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D8.2 Skills4EOSC Advocacy kit

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Deliverable Abstract

The "Skills4EOSC Advocacy Kit" advances Open Science (OS) skills to policymakers and funders, ensuring sustained policy backing and funding for OS Competence Centres. Developed collaboratively, it offers versatile materials—text, video, and presentations—under a CC BY 4.0 DEED license. Designed to influence decision-making, the kit adapts its advocacy to diverse stakeholders, aiming for lasting impact beyond the project's scope.

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v.0.1	***Q4-2022***	***Initial review of existing advocacy kits and structuring of documents***	***Jeremy Azzopardi (JA)***
V 0.2	***Q1-2023***	***Initial Literature review on Open Science Competence Centres***	***JA***
V 0.3	***Q2-2023***	***Initial draft***	***JA***
V 0.4	***2023-08-22***	***Update after T8.5 partner feedback***	***JA***
V 0.5	***2023-11-09***	***Removed report aspect and focused on Advocacy Kit content***	***JA***
V 0.6	***2024-01-19***	***Final draft ready for Task 8.5 internal review***	***JA***
V 0.7	***2024-02-05***	***T8.5 internal review feedback integrated. Draft for external reviewers***	***JA***
V 0.8	***2024-03-08***	***Integrated feedback from external reviewer 1 – Laurence Horton (Glasgow)***	***JA***
V 0.9	***2024-04-03***	***Integrated feedback central S4E leadership***	***JA***

TERMINOLOGY

https://eosc-portal.eu/glossary

Terminology/Acronym	*Definition*
CC	(Open Science) Competence Centre
CNRS	Centre national de la recherche scientifique (France)
CSC-IT	Finnish IT Center for Science /CSC – Tieteen tietotekniikan keskus Oy (Finland)
DCC	Digital Curation Centre (UK)
FAIR	The FAIR principles for machine-actionable data, metadata and other digital objects. FAIR stands for Findable, Accessible, Interoperable, Reusable. The acronym and principles are defined in a 2016 paper (Wilkinsson et al., 2016).

OECD	The Organization for Economic Co-operation
OPERAS	Research Infrastructure for Open Scholarly Communication in the European Research Area for Social Sciences and Humanities (Belgium)
OS	Open Science
RI	Research Infrastructure
SES	Stakeholder Engagement Strategy
TU-Delft	Delft University of Technology / Technische Universiteit Delft (Netherlands)

Contents

1 Skills4EOSC Advocacy toolkit: Introduction

This advocacy toolkit is a deliverable of the Skills4EOSC project Task 8.5, with the purpose to "design and create an advocacy kit to help project partners and their networks promote Open Science (OS) skills at the level of policy makers and funders, thus ensuring a steady policy support and national/regional funding streams to keep the CCs going." (Skills4EOSC, 2021: 26)

The advocacy toolkit has been created to provide materials for communicating the importance of supporting and promoting Open Science Skills to policy makers and funders. It can be also utilised by anyone involved in Open Science to explain and promote the benefits of Open Science skills within their organization. The advocacy material can be adapted to any form of communication, such as elevator pitches or presentations.

This toolkit is produced by Chalmers University of Technology (Sweden), leader of task 8.5, along with T8.5 participants: Università di Torino (Italy), CSC-FI (Finland), OPERAS (Belgium), TU-Delft (Netherlands), DCC/University of Edinburgh (UK), CNRS (France).

The advocacy kit refers to the Stakeholder Engagement Strategy produced in Task 8.1, which identified advocacy needs and goals with regards to funders and policy makers, collecting and creating a body of material that can be adapted to communicate the importance of Open Science, Open Science Skills and the need to support Open Science Competence Centres through policy and funding.

Advocacy is defined as "arguing for a position that has the support of verifiable facts and may be used to impact decision making or affect policy change" (Cockrell et al.; 2018: 1). Advocacy material therefore needs to promote a previously decided message - a position or direction with the help of facts, aiming to influence decision making and policy towards such a position.

Although the main message is the promotion of Open Science skills, the content of the message may vary depending on the target audience.

While advocacy activities will be conducted throughout the duration of Skills4EOSC, this advocacy toolkit is meant to be a resource for Skills4EOSC partners beyond the Skills4EOSC project's conclusion.

1.1 Contents of the advocacy kit

This advocacy kit contains material in three formats:

1. Text material
2. Video material
3. Presentation material

All materials have a CC BY 4.0 DEED licence, allowing for free copying redistribution, and adaptation with appropriate credit given.[1] The kit will be available on the project's website at the following link: https://www.skills4eosc.eu/resources/advocacy-kit/

Text advocacy material

The text advocacy material describes Open Science, its benefits, and challenges, as well as the need for Open Science skills, along with providing examples of these skills. It then moves on to describe Open Science Competence Centres as effective means for organising and disseminating knowledge about Open Science and FAIR (Findable, Accessible, Interoperable, and Reusable – see Wilkinson et al., 2016), and how these centres s can help address challenges related to Open Science Skills.

The material then offers concrete suggestions for funders and decisions-makers to support Open Science and facilitate the organisation and development of Open Science skills.

A variety of literature and resources has been consulted to create this advocacy material. These included existing advocacy toolkits and advocacy guides (both general and Open-Science specific, as well as those tailored for policymakers and funders, research, and commentary on advocacy), existing resources on Open Science skills and Open Science policy, Open Science literature and resources created by the European Commission. Furthermore,

[1] https://creativecommons.org/licenses/by/4.0/

Skills4EOSC colleagues' deliverables and internal documents provided invaluable input for the execution of this task. All sources have been cited accordingly.

Video advocacy material

Six short videos were produced from interviews with professionals involved in Open Science. The videos are as follows:

Video 1 - Open Science, why do we need it?

DOI: 10.5281/zenodo.10564842

Summary:

Interview with York Sure-Vetter, Director of NFDI, Germany and Professor at Karlsruhe Institute of Technology; Eva Maria Méndez, PhD in Library and Information Science; Joaquín Tintoré, Professor of Physical Oceanography; Michael Arentoft, Head of Unit, Open Science, DG R&I, European Commission; and Iryna Kuchma, Open Access Programme Manager for EIFL on the necessity of funding Open Science infrastructure and Open Science in general in order to accelerate the shift towards more openness and higher quality in science.

Open Science is an attitude of collaboration, transparency, and equitability. SOCIB is one research organisation which makes research data available, which in turn triggers a new understanding in oceanography and allows for faster responses to societal needs. Funding Open Science means funding higher quality, faster, and more impactful science. Funders can also fund Open Science infrastructure to facilitate the shift to Open Science.

Video 2 - Open Science to enable collaboration.

DOI: 10.5281/zenodo.10564854

Summary:

Interview with Maria Bellantone, PhD in materials science; Bregt Saenen, Senior Policy Officer for Open Science at Science Europe; Pilar Rica Castro, Senior project officer for Open Access, Spanish Foundation for Science & Technology; and Iryna Kuchma, Open Access Programme Manager for EIFL on the importance of policies supporting Open Science infrastructures as a tool for implementing and promoting Open Science.

Open Science fosters inter- and transdisciplinarity. This requires open data infrastructure and interoperability. Open Science policies can be a tool for changing how research is performed and assessed. The Spanish Foundation for Science and Technology funds such infrastructures at a local level. This provides digital infrastructures and expertise to make it possible to share interoperable data. This interoperability also makes it possible for infrastructures to collaborate. Funders have a responsibility to ensure that the research they fund makes an impact, and Open Science infrastructure increases the impact potential of research.

Video 3 - Open Science: a better return on investment.

DOI: 10.5281/zenodo.10564856

Summary:

An interview with Roberto Sabatino, Research Engagement Officer at HEAnet, Dublin Ireland; Nadia Tonello, Data Management Manager at the Barcelona Supercomputing Centre; and Eva Méndez, PhD in Library and Information Science on the potential of Open Science to enhance humanity's ability to respond to crises and to provide a better return on investment.

Science is increasingly collaborative, and this includes sharing data. Funding needs to include data management, sharing, and infrastructure. Increased interoperability in research can help humanity collaboratively face challenges such as climate change. The response to the Covid-19 pandemic was also facilitated by data sharing, showing the positive societal impact and net benefit of Open Science.

Video 4 - Open Science: equitable access for everyone.

DOI: 10.5281/zenodo.10564859

Summary:

An interview about the necessity of funding Open Science platforms as a means of achieving equitable science with Iryna Kuchma, Open Access Programme Manager for EIFL; Ana María Cetto, Professor of Physics at Universidad Nacional Autónoma de México; Yensi Flores, Postdoctoral researcher at the Cancer Research Centre, University College Cork; and Bregt Saenen, Senior Policy Officer for Open Science at Science Europe.

Science is a global enterprise targeting global problems – limiting access to science defeats this purpose. Open Science platforms are necessary for researchers from all countries and organizations to be able to participate in the global scientific effort. Funding bodies can support Open Science platforms as a way of ensuring equitable and trustworthy science.

Video 5 - Open Science: why do we need data stewards.

DOI: 10.5281/zenodo.10564861

Summary:

An interview on the need of data professionals and Open Science skills with York Sure-Vetter, Director of NFDI, Germany and Professor at Karlsruhe Institute of Technology; Jessica Lindvall, Head of Training at SciLifeLab Training Hub; Anne Sophie Fink, Head of Data Management at DeiC (Denmark); and Sally Chambers, Director at DARIAH-EU.

Modern research and technology can require not only large amounts of data, but also good data quality. Ensuring good data quality requires specialized expertise. Data stewards and other data management professionals support researchers with providing and working with good quality data which are also FAIR. Open software, open infrastructures are also important bits in the Open Science puzzle, all of which require funding. The uptake of Open Science depends on widespread Open Science awareness and skills. These require outreach, training, and formal education.

Video 6 - Open Science: science for and with citizens.

DOI: 10.5281/zenodo.10564863

Summary:

An interview on Open Science funding with Ignasi Labastida, director of the Office for the Dissemination of Knowledge, University of Barcelona; Bregt Saenen, Senior Policy Officer for Open Science at Science Europe; Victoria Tsoukala, Policy Officer – Open Science at the European Commissions, DG-Reearch and Innovation; and Sumithra Vellupilai, Senior Research Officer at the Swedish Research Council.

Universities should fund Open Science as a means of sharing knowledge, and as a means of providing tools for all of society to access knowledge. All parts of society should be able to benefit from the knowledge produced through the scientific process. Making openness the norm is a way for including society's stakeholders in the research process. This level of openness and transparency requires funding infrastructure for sharing articles, data, and other research results.

Presentation advocacy material

The presentation advocacy material consists of 30 slides, that introduce Open Science, Open Science skills, and Open Science competence centres. These slides also highlight the benefits of Open Science and offer guidance on supporting Open Science uptake and implementation aimed at funders and policy makers. This presentation is a general introduction to Open Science, Open Science skills and Competence centres, tailored for stakeholders with limited familiarity with Open Science concepts.

1.2 Target audiences

The material in this advocacy kit is intended for the use of Skills4EOSC partners when engaging in advocacy efforts with decision and policy makers and funders. Skills4EOSC partners are expected to be relatively well-versed in Open Science, Open Science skills and related concepts.

Funders and policy makers are a large and diverse group with varying levels of awareness of and engagement with both Open Science and FAIR, as indicated in the internal Skills4EOSC Task 8.1 Stakeholder report. (Czuray & Saurugger, 2023)

Advocacy has been described as an ongoing challenge for scientists. Effective communication scientists, funders, policy makers, the media, the public and other stakeholders is hindered by differences in expectations, communication styles and background knowledge. (Cockrel et al., 2018; Baron, 2010)

Given the broad group of stakeholders and the general difficulty to communicate across groups, it is crucial to focus on advocacy material that can lay the groundwork for improved communication regarding the importance of Open Science skills between the Open Science skills community (such as Skills4EOSC partners) and funders and policy makers.

1.2.1 Decision- and policy makers

The Skills4EOSC Stakeholder Engagement Strategy (SES) defines decision and policy makers as working in state or government organizations and authorities, those representing researchers in universities and university networks, or as working in funding agencies or organizations. (Czuray & Saurugger, 2023)

This group demonstrate diversity in terms of access channels and communication methods, as well as differing levels of knowledge of and engagement with Open Science and FAIR in general, on an organizational, regional, national, and international level. (Czuray & Saurugger, 2023)

SES identifies five main subgroups of decision and policy makers: Governmental organizations and ministries, University networks, Researcher representatives: Universities, (Vice) rectors, and research infrastructures. These infrastructures can vary in type and services offered and operate at national or European level. (Czuray & Saurugger, 2023)

According to the report *Digital skills for FAIR and Open Science* (Barker et al., 2021), policy makers require a specific skillset to be able to navigate the FAIR

and Open Science landscape in relation to their roles. These skills include a reasonable understanding of Open Science, privacy[2] and security, and FAIR principles. This skillset should make it possible for policy makers to navigate the Open Science and FAIR services landscape and the ability to understand the needs of the scientific community in this area. The need to understand FAIR and Open Science also stems from the need for funding agency and policy makers to monitor the implementation of FAIR and Open Science in relation to their policies. (Barker et al., 2021)

1.2.2 Funding organizations

Funding organisations can be national or international, private, or public. Their knowledge of and engagement with Open Science may vary. The value proposition for funding organizations lies in the potential of harmonizing existing and future policies related to FAIRness and Open Science (Czuray & Saurugger, 2023). Encouraging a cultural shift toward FAIR and Open Science is an important first step, followed by facilitating the change at a practical level with resources and incentives.

[2] In relation to data protection and preventing harm.

2 Advocacy material

2.1 What is Open Science?

The goal of Open Science is to make scientific research more accessible, transparent, and reproducible. There are several definitions available, two of which are reproduced below:

“Open science is an approach to research based on open cooperative work that emphasizes the sharing of knowledge, results, and tools as early and widely as possible. It is mandatory under Horizon Europe, and it operates on the principle of being ‘as open as possible, as closed as necessary’.” (European Commission, 2023)

“Open science is a set of principles and practices that aim to make scientific research from all fields accessible to everyone for the benefits of scientists and society. Open science is about making sure not only that scientific knowledge is accessible but also that the production of that knowledge itself is inclusive, equitable and sustainable.” (UNESCO, 2023)

Definitions of Open Science vary widely. The two above were selected to reflect major international policy approaches to Open Science. They have several common features: openness, sharing, a focus on societal benefits as well as cooperative, equitable and sustainable production of knowledge. The European Commission’s definition prioritizes more effective knowledge production, while UNESCO’s primary objective is on increasing access to produced knowledge. In both cases, the definition of Open Science implies a broader societal impact and benefits through increased openness, cooperation, and inclusiveness (figure 1).

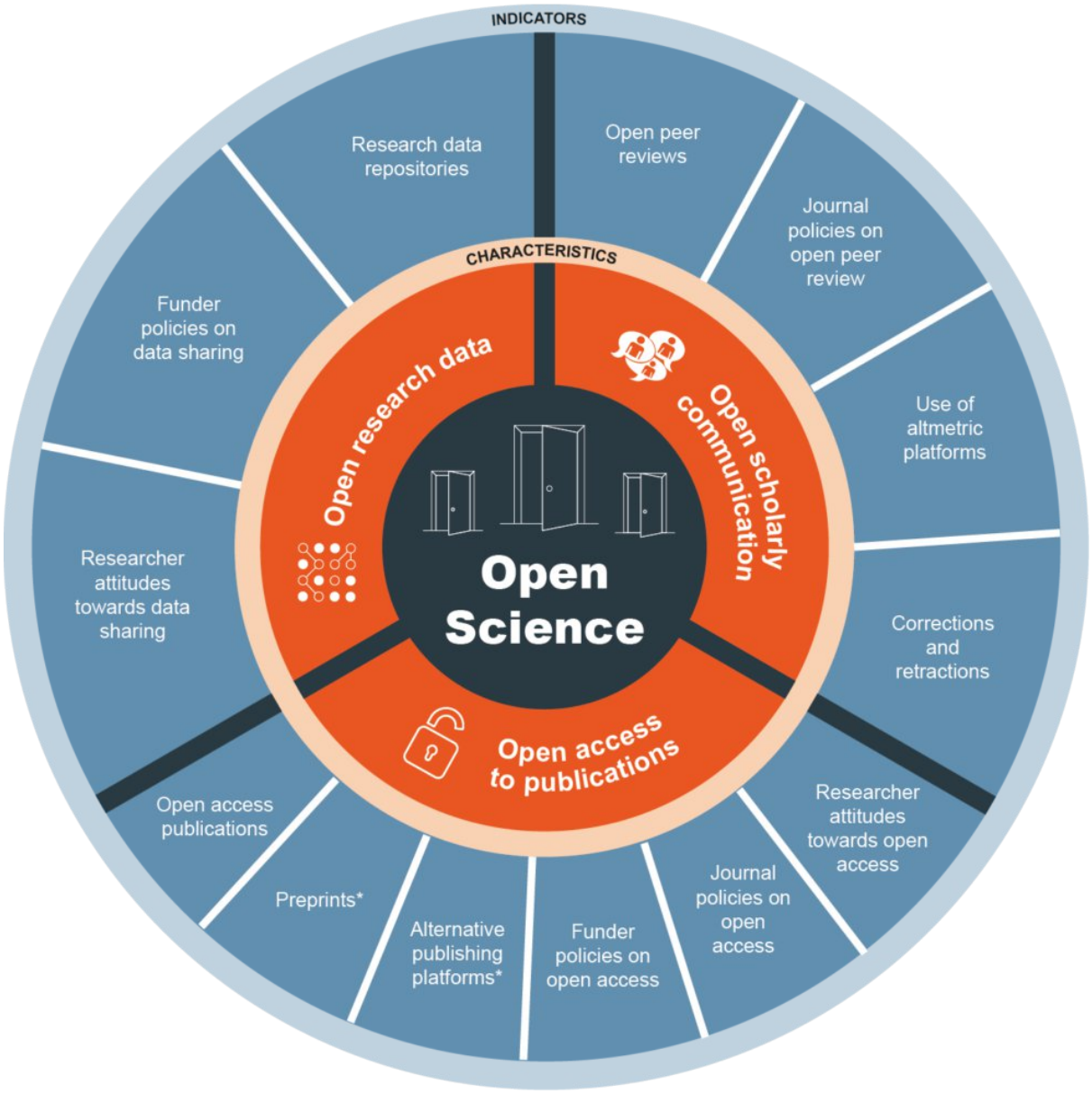

Figure 1: The societal impact of Open Science.[3]

These are just two examples of how Open Science is defined – one could argue that each person, research group and organization has their own definition of Open Science according to their vision, experience, and priorities. The definitions provided above will be used as working definitions for the purposes of this advocacy kit.

[3] Source: Open Universal Science (https://opusproject.eu/openscience-news/the-societal-impact-of-open-science-a-comprehensive-review/)

2.2 What are the benefits and challenges of Open Science Skills?

Open Science skills refer to the abilities and knowledge required to conduct research and share data, methods, and results in an open, transparent, and reproducible manner. In practice, this can include skills and awareness of research data management and version control, the FAIR principles, open-access publishing, publishing research data and code/software, citizen science, as well as open communication with stakeholders. (Lund University, 2022; Manola, Lazzeri, and Barker, 2021) Figure 2 provides an overview of Open Science skills.

The development and uptake of Open Science skills within the scientific community is indispensable to making Open Science more widely implemented (and accepted) as part of the scientific process.

Inevitably, the uptake and propagation of new skills is set to meet some challenges, such as a reluctance to change from researchers and research institutions. While researchers can reasonably be expected to adapt to the new Open Science paradigm, they cannot fully do so without institutional support, both local and (inter)national (see sections 2.5 and 2.6 for more information on how this shift can be supported, especially when it comes to Open Science skills). Identifying and addressing the challenges behind this reluctance is critical – addressing issues such as:

- increased effort required to make data openly accessible,
- increased data management costs,
- increased need of expert support and infrastructures,
- increased recognition of open science efforts through a change in metrics used,
- the need for policy and funding support for Open Science activities,
- etc.

require coordinated efforts by policy-making and funding bodies.

Open Science skills are increasingly put forward as a requirement, and as a competitive edge, for obtaining research funding. For instance, Horizon Europe funding applicants must describe which Open Science practices will be implemented in a research project, and how these will contribute to the projects aims. (European Commission, 2021)

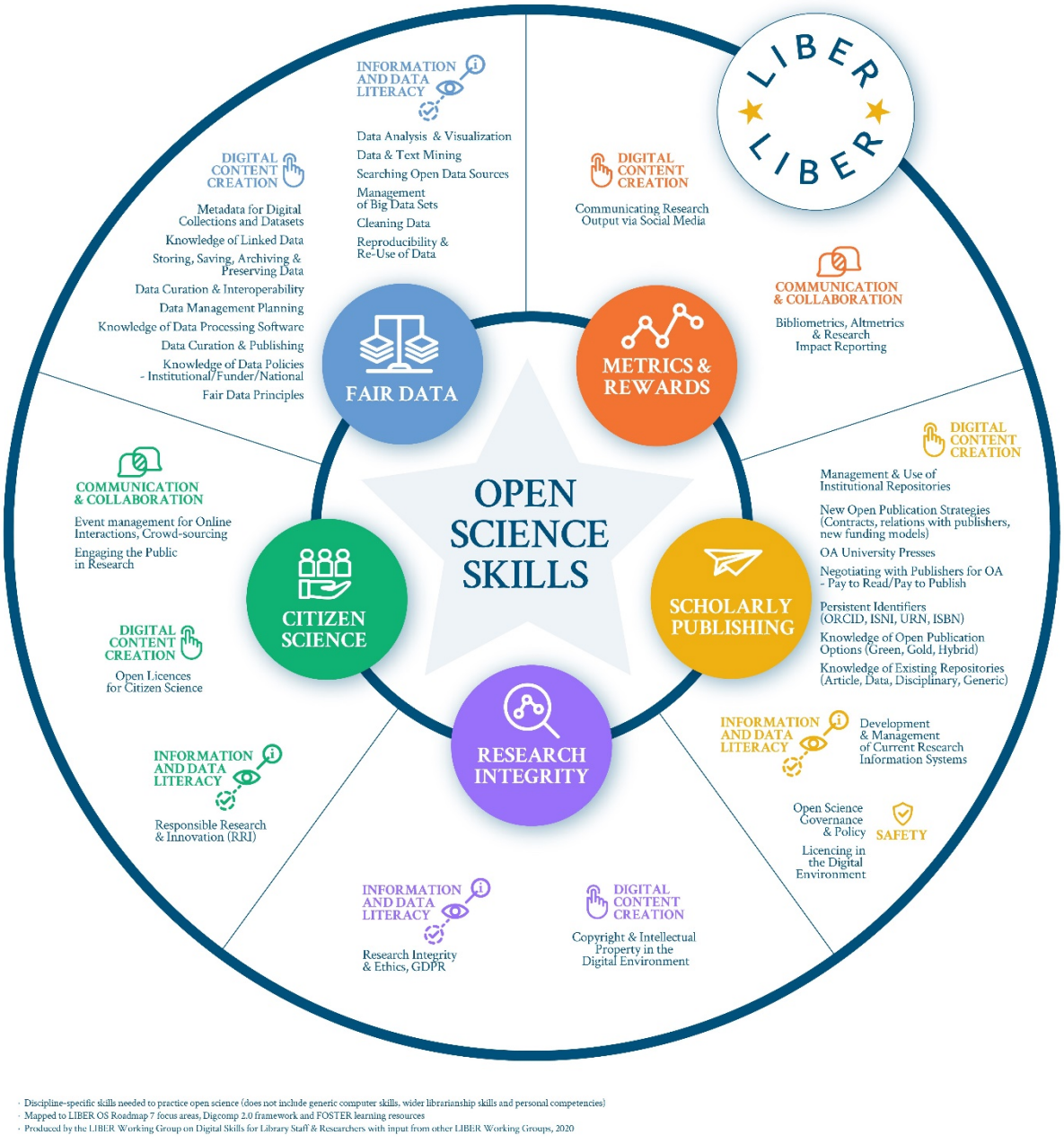

Figure 2: Open Science Skills visualisation. (McCaffrey et al., 2020)

The Organization for Economic Co-operation (OECD) gives the following rationales for supporting Open Science and Open Data (OECD, 2015:18)[4] – these benefits are all dependent on researchers being able to implement Open Science, which requires Open Science skills:

More equitable access to knowledge

By openly sharing research, researchers can help ensuring that knowledge is more widely available and that researchers from under-resourced communities have equal access to the latest findings. (Meyer et al., 2019)

Increased research efficiency

By collaborating and sharing resources, researchers can avoid duplicating efforts and can more easily build on the work of others (Meyer et al., 2019). Costs of creating, transferring, and using research data are decreased, as is data duplication. More research can be carried out on the same data, and opportunities for local and international participation in research are increased (OECD, 2015:18).

Improved transparency and quality

The research validation process is improved by making it easier to reproduce and verify results (OECD, 2015:18). By openly sharing data, methods, and results, researchers can help to increase the transparency and reproducibility of their work, making it easier for others to verify their findings and build upon their research. (Meyer et al., 2019)

Improved public trust in science

By making research more open and transparent, researchers can help to build public trust in the scientific enterprise. (Meyer et al., 2019) Increased openness and transparency of research could also promote the obverse – and increased scepticism of pseudoscience – by helping develop critical thinking among non-scientific audiences.

[4] See figures 3 and 4 for a visual summary.

Faster knowledge transfer

Delays in the re-use of scientific data are reduced. Articles and data are more rapidly and widely accessible. (OECD, 2015:18) By making research more accessible, researchers can create opportunities for others to build upon their work and make new discoveries. (Meyer et al., 2019)

Increased effect of knowledge on the economy

Innovation and knowledge spillovers into the economy are boosted. Consumers can also be made more aware of their choices and select more discerningly. (OECD, 2015:19)

Better coordination when addressing global challenges

Open Science and Open Data can facilitate collaboration and knowledge transfer, as well as help identify solutions. (OECD, 2015:19) An example of this is the Covid-19 pandemic, where many countries and organisations facilitated collaborative work through Open Science initiatives.[5]

Citizen engagement in science and research

Openness in science and data sharing may increase trust in science, as well as greater citizen engagement, including participating in citizen science and experiments. (OECD, 2015:18)[6]

More impactful research

By making the research more open and accessible, researchers can reach larger audiences and have more impact on the community and society. (Meyer et al., 2019)

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[5] See OECD's website for concrete examples of collaborations: https://www.oecd.org/coronavirus/policy-responses/why-open-science-is-critical-to-combatting-covid-19-cd6ab2f9/

[6] More resources about Open Science benefits: https://www.fosteropenscience.eu/content/what-are-benefits-open-science & https://www.oecd.org/sti/inno/open-science.htm

Figure 3: Stakeholders in Open Science. [7]

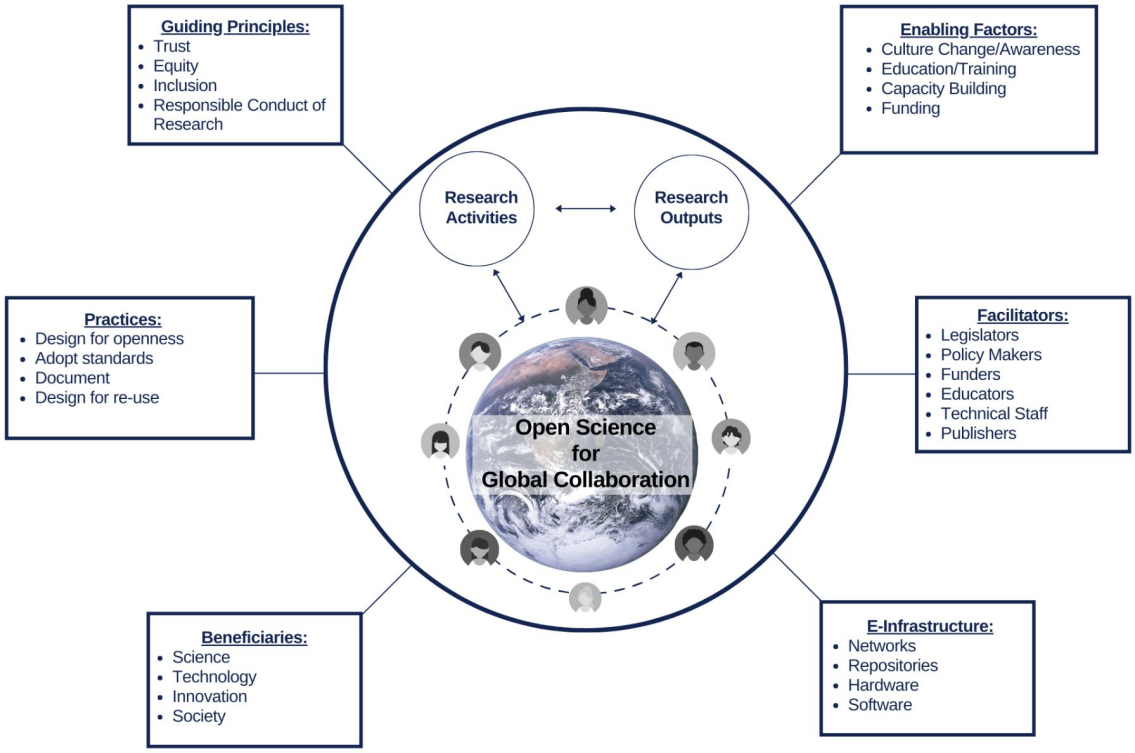

Figure 4: Open Science ecosystem - stakeholders and facets. (Bauzer Medeiros et al., 2020)

2.3 Why are Open Science skills not 'keeping up' with other areas of Open Science implementation?

Although Open Science is increasingly popular and being implemented in research, the supply of adequately trained people able to meet existing

[7] Source: Fosteropenscience.eu (https://www.fosteropenscience.eu/content/what-are-benefits-open-science)

needs for FAIR and Open Science skills is relatively low. Increasing demand will exacerbate these issues (European Commission, 2021).

Some areas of expertise, such as data ethics and intellectual property rights are in short supply even among FAIR and open science experts. “The research community is not equipped to explore FAIR and open science opportunities presented in an interdisciplinary environment.” (European Commission 2021: 27)

Although the European Commission’s vision is to strengthen the European Research Area by promoting deepened integration among national policies, ensuring FAIR and Open Science trained personnel with the help of policy and programmes remains a challenge. (European Commission, 2021) The following reasons are given by the European Commission report: *Digital skills for FAIR and Open Science: report from the EOSC Executive Board Skills and Training Working Group* (European Commission, 2021):

- Digital skills governance is fragmented, with differing priorities for Open Science digital skills – although initiatives are many, these are not coordinated, and can also have different target groups.
- There are also few if any national policies on competence building. One reason could be that responsibility for digital skills, research and education is often distributed between different authorities within a given country. National strategies are necessary for providing a common set of objectives, at least nationally.
- Most countries lack a stand-alone strategy for digital skills – in most cases this is part of a broader digitalization strategy and focus on skills varies. This also increases the problem of siloisation, where different skillsets are prioritized by different stakeholders.
- Stakeholders in Open Science skills vary from country to country, but national coalitions for digital skills and jobs act as a coordinating force with the potential to drive initiatives and coordinate work towards national

strategies.[8] Yet even here, coalitions are led by different stakeholder groups.

On a positive note, a significant amount of relevant training targeting different groups has been identified. An appropriate European framework, the European Commission's Digital Competence Framework for Citizens - DigiComp 2.0 (Vuorikari et al., 2016) - is also endorsed in most countries for use with certification of digital skills (European Commission, 2021).

- A major gap in combined action for digital skills for Open Science (and FAIR) exists, with an uneven and incomplete application of digital skills, a lack of reward systems and career paths for new roles within research, such as data scientists, as well as an uneven focus on FAIR by itself rather than on Open Science and FAIR.
- Finally, Open Science strategies are mainly focused on research and infrastructures, with little focus on related digital skills at multiple levels.

(Adapted from Barker et al., 2021.)

2.4 What are Open Science Competence Centres and what are their benefits?

There are multiple definitions of Competence Centres in literature (such as Herterich et al., 2019). This advocacy kit makes use of Skills4EOSC's definition for Competences Centres, also called Competence Centre Nodes within the context of a broader Competence Centre Network:

"**CC Nodes** are dedicated to knowledge organization and transfer in the Open Science, FAIR research output management and EOSC context. They are usually associated with excellence, advice, training and knowledge transfer,

[8] https://digital-strategy.ec.europa.eu/en/policies/national-coalitions "National and regional coalitions bring together a range of partners who develop concrete measures to bring digital skills to all levels of society. Partners include ICT and ICT-intensive companies, education and training providers, education and employment ministries, public and private employment services, associations, non-profit organisations and social organisations." These national coalitions are present in every EU country except for Finland, Germany,

interdisciplinarity, standardization, and a collaborative approach of different institutions or departments. The structure, operational mode and organization of Skills4EOSC Competence Centres may vary very widely, depending on the Country, Region or Domain they operate in. They constitute the nodes of the broader Skills4EOSC Coordination Network that ensures harmonisation and alignment at European level." (4CH Project, n.d.)

Open Science Competence Centres can help foster collaboration by acting as community and networking hubs. They can help address the fragmented landscape of Open Science learning and training resources.

As knowledge hubs, Open Science Competence Centres can also contribute to a clearer definition of digital professional profiles and career paths for relevant roles such as "data scientists, data stewards, data curators, research engineers", etc. (European Commission, 2021: 16)

Open Science Competence Centres not only provide training but can also provide direct Open Science support to researchers in making research more FAIR and openly accessible. This expertise can in turn promote transparency and reproducibility in science.

Some high-level organizational and strategic characteristics of an Open Science skills Competence Centre can be (see also figure 5 for an alternative overview):

- Being able to influence the broader Open Science ecosystem thanks to having a critical mass of significant actors.
- Being relatively autonomous, e.g. by being a legal and independent entity.
- Acting as a unifying voice for raising issues and attracting interest to Open Science and Open Science skills by providing a wide set of services and fulfilling a variety of functions.
- Acting as an inclusive platform and collaborative space. These actors can also be represented as partners in the CC's strategic decision-making.
- Involved in sustaining and supporting grassroots networks, such as Open Science Communities, Data Steward Networks, etc.
- Contributing to defining a relevant Open Science skills agenda for its area, thus building consensus.

- Influencing the Open Science ecosystem to develop an environment conducive to Open Science skills development and dissemination.
- Implementing large-scale research programmes to encourage change and collaboration.
- Acting as a hub for innovation activities, while also serving to implement strategies produced within a collaborative environment.

(adapted from Henckens et al., 2019, Meyer et al., 2019, European Commission, 2021, and internal Skills4EOSC project material)

Figure 4. FAIRsFAIR summary of competence centres features (based on the characterisation of 36 competence centres, (adapted from Herterich et al., 2019, p. 9)

Figure 5: Summary of competence centres features.[9]

Competence Centres can also support the implementation of a national Open Science digital skills strategy by developing and promoting guidelines and recommendations to support the implementation and use of Open Science digital skills and resources. (Henckens et al., 2019)

[9] Source: FAIRsFAIR (https://www.slideshare.net/slideshow/digital-skills-for-fair-and-open-science/246160111)

As knowledge spaces, Competence Centres can focus on collaboration between stakeholders to improve local conditions for innovation, articulating needs and requirements within Open Science skills, providing some level of forecasting of future needs, scanning, processing, and filtering relevant information into usable knowledge, combining knowledge from several partners or sources, generating new knowledge, providing advising and brokering services. (Meyer et al., 2019)

Competence Centres provide a space for consensus-making, a collaborative environment for academic, public, and private stakeholders to create ideas and strategies, testing and validating them, providing a platform for accreditation, validation, regulation, and evaluation. (Meyer et al., 2019)

At a more concrete level, a CC could provide several services and functions. The following list is summarized from a review of existing European Competence Centres (European Commission, 2021: 29, adapted from Herterich et al., 2019; Newbold et al., 2020):

- Open Science training and training material,
- Data management services or research software engineering,
- Guidance material and support/advisory services,
- Building and maintaining communities (e.g. training communities, juridical experts, IT implementation, etc.),
- Building, maintaining, and contributing to resource, service, or policy catalogues (e.g. a research data catalogue or a data repository catalogue),
- Involved in creating or disseminating standards (e.g., metadata standards in a data catalogue).

Note that not all Competence Centres can be expected to implement services or functions but may specialize in a subset.

Specific benefits of Competence Centres versus a less unified landscape can include:

- Reduced expenses related to Open Science skills resource development, training, expertise, as well as marketing/communication,

- Faster reaction to external Open Science skills needs due to quicker access to intelligence of external developments and ability to use common (supported) platforms,
- Higher potential to influence Open Science skills trajectory,
- Easier and faster access to latest technologies and developments,
- Broader training availability,
- Minimized risk of knowledge loss at an organizational level.

(adapted from Sztangret (2016))

2.5 How can Open Science Competence Centres address the lack of Open Science skills?

In general, Competence Centres are a way of systematically acquiring, organising, and communicating knowledge (implicit and explicit) in an organisational manner. (Sztangret 2016)

In concrete terms, Competence Centres can be an infrastructure which collects procedures, technical and management tools to create, share and expand knowledge within a defined area. (Sztangret 2016)

Competence Centres can act as a knowledge repository and a resource hub in a typically fragmented landscape. (Sztangret 2016)

“Competence Centres are a useful way to enable provision of the training needed to support the EOSC vision” (European Commission, 2021: 27)

Competence Centres can address competence gaps in Open Science by providing training, guidance, and advisory services and resources. Apart from empowering trainers, Competence Centres can also serve as collaboration hubs for stakeholders. (European Commission, 2021)

2.6 How can policy makers and funders support Competence Centres and encourage collaboration?[10]

By supporting the implementation and alignment of Competence Centres, funders and policy makers can facilitate the development of 'clusters' of Open Science and FAIR skills (European Commission, 2021:28). This makes it possible for all stakeholders to access the benefits of Competence Centres as mentioned in the previous section.

Funders

In 2021, in a report on digital skills for FAIR and Open Science, the EOSC Executive Board Skills and Training Working Group gave recommendations on "next steps for overcoming barriers and leverage opportunities to maximise vital skills and training development". Advocating to national and international European funders for Open Science skills and FAIR training is among the recommendations listed in this report. (European Commission, 2021)

It is important to note that flexibility is required when looking to fund Open Science Competence Centres, since they may have differences in their organizational structures or the challenges they face. One-size-fits-all solutions may not be optimal. (European Commission, 2021)

Funders can include general Open Science measures in their grant selection process, as well as making it a requirement for grantees (Center for Open Science, 2023). Examples of Open Science practices which can be encouraged by funders are listed below.

Data Management Plans:

- Require submissions to include a DMP.
- Make DMPs part of the application evaluation process.

[10] European Commission, Directorate-General for Research and Innovation, Manola, N., Lazzeri, E., Barker, M. (2021). *Digital skills for FAIR and Open Science : report from the EOSC Executive Board Skills and Training Working Group*, (N.Manola, editor, E.Lazzeri, editor, M.Barker, editor, I.Kuchma, editor, V.Gaillard, editor, L.Stoy, editor) Publications Office. https://data.europa.eu/doi/10.2777/59065

- Publish DMPs alongside lists of funded projects.
- Even better, specifically require DMPs to also include a plan for publishing data produced within the project.

Data sharing and re-use

- Recommend and provide guidance on citing datasets, code and other materials.
- Provide guidance on sharing data that cannot be made openly available.

Budget and reporting

- Allow applicants to budget for data management, curation and archiving – allow funds specifically for these activities.
- Specify recommended reporting guidelines for grant reports and publications. Even better, require the use of checklists when producing grant reports and publications.[11]

Reproducibility

- Encourage computational reproducibility of methods and results by recommending/ requiring grantees to publish analytical code to allow for independent verification of reported results.[12]

(List adapted from the TOP funders implementation guide[13])

The Center for Open Science also has recommendations for preregistrations, registered reports, replication studies and collaboration/team science that can be implemented by funders.[14]

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[11] The Center for Open Science recommends the following transparency list: https://www.nature.com/articles/s41562-019-0772-6

[12] See journals listed as implementing analysis code transparency for examples: https://topfactor.org/journals?factor=Analysis+Code+Transparency

[13] https://www.cos.io/initiatives/top-funders

[14] See https://www.cos.io/initiatives/top-funders

Policy makers

Policies supporting Open Science can be an effective tool to encourage the development and uptake of Open Science skills and Competence Centres. Open Science policies can be at any level, from communities to universities, to national policies and guidelines on Open Science (UNESCO, 2023).

Although Open Science policies supporting Open Scholarship practices (and strategies informing them) are increasingly widespread, separate strategies for supporting the development and uptake of Open Science skills may be useful to also support Open Science Infrastructures and actions related to Open Science skills, such as Competence Centres. Open Science skills and Competence Centres can also be supported via policies covering training and digital skills, lifelong learning, as well as through strategic plans for digital skills, cybersecurity, and AI. (UNESCO, 2023; Barker et al., 2021)

Policies focusing on development and uptake of Open Science skills can be tools for incentivising and managing Open Science practices and conduct, as well as securing financing for Open Science. Such policies can also guide and support cultural and organisational changes needed to implement, support and expand Open Science practices and skills, as well as to build capacity for growth. (UNESCO, 2023)

They are also a way to provide stability for Open Science infrastructures such as Competence Centres, since they not only can secure and clarify long-term funding plans, but also concretely facilitate the development of necessary infrastructure, adoption of Open Science practices, and an increase in access to training and support in Open Science. (UNESCO, 2023).

It is important to be clear about the purposes and goals of such policies when designing them. It is also necessary to adopt an iterative approach, where the policy can be reviewed and updated if its goals are not met. Keep in mind that a one-size-fits-all policy may not be the most suitable for improving Open Science skills. (Barker et al., 2021; UNESCO, 2023).

To this end, it is also important to develop mechanisms for evaluating relevant policies' effectiveness. Maturity models can be a tool for this.

Providing clear feedback channels for stakeholders is also important. (Barker et al., 2021)

Policy makers can enhance Open Science at policy-level by supporting Open Science skills training, while keeping in mind existing and upcoming Open Science skills training and curricula. These can be coordinated and aligned, where possible. Using existing Open Science skills frameworks is a way to keep policies aligned (Barker et al., 2021). Policy makers can integrate Open Science in the academic reward/ranking system by making Open Science part of the selection process for academic positions and evaluation (Center for Open Science, 2023).

Some other suggestions for supporting and promoting Open Science skills:

- Be aware of national Open Science policies and legislation – they may be present in some form at a regional or national level. Responsibility for open science skills and support may be scattered among different authorities. Barker et al., 2021)
- Involve different stakeholders in the development, implementation, and evaluation of policies – stakeholders may have different expectations and priorities for Open Science and FAIR, as well as different ways to engage with the Open Science skills ecosystem. (Barker et al., 2021)
- Complement Open Science skills support with Open Science support – support functions and infrastructures can be found in Competence Centres developing and promoting Open Science skills, or they may be separate entities. An example of such infrastructures would be data repositories. (Barker et al., 2021; UNESCO, 2023)
- Support and promote skills and career frameworks which work towards making open science skills and career a norm in the scholarly landscape (Barker et al., 2021; Center for Open Science, 2023)

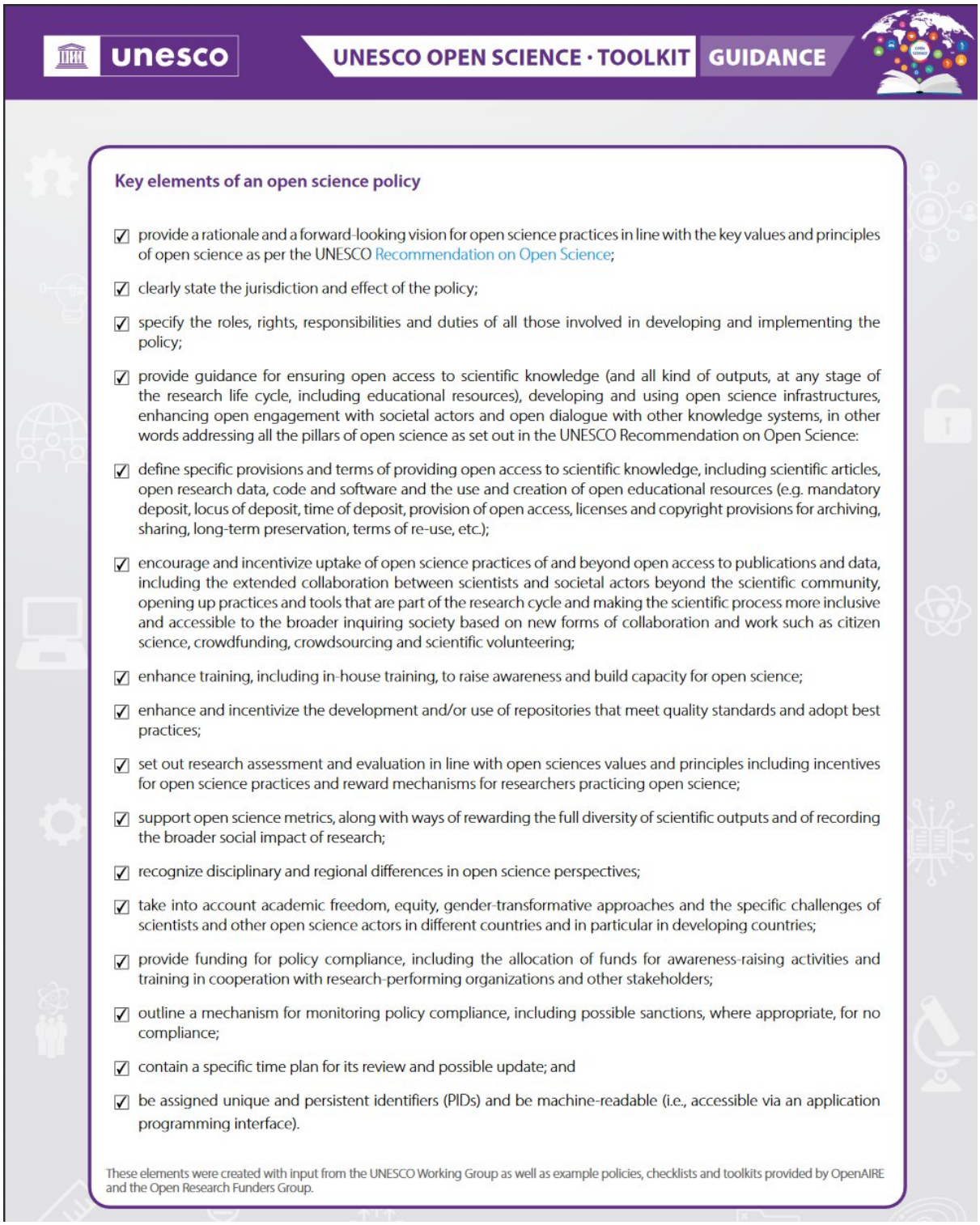

Figure 6: Key elements of an open science policy (UNESCO, 2022:7).

Transparency and Openness Promotion Guidelines

Funders and policy makers within academic publishing can make use of the Transparency and Openness Promotion Guidelines (TOP)[15]. The guidelines comprise eight transparency standards, each with three stringency levels. (Nosek et al., 2015)

Summary of the eight standards and three levels of the TOP guidelines

Levels 1 to 3 are increasingly stringent for each standard. Level 0 offers a comparison that does not meet the standard.

	LEVEL 0	LEVEL 1	LEVEL 2	LEVEL 3
Citation standards	Journal encourages citation of data, code, and materials—or says nothing.	Journal describes citation of data in guidelines to authors with clear rules and examples.	Article provides appropriate citation for data and materials used, consistent with journal's author guidelines.	Article is not published until appropriate citation for data and materials is provided that follows journal's author guidelines.
Data transparency	Journal encourages data sharing—or says nothing.	Article states whether data are available and, if so, where to access them.	Data must be posted to a trusted repository. Exceptions must be identified at article submission.	Data must be posted to a trusted repository, and reported analyses will be reproduced independently before publication.
Analytic methods (code) transparency	Journal encourages code sharing—or says nothing.	Article states whether code is available and, if so, where to access them.	Code must be posted to a trusted repository. Exceptions must be identified at article submission.	Code must be posted to a trusted repository, and reported analyses will be reproduced independently before publication.
Research materials transparency	Journal encourages materials sharing—or says nothing	Article states whether materials are available and, if so, where to access them.	Materials must be posted to a trusted repository. Exceptions must be identified at article submission.	Materials must be posted to a trusted repository, and reported analyses will be reproduced independently before publication.
Design and analysis transparency	Journal encourages design and analysis transparency or says nothing.	Journal articulates design transparency standards.	Journal requires adherence to design transparency standards for review and publication.	Journal requires and enforces adherence to design transparency standards for review and publication.
Preregistration of studies	Journal says nothing.	Journal encourages preregistration of studies and provides link in article to preregistration if it exists.	Journal encourages preregistration of studies and provides link in article and certification of meeting preregistration badge requirements.	Journal requires preregistration of studies and provides link and badge in article to meeting requirements.
Preregistration of analysis plans	Journal says nothing.	Journal encourages preanalysis plans and provides link in article to registered analysis plan if it exists.	Journal encourages preanalysis plans and provides link in article and certification of meeting registered analysis plan badge requirements.	Journal requires preregistration of studies with analysis plans and provides link and badge in article to meeting requirements.
Replication	Journal discourages submission of replication studies—or says nothing.	Journal encourages submission of replication studies.	Journal encourages submission of replication studies and conducts blind review of results.	Journal uses Registered Reports as a submission option for replication studies with peer review before observing the study outcomes.

Figure 7: Standards and implementation levels of the TOP guidelines (Nosek et al., 2015).

[15] https://osf.io/9f6gx/wiki/Guidelines/

These standards have over 5000 signatory journals from several international publishers[16]. For more information on compliant journals, visit TOP Factor[17]. These guidelines can be used as a tool for encouraging Open Science practices within the scientific process.

Funders can also encourage the use of journals that adhere to these guidelines.

More resources on implementing the TOP guidelines are available on their website.[18]

[16] https://www.cos.io/initiatives/top-guidelines

[17] https://www.topfactor.org/

[18] . The full TOP Guidelines: https://osf.io/9f6gx/wiki/Guidelines/, Resources for implementing TOP Wiki page on Open Science Foundation: https://osf.io/kgnva/wiki/home/, Sample implementation for funders: https://osf.io/dbtzw

References

4CH Project. (n.d.). *What is a competence centre?* Retrieved October 25, 2023, from https://www.4ch-project.eu/what-is-a-competence-centre/

Barker, M., Manola, N., Gaillard, V., Kuchma, I., Lazzeri, E., Stoy, L., & Piera, J. (2021). *Digital skills for FAIR and open science: Report from the EOSC Executive Board Skills and Training Working Group*. European Commission. DOI: 10.2777/59065

Baron, N. (2010). Escape from the ivory tower: a guide to making your science matter. Island Press.

Bauzer Medeiros, C., Darboux, B. R., Sánchez, J. A., Tenkanen, H., Meneghetti, M. L., Shinwari, Z. K., Montoya, J. C., Smith, I., McCray, A. T., & Vermeir, K. (2020). *IAP input into the UNESCO Open Science Recommendation*. InterAcademy Partnership (IAP). https://www.interacademies.org/sites/default/files/2020-07/Open_Science_0.pdf

Center for Open Science (n.d.). *Open Science.* Retrieved December 15, 2023, from www.cos.io/open-science.

Cockrell, M., Dubickas, K., Hepner, M., Ilich, A., & McCarthy, M. (2018). *Embracing advocacy in science.* Fisheries, 43(4), 179-182. DOI: 10.1002/fsh.10055

Commonwealth Foundation (2017). *Advocacy Tool Kit*. Retrieved March 02, 2023, from https://commonwealthfoundation.com/wp-content/uploads/dlm_uploads/2018/10/APSP-advocacy-toolkit-2018.pdf

Czuray, M., Saurugger, B. (2023). *Stakeholder Engagement Strategy*. Internal Skills4EOSC report: Unpublished.

AllTrialsUSA (2017). *Advocating for transparency policies - a toolkit for students, researchers, staff, and librarians*. Retrieved March 02 2023, from https://github.com/AllTrialsUSA/FSCI2017/blob/master/Transparency-advocacy-toolkit.md

EOSC-hub (2020). *EOSC-hub Competence Centres*. Retrieved November 18, 2023, from https://confluence.egi.eu/download/attachments/18973612/EOSC_HUB_CCs_Flyer_WEB_May2020%20v2.pdf?version=1&modificationDate=1589870748795&api=v2

EOSC-Hub (2021). *EOSC-hub D8.1 Report on progress, achievements and plans of the Competence Centres*. Retrieved 1 December, 2023, from https://documents.egi.eu/public/ShowDocument?docid=3485

European Commission, European Research Executive Agency (2023). *Open Science in Horizon Europe.* Retrieved December 4, 2023, from https://rea.ec.europa.eu/open-science_en

European Commission, Directorate-General for Research and Innovation (2021). *Horizon Europe, open science: early knowledge and data sharing, and open collaboration*, Publications Office of the European Union. DOI: https://data.europa.eu/doi/10.2777/18252

Henckens, M. L. C. M., Biermann, F. H. B., & Driessen, P. P. J. (2019*). Mineral resources governance: A call for the establishment of an International Competence Center on Mineral Resources Management*. Resources, Conservation and Recycling, 141, 255-263.

Herterich, Patricia, Davidson, Joy, Whyte, Angus, Molloy, Laura, Matthews, Brian, & Kayumbi Kabeya, Gabin. (2019). *D6.1 Overview of needs for competence centres (1.0 DRAFT)*. FAIRsFAIR. DOI: 10.5281/zenodo.3549791

Lund University (2022). *Open science skills for competing for funding from Horizon Europe*. Retrieved March 02, 2023, from https://openscience.blogg.lu.se/open-science-skills-for-competing-for-funding-from-horizon-europe/,

McCaffrey, C., Meyer, T., Riera Quintero, C., Swiatek, C., Marcerou-Ramel, N., Gillén, C., Clavel, K., Wojciechowska, A., Brinken, H., Prevoo, M., & Egerton, F. (2020). Open Science Skills Visualisation - Visualisation des compétences en science ouverte (Version 2). Zenodo. https://doi.org/10.5281/zenodo.4727592

Meyer, M., Kuusisto, J., Grant, K., De Silva, M., Flowers, S., & Choksy, U. (2019). *Towards new Triple Helix organisations? A comparative study of competence centres as knowledge, consensus and innovation spaces*. R&D Management, 49(4), 555-573. DOI: 10.1111/radm.12342.

Nosek, B. A., Alter, G., Banks, G. C., Borsboom, D., Bowman, S. D., Breckler, S. J., ... & Yarkoni, T. (2015). *Promoting an open research culture. Science, 348(6242), 1422-1425*. DOI: 10.1126/science.aab2374

OECD (2015). *Making Open Science a Reality*. OECD Science, Technology and Industry Policy Papers, 25. Paris: OECD Publishing. DOI:10.1787/5jrs2f963zs1-en

Skills4EOSC (2022). *Skills4EOSC project proposal part B, 2021*. Internal Document: Unpublished

Sztangret, I., & Katowice, et al. (2016). *The Competence Centres in IT business ecosystem. Case study*. Journal of Economics and Management, (24), 99-110. DOI: 10.22367/jem.2016.24.08

UNESCO. (2022). Developing policies for open science. UNESCO. DOI: 10.54677/vhny8608

UNESCO. (2023). *UNESCO Recommendation on Open Science.* UNESCO Open Science. Retrieved 30 November, 2023, from https://www.unesco.org/en/open-science/about

University College London (2015). *Advocating Open Access*. Retrieved March 02, 2023, from https://cpb-eu-w2.wpmucdn.com/blogs.ucl.ac.uk/dist/6/282/files/2015/06/Advocacy-toolkit.pdf

Vuorikari, R., Punie, Y., Gomez, S. C., & Van Den Brande, G. (2016). *DigComp 2.0: The digital competence framework for citizens. Update phase 1: The conceptual reference model* (No. JRC101254). Joint Research Centre (Seville site).

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., et al. (2016). *The FAIR Guiding Principles for scientific data management and stewardship*. Scientific Data. 3 (1): 160018. DOI: 10.1038/SDATA.2016.18.