raising awareness regarding open science is the most effective and efficient way to speed up onboarding to these topics.

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