A Vision for Open Science

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This document elaborates on the outcome of the workshop ***Research Institutions and Libraries and the role of Funders in the European Open Science Cloud***[1], held at the LIBER 2018 Conference in Lille, France and organised by LIBER as part of the EOSCpilot project[2].

Introduction

The implementation of the European Open Science Cloud (EOSC) is in full swing. When operational, the EOSC will provide a seamless environment for research collaboration by sharing services and research outputs across disciplines while reducing fragmentation of existing infrastructures. However infrastructure, services and tools are not the only developments we need. The way science and scholarly communication are carried out and promoted has a critical impact on the approach to open science. Unfortunately, this is not based on a very solid foundation as the incentives for researchers are not sufficient or not strong enough.

The workshop[3] brought together key representatives of research funding organisations, research institutions and libraries. They discussed the limitations of the current system and gave their vision of how the status quo can be changed: research funders by mandating and supporting open science, institutions by promoting and rewarding researchers' careers, and research institutions and libraries by contributing to the EOSC infrastructure and tools, and by supporting the development of relevant skills.

This document is not simply a summary report of the workshop. It is an attempt by several workshop participants to reflect on the session outcomes. In this way, they contribute to the promotion of the open science vision: a vision in which open science and open scholarly communication are considered the norm, researchers are fully equipped with the required skills and institutions recognise and reward open science in their promotion and hiring criteria. In this vision, the EOSC has also effectively implemented a trusted environment for research within Europe and globally, and research institutions support the provision of tools and services as part of the local EOSC infrastructure.

1 Proceedings of Workshop Research Institutions and Libraries and the role of Funders in the European Open Science Cloud. Zenodo. http://doi.org/10.5281/zenodo.1319411

2 https://eoscpilot.eu

3 https://eoscpilot.eu/events/eoscpilot-workshop-research-institutions-and-libraries-and-role-funders-european-open-science

1. The Role of Funders

Funding organisations have a key role in ensuring that open science practices are embedded into the research culture of the future. Open science represents an approach that is collaborative, transparent and accessible. Currently, some researchers already practise open science. Some publish papers in open access journals; some provide data in open access repositories; some engage in open peer review and some share protocols, materials and software to make their research reproducible. However, this approach is not yet the norm.

Some funding bodies have had policies in place for some time to ensure that outputs of funded research are made available with as few restrictions as possible so that they can be accessed and reused by researchers and other users. However, policies and guidelines are not in themselves sufficient to determine a shift towards open science and researchers often are still unclear how outputs should be managed and curated throughout the research process, how results should be shared, and what platforms or tools should be used. Often current infrastructures do not allow effective management and sharing of research results and there is a lack of standards and common best practices across many research disciplines.

FUNDERS HAVE THE OPPORTUNITY AND THE RESPONSIBILITY TO SHIFT THE INCENTIVES INHERENT IN GRANT APPLICATION PROCESSES AND IMPROVE THE WAY RESEARCH IS EVALUATED.

Participants in the workshop recognised the urgent need to change the status quo and argued that it will be crucial that all stakeholders work collaboratively to facilitate this change. While different stakeholders have different responsibilities, it is important that they all align on a common vision for open science to be embedded in research culture.

There is a perception that research evaluation is mainly based on researchers' prestige, which very often is inferred from the prestige of the journals in which the researchers publish. Journal prestige is mainly based on its journal-based metrics (such as impact factors). We discussed the importance of developing alternative methods of evaluation, minimising those based on the prestige of the journals where articles are published, as well as the role of institutions regarding the evaluation of research and career progress (see section 2 of this document).

Funders have the opportunity and the responsibility to shift the incentives inherent in grant application processes and improve the way research is evaluated. Many funders, including those who participated in this workshop, have already been involved in initiatives aiming to incentivise open science (by signing The San Francisco Declaration on Research Assessment, DORA[4], or changing application processes to value all research outputs[5], or launching specific funding calls to fund open science initiatives[6]).

To facilitate open science, it was suggested that funders could:

- **Consider open science practices as one of the criteria to allocate grants.** These might include explicitly recognising a broad range of research outputs, valuing open practices as part of a researcher's track record, rewarding data sharing and data re-use, assessing the impact of a given contribution.
- **Invest in infrastructure that supports the implementation of open science,** be it resources or services to access, share, and assess research.
- **Engage in discussions to resolve misunderstandings and misconceptions concerning open science.** For example, defining what open science means – being clear on appropriate custodianship and use of data, and giving credit to data producers.

4 https://sfdora.org
5 https://www.cancerresearchuk.org/funding-for-researchers/research-features/2018-02-20-improving-research-evaluation-dora
6 https://wellcome.ac.uk/funding/open-research-fund

- **Provide practical information on e.g. the FAIR principles in data and code management.** Certain conditions may apply. The data may not always be suitable for full open access but should be 'as open as possible, as closed as necessary'.
- **Invest in collaborations, team science and initiatives to increase reproducibility.**

We discussed the responsible use of metrics and argued that institutions and funders should resist the temptation of simply replacing the current journal impact factor metric with an alternative metric system. There was also a discussion to what extent the attempts to measure quality with quantitative metrics are justified and whether quantitative metrics can be ever used effectively without the metrics becoming the targets. Finally, any possible future metrics should be transparent and open.

Recent efforts towards developing alternative methods of evaluation are evident from the work on DORA and the Leiden Manifesto[7], as well as the launch of cOALition S[8] and Plan S: an initiative supported by several European funders to make full and immediate open access a reality. DORA and the Leiden Manifesto encourage researchers to move away from using journal-based metrics as measures of research quality and place emphasis on the value of all research outputs and not just publications. Plan S also supports the DORA recommendations[9] and commits to fundamentally revise the incentive and reward system of science. It is with bold initiatives[10] such these that we can speed up the cultural change.

The main role of funders in this context is to set clear policy expectations and provide the funding required to support the research community in adopting open science practices, and develop and sustain key underpinning infrastructures and resources.

This workshop also gave us an opportunity to discuss how funders, institutes and libraries, publishing services and digital/tech companies may work together to facilitate the use of relevant infrastructures that may allow dissemination of outputs while ensuring discoverability, accessibility, interoperability and reusability of results. The EOSC is certainly one good example that holds promise to achieve this goal.

Moreover, we have an opportunity to embrace current and developing digital technologies to improve our processes. For example, the use of FAIR metrics[11], Artificial Intelligence and blockchain approaches could help streamline processes such as monitoring compliance and peer review or tracking/measuring the use of different types of outputs. Digital technologies can help us improve our funding processes as well as enable us to better recognise the efforts and the way of working of our researchers in terms of open science. In section 3, we address the role of institutions and libraries in supporting the infrastructure, services, and tools that put them at the heart of the EOSC ecosystem.

2. Recognition of Open Science in the Career of Researchers

Changing practice from the approaches currently used in many disciplines will require a fundamental change in the way scientists carry out research. For this to happen, the open science approach must be recognised and rewarded by both employers (when recruiting and promoting researchers) and research funders (when performing peer review in grant applications).

Funding incentives are important in motivating researchers and research support staff to develop and apply open science skills in practice. Aside from funding, recognition is key. If open science practices are required, at

7 http://www.leidenmanifesto.org
8 https://www.scienceeurope.org/coalition-s
9 https://sfdora.org/read
10 "Incentivizing the sharing of research outputs through research assessment: a funder implementation blueprint" by Open Research Funders Group (RFD) available at http://www.orfg.org/s/ORFG_funder-incentives-blueprint-_final_with_templated_language.docx
11 https://www.nature.com/articles/sdata2018118

the same time as researchers continue to be judged, measured and rewarded by the number of publications in high impact factor venues, disjoint and distrust will develop within the academic community[12].

A lot of important groundwork in this field has been already accomplished: both in terms of recognising that academic rewards system needs to be revised (for example, the report of the European Commission's Working Group on Rewards under Open Science[13]), and proposing changes to metrics and assessment systems[14] (also supporting the DORA declaration mentioned above). In addition, there are examples of institutions which have changed their criteria for hiring and for promotion[15]. Nonetheless, workshop participants reiterated that in order to put open science into practice it was essential to change evaluation criteria, specifically those related to recruitment, performance and promotion.

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As mentioned above, a responsible use of metrics and more appropriate criteria for the assessment of research outputs are essential. We argue that efforts should aim not only at identifying and using the right metrics but also at measuring the right things, such as acknowledging relevant activities, rewarding intersectoral / interdisciplinary / open science activities. In order to stimulate innovation and productive collaboration within the competitive academic environment, rewards and incentives should focus on teams and groups of researchers, rather than individuals. Recruitment and promotion criteria could include teamwork, group performance, and group leadership to support this shift. Such approach would also help to ensure that the necessary open science skills (as described in section 4) are present within the teams and not required of any single individual.

3. The Role of Research Institutions & Academic / Research Libraries in the EOSC: Supporting the Development & Adoption of Tools, Services & Infrastructure Components

The previous sections emphasised the responsibility of funders and research institutions in implementing the cultural change required for open science to flourish. Similarly, research institutions and libraries are key players in the set-up of tools, services and infrastructure components that contribute to the EOSC.

Research libraries are key in the promotion and advocacy of open science within institutions and active participants in data stewardship, helping, supporting and encouraging researchers to increasingly make their outputs openly available[16]. They actively work to innovate the present paper-centric scholarly communication and scholarly publishing systems, introducing alternative channels in compliance with open science policies; they guide researchers towards innovative publishing models, at times acting as publishers too.

Institutions and funders collaborate on supporting infrastructure and services for open science already, especially on institutional repositories, research data management, and data stewardship as well as on services and collaboration tools to support researchers in all phases of the research cycle. Research institutions and libraries should leverage their work and evolve further. Although acquisition of research literature will remain an important part of libraries' work, they will develop as curation centres and focus much more on acquiring,

12 https://www.nature.com/articles/d41586-018-05467-5
13 http://ec.europa.eu/research/openscience/pdf/os_rewards_wgreport_final.pdf
14 https://ec.europa.eu/research/openscience/pdf/report.pdf
15 https://www.nature.com/news/fewer-numbers-better-science-1.20858
16 "10 ways libraries can support the implementation of Plan S" by SPARC Europe available at https://sparceurope.org/librariesplans

describing, organising and storing the intellectual output of the institution. They will be more interoperable, sharing their own collections (e.g. institutional repositories, digital libraries, databases, etc.) and harvesting others' collections relevant for their users.

Infrastructure & Tools

By managing and monitoring institutional repositories, research libraries support a stable, quality-controlled infrastructure to deposit, curate, verify and disseminate all kind of research outputs as well as other kinds of materials and documents relevant for the institution. However, these are still far from being a backbone of the institution's information system, as they should be. Often considered as a "green" way to self-archive already published works, the role of institutional repositories in storing a wide range of unique types of publications and documents (e.g. theses and dissertations, reports, working papers, educational materials, policies, multimedia materials, etc.) is somehow disregarded. Institutional repositories implement preferably open formats, open standards, and long-term preservation policies, contributing to the establishment of sustainable solutions for the long-term preservation of repository objects. In the future, institutional repositories will be integrated into all working processes providing the effective management of the research and intellectual output of the institution.

Standards & Interoperability for Research Data Management

Standards for Research Data Management (RDM) within and across disciplines (for example generic and discipline-specific metadata standards) need to be widely promoted and adopted. Research libraries have a role in disseminating them to relevant research communities, as well as in improving descriptive metadata standards for publications in accordance with novel developments and publishing models; in integrating persistent identifiers (PIDs) within research infrastructures; in providing metadata exchange standards and APIs with increased usability for researchers.

Data Management Plans

There is a need for know-how and best practices in standardisation of research data documentation, as well as of access to research data and Data Management Plans (DMP).

Funders and institutions need to set requirements and minimal conditions on DMPs, so as to tailor them to specific research institution and funder's regulations. Research institutions have a responsibility to oversee the completion of DMPs and the handover to repositories, so that DMP usage becomes regular practice.

Machine-actionable DMPs (maDMPs)[17] are tools for reporting on the outcomes of a research project that enable information exchange across relevant parties and systems. These are essential tools to automate the creation and maintenance of DMPs, to alleviate administrative burdens and improve the quality of the information contained in a DMP, across a whole project lifetime. In this vision, a DMP is not used only in the application stage, but as an ongoing tool. Other components of the DMP include machine-actionable policies, PIDs and Digital Object Identifiers (DOI).

Multilingualism

There are 24 official languages in the EU but, in recent decades, English has become the global language of scholarly communication in many disciplines. As a result, the societal impact of knowledge published solely in English language is reduced for local communities. The open access movement, providing numerous opportunities for the global dissemination, is giving rise to non-English publications on locally relevant research (Leiden Manifesto). Translation and multilingual tools are needed to decrease the language barrier in the open science world.

17 Simms S, Jones S, Mietchen D, Miksa T (2017) Machine-actionable data management plans (maDMPs). Research Ideas and Outcomes 3: e13086. https://doi.org/10.3897/rio.3.e13086

4. In 2030, the Following Skills are Common Among Researchers

Tools, services, and infrastructure are essential enablers of open science. However, the mere presence of these components does not mean that open science will become the norm and will be put into practice at every institution. For this to happen, both researchers and support staff need to have sufficient knowledge and skills to adhere to open science practices, to use the tools, services and infrastructure effectively, and to support their colleagues in the transition. Institutions and libraries can help by promoting awareness and supporting training for students, researchers, faculty, editors and publishers.

Some groundwork for defining and agreeing on the set of skills needed to put open science into practice has already been accomplished. For example, the European Commission's Working Group on Rewards under Open Science published a report proposing that researchers should be rewarded for practising Open Science[18], including an 'Open Science Careers Assessment Matrix'. EOSCpilot (European Open Science Cloud Pilot) has developed a comprehensive Skills Framework, offering a useful overview of the skills to practice open science and make data FAIR[19].

During the workshop, we highlighted two sets of overarching skills which we thought were essential for open science to be embraced by the research community: 1) **data management** and **data science skills**, 2) understanding of **roles and responsibilities** and **legal obligations**.

IT IS HIGHLY UNREALISTIC TO EXPECT A SINGLE INDIVIDUAL TO HAVE ALL THE NECESSARY SKILLS. TO THE CONTRARY, OPEN SCIENCE DEPENDS ON COLLABORATION, PRACTICE EXCHANGE AND SKILL SHARING.

In terms of data management and data science skills, we thought it was essential that researchers adhered to good data management practice during the entire research lifecycle and across all different career levels. This should start already at the data management planning stage and is related not only to basic data management organisation issues, such as backup and storage but also adherence to research integrity standards (from the experimental design stage all the way to data analysis and presentation). During research, data needs to be properly versioned and documented to enable future re-use. Finally, it is important that research teams know how to curate research data, how to decide which data have to be preserved long-term and how to best achieve this. In addition, we also recognised the fact that data goes hand-in-hand with research code (and software) and as such it is necessary that researchers adhere to good code management practices and are able to use code and software effectively for data processing, analysis and visualisation.

We also discussed the need to understand (and assume) roles and responsibilities and to understand legal obligations associated with open science. First, the roles and responsibilities of the different stakeholders need to be clearly defined. This starts at the very top (policies at organisational levels) but needs to be also defined at all levels of organisational granularity, such as at faculties and departments, within project consortia and individual project teams, and in relationships such as those between students and supervisors. Legal terms define roles and responsibilities, but also rights and obligations. Understanding of the latter is of key importance when working with data. Compliance with the European General Data Protection Regulation[20] is dependant on understanding of the legal obligations of those processing personal data and their awareness of the rights of natural persons. Adherence to contractual obligations is also necessary when it comes to public-private partnership and it enables effective contract negotiations. Finally, the understanding of legal obligations is also necessary for researchers to re-use and to effectively share their research outputs.

18 http://ec.europa.eu/research/openscience/pdf/os_rewards_wgreport_final.pdf
19 https://drive.google.com/file/d/1QjKsjcpi2JqznWTzSDCGK1viD7u52tuh/view
20 https://ec.europa.eu/commission/priorities/justice-and-fundamental-rights/data-protection/2018-reform-eu-data-protection-rules_en

The discussion around the roles and responsibilities and the legal obligations also served as a perfect example of how important it was to recognise the broad variety of skills required to put open science into practice. It is therefore highly unrealistic to expect a single individual to have all the necessary skills. To the contrary, open science depends on collaboration, practice exchange and skill sharing - and crucially also between researchers and research support staff. In addition, it is important to consider necessary skills at an appropriate level of maturity. Which team members should just have sufficient knowledge and awareness of certain matters? Which ones need to have the skills enabling them to put the knowledge into practice? Which ones need to demonstrate appropriate behaviours and attitudes to change cultures?

Conclusion

The transition to open science is happening. It comes from a need for all researchers to be more innovative, collaborative, and to advance faster. Today's technology and online infrastructures allow us to conduct research in a more open and collaborative way, using tools and mechanisms that allow a more efficient way to design, analyse, report, share and disseminate data so that value from research can be extracted.

We imagine a future where all funding bodies as well as institutions and researchers recognise the benefit of open science and embed best open science practices into their processes. Collaboration and concerted efforts of all key players involved in research are necessary to ensure a future where research benefits from optimal reuse of research output, and a real impact on society can be achieved.

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