



The ROSiE General Guidelines on Responsible Open Science

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Legend: AI - Artificial Intelligence; CARE- Collective benefit, Authority to control, Responsibility, Ethics; CC- Creative Commons; CoARA- Coalition for Advancing Research Assessment; DORA- The Declaration on Research Assessment; ECoC- European Code of Conduct for Research Integrity; FAIR- Findable, Accessible, Interoperable, Reusable; LMIC- Low- and middle-income countries; OA- Open Access; OS- Open Science; RFO- Research Funding Organisation; RPO- Research Performing Organisation; UNESCO- United Nations Educational, Scientific and Cultural Organization

1. Introduction

- 1.1. The ROSiE guidelines are the Open Science (OS) complement to the ECoC. It is an aspirational document that aims to provide guidance on how to conduct Open Science (OS) responsibly in everyday research practice, following established ethical and integrity principles and values. The articles of these guidelines primarily apply to research but may also be suitable to processes leading to innovation.
- 1.2. In addition to the fundamental principles of reliability, honesty, respect and accountability of the ECoC, other principles should be considered in the context of responsible OS, including sharing and solidarity (especially of data, knowledge, and infrastructures), collaboration (including citizen science practices and stakeholder engagement), and equity (especially regarding access to OS infrastructures and funding).
- 1.3. The ROSiE Guidelines also affirms the principles stipulated in the UNESCO Recommendation on Open Science; the San Francisco Declaration on Research Assessment (DORA); the Coalition for Advancing Research Assessment's (CoARA) Agreement on Reforming Research Assessment; the principles of Findability, Accessibility, Interoperability, and Reusability (FAIR); and the principles of Collective Benefit, Authority to Control, Responsibility, and Ethics (CARE) for Indigenous Data Governance.
- 1.4. The values of transparency, openness, accountability, and traceability, along with their associated norms (such as open access, open data, open methods, open materials, among others), increase scientific credibility by allowing research to be more reproducible, which can increase integrity and trust in science.



- 1.5. While OS is an essential component of responsible research practice, it should be balanced with other values, and additional safeguards should be created to prevent misuse and abuse.
- 1.6. National and European policies conducive to responsible OS are instrumental in signalling to researchers and research performing organizations (RPOs) the political commitments to support and promote OS.

2. Research Environment and Infrastructures

- 2.1. Policy reforms and OS advocacy are crucial for creating a culture that promotes, supports, and rewards OS. A policy environment conducive to responsible OS requires aligned action on the European, national, and institutional levels.
- 2.2. To promote good OS practices, RPOs should facilitate effective communication and establish clear collaboration guidelines that account for diverse research practices and promote coherence among different conceptions of openness. It is also important to consider scientific discipline-related challenges when implementing OS practices.
- 2.3. Cooperation and exchange of information between policymakers, the research community, and the public are particularly important. Systematic, evidence-based analysis and operational synthesis are needed for better informed and aligned OS policies on national and international levels.
- 2.4. Policymakers, Research Funding Organizations (RFOs), and RPOs should involve all relevant stakeholders (including researchers, library and other research-support staff, citizen scientists, and the public) in formulating OS guidelines and developing support materials and infrastructures.
- 2.5. RFOs should be aware and sensitive to the fact that OS practices and regulations in different countries are diverse. The baseline for openness requirements should be clear and attainable to all European countries.
- 2.6. Policymakers and RFOs should provide incentives to RPOs for the promotion and practice of OS.
- 2.7. OS facilitates collaborative research as it enhances transparency and facilitates access to and sharing of knowledge and data. However, to increase its impacts, the OS policies, the requirements and possibilities of openness should be made clear to researchers and RPOs.
- 2.8. RPOs should provide clear guidance and training to researchers on how to behave in a responsible manner, including good communication and clear premises to promote good OS practices,



- given diverse research practices, epistemologies, and other related areas of responsible research.
- 2.9. RPOs should provide researchers with the necessary resources and infrastructure to support, promote, and incentivize responsible OS practices. These resources and infrastructure should be accessible and affordable to all researchers, regardless of their location or institutional affiliation.
 - 2.10. When designing OS infrastructure, transparency versus confidentiality, legal and ethical questions linked to auditability, accountability and responsibility, degree of decentralization and distribution, among others, should be considered.
 - 2.11. RPOs should provide and invest in good data management schemes that allow for secure storage and use of research data and metadata. Before creating new OS infrastructures, it is necessary for RPOs to consider improving existing infrastructure, such as high-performance computing, cloud computing, and data storage.
 - 2.12. Policymakers and RPOs should provide adequate research support structures and services, such as services for data stewardship, that would help researchers translate OS-supportive principles, such as the FAIR and, when applicable, CARE principles, into practice.
 - 2.13. When considering technologies in OS infrastructures, such as artificial intelligence (AI) and blockchain, it is important to continuously explore their usefulness, limitations, and risks to ensure they safeguard ethics and integrity appropriately.
 - 2.14. Stakeholders from business and industry are highly encouraged to implement OS principles and practices in their organisations.

3. Protection of Research Participants, the Environment, Ecosystems, and Cultural Heritage

- 3.1. Research participants' autonomy, dignity, and other rights should always be respected. In an OS environment, alternative modes of engagement and consent might have to be considered and ethically reflected on by researchers and research ethics committees.
- 3.2. Informed consent forms and procedures should include at a minimum, information on OS practices, privacy protection, limitations, and risks of reidentification. Researchers should ensure that informed consent processes ensure understanding among the research participants.
- 3.3. Protecting the privacy and control interests of research participants and their communities is essential in an open data environment. Researchers, research ethics committees, RPOs, and policymakers should analyse the risks of reidentification and dual use in different



fields and develop governance mechanisms and technical solutions to address these risks. Exploring other approaches to protect privacy, other than anonymization, is increasingly becoming important and is thus recommended.

- 3.4. It should be recognized that respect for ecosystems and cultural heritage may limit openness in research. The principle of openness according to the nuances of different research fields and methods should be explored. Special consideration should be placed on cultural data and the necessity of restrictive access in some instances.

4. Open and Reproducible Research Practices

4.1. *Open research practices*

- 4.1.1. As much as reasonably possible, researchers and RPOs should ensure open access to the entire research lifecycle, which includes, as the ECoC states, publications, data, metadata, protocols, code, software, images, artefacts, and other research materials and methods.
- 4.1.2. Contracts with RFOs and other entities should include equitable agreements about access to and dissemination of research results.
- 4.1.3. RPOs and repositories should ensure appropriate infrastructures to allow the proper conservation and management of all research results generated in the research lifecycle, including those unpublished, ensuring their protection and adequate access to them for a reasonable time.
- 4.1.4. Researchers and RPOs should ensure that the research lifecycle, including interim evaluation results, are documented in a detailed, accurate, and clear manner in accordance with the guidelines specific to the subject of study. All information and resources produced throughout the research lifecycle, including those that have not yet been published, should be responsibly managed and conserved by the research institutions and the researchers.
- 4.1.5. Researchers should ensure that sources are verifiable and that open data practices are responsible, to allow the research to be examined and, when relevant, reproduced. The methods used and the respective steps of the entire research lifecycle should be clear.
- 4.1.6. Researchers should always provide references when reusing research data, materials, software, and tools.

4.2. *Open data*

- 4.2.1. Whenever possible and reasonable, research data should be open and accessible to promote integrity, accountability, advance public



awareness, ensure public trust, encourage data reuse, advance collaborative research, and guide practice and policy.

- 4.2.2. Responsible research data management should ensure that data are FAIR and foster CARE, whenever possible.
- 4.2.3. In an OS environment where multi-country and multi-regional research is common, open data regulations should be aligned and jurisdictions clear.
- 4.2.4. Policymakers should guide practice and policy by promoting the use of open and accessible research data in decision-making processes and collaborations across different disciplines and sectors.
- 4.2.5. RFOs should:
 - 4.2.5.1. incentivise data sharing through, for example, the inclusion of open data requirement in data management plans.
 - 4.2.5.2. revise or provide new measures for data quality assurance.
- 4.2.6. RPOs should:
 - 4.2.6.1. institutionalise and incentivise data sharing and compliance with FAIR and CARE principles;
 - 4.2.6.2. implement permanent data management infrastructures, with competent data managers, to make open or FAIR data sharing and reuse easily accessible to researchers;
 - 4.2.6.3. equip researchers, librarians, research support officers, data stewards, and/or data protection officers with knowledge on FAIR and, if applicable, CARE principles from the onset of their careers;
 - 4.2.6.4. provide infrastructure that supports the different stages of the research lifecycle allowing for both open and restricted sharing and archiving of research data, and that is able to support large-scale data;
 - 4.2.6.5. provide incentives and infrastructure, such as data repositories equipped with translation tools, to allow for data to be accessible in English as well as native languages;
 - 4.2.6.6. monitor the implementation of open data practices.
- 4.2.7. Researchers should:
 - 4.2.7.1. collect, analyse, and present research data with the prospect of making it open and reusable;
 - 4.2.7.2. ensure that research data is properly documented, formatted, and stored to facilitate findability and reusability;
 - 4.2.7.3. ensure that datasets are uploaded in repositories that assign a DOI or other persistent identifiers;
 - 4.2.7.4. respect privacy and confidentiality by de-identifying research data where necessary and complying with ethical guidelines and legal requirements;



- 4.2.7.5. encourage data reuse by providing appropriate metadata, licenses, and citations that enable other researchers to find, access, and use the data for other studies;
- 4.2.7.6. guarantee that the data will be made 'as open as possible but will be allowed to stay as closed as necessary,' safeguarding legitimate interests or constraints;
- 4.2.7.7. provide a good account of why research or data are not open or give a convincing explanation why certain portions of the research or data cannot be open;
- 4.2.7.8. provide transparent and repeatable data acquisition protocols, that should be in full compliance with FAIR and CARE principles;
- 4.2.7.9. ensure that metadata and data are well described so that they can be replicated and/or combined in different settings;
- 4.2.7.10. in publications, ensure that it is clearly described how/where data, software codes, and research materials can be accessed and/or obtained in publications.

4.3. *Open Methods and Tools*

- 4.3.1. Researchers should be open and honest about the methodological techniques or study design used in their research. This includes documenting these methods in study protocols, logs, laboratory journals, readme files, or reports. The research lifecycle steps should be verified, and the line of reasoning should be clear. This means the description of research should be detailed enough for the data collection and analysis to be replicated.
- 4.3.2. Whenever possible, researchers should contribute to and make use of open-source tools, open codes, open hardware, and open software in their research. This allows other researchers to replicate the research, build on the findings, and potentially identify errors or limitations in the methodology.
- 4.3.3. When developing new methods or tools researchers should make them openly available to the research community. This promotes innovation and allows for the development of new techniques and tools that can be used by other researchers in the future.

4.4. *Open Access Publication*

- 4.4.1. Researchers have an ethical and social responsibility to make their research results open to peers and to the public in a timely manner.
- 4.4.2. Policymakers, RFOs, and RPOs should promote open access models that incur no costs for the researchers and readers.
- 4.4.3. RFOs and RPOs should provide guidelines to support researchers in finding reputable publishers to avoid supporting predatory practices.



- 4.4.4. Publishers and researchers are encouraged to use Creative Commons (CC) licenses, meaning authors retain their rights under predefined conditions.
- 4.4.5. Preprints are an important element of OS; however, preprints should be treated according to their status, not as peer-reviewed publications. Papers deposited on preprint platforms have not been subjected to formal quality control, such as peer review, and thus should be read carefully, especially by non-experts.

5. Researcher Evaluation

- 5.1. A crucial pathway towards a culture and environment supportive of OS is the adoption of research assessment and funding schemes that enable and reward researchers who act in accordance with good OS practices.
- 5.2. In accordance with DORA and CoARA recommendations, research performance assessment systems should prioritise quality and openness of the research results over the quantity of published papers. In the evaluation of a researcher's performance, RPOs and RFOs should use a multidimensional approach; bibliometric criteria should not be the only or main criteria. Evaluation systems should also consider the potential positive societal impact of research in accordance with OS and research integrity principles.
- 5.3. Evaluation systems should support peer-review processes that are open and transparent.
- 5.4. The research community should acknowledge the merit of data collection in the context of research evaluation. The promotion of publishing peer-reviewed data papers might help in this endeavour.

6. Citizen Science

- 6.1. Following the definition of the European Citizen Science Association, citizen science refers to public participation in scientific processes. "The main characteristics are that: (1) citizens are actively involved in research, in partnership or collaboration with scientists or professionals; and (2) there is a genuine outcome, such as new scientific knowledge, conservation action or policy change."
- 6.2. Citizen science is likely to support the overall OS goals of empowering citizens, public education, increased public trust in science, as well as contributing towards dissemination of research results and development of experience- and evidence-based policies.
- 6.3. Citizen science offers a potential for socially relevant research and innovation, however, the involvement of citizen scientists without proper support can potentially be an ethics and integrity challenge.



Policymakers, RFOs, RPOs, and researchers are responsible for promoting and supporting citizen science. This is done specifically by ensuring support throughout the research lifecycle, through the provision of adequate funding, training, flexible grant structures that accommodate extended timeline research, and encouraging collaborations and building synergies between researchers and other stakeholders.

- 6.4. Researchers working with citizen scientists should ensure transparency and open communication to diminish unavoidable power imbalance.
- 6.5. Policymakers in collaboration with the scientific community should develop targeted strategies on how to involve diverse societal actors in citizen science and other public engagement activities to avoid situations where inequalities existing in society are replicated in activities of public engagement.
- 6.6. The research community should ensure that existing knowledge about citizen science approaches is shared so that researchers and citizen scientists learn from each other.

7. Training and Education

- 7.1. Policymakers and RPOs should ensure that training and education in responsible OS focuses on the entire research lifecycle and start early-on, integrating the development of relevant attitudes and skills into higher education and perhaps even high school curricula.
- 7.2. RPO activities meant to increase the number of OS trainers, e.g., train-the-trainer programmes and support training for the integration of OS in research, should be implemented at different organisational levels.
- 7.3. OS training should be tailored to the needs and specificities of diverse scientific disciplines addressing discipline-specific legal, ethics, and integrity challenges.
- 7.4. OS training should also consider the potential effects of informal education, e.g., role modelling, and create awareness for the benefit of OS practiced responsibly by supervisors and mentors. Senior researchers, research leaders, and supervisors should be role-models and encourage and support their team members in practicing responsible OS.

8. Inclusivity

- 8.1. Researchers should be aware of potential biases in research related to gender, ethnicity, age, disability, epistemological frameworks, and other factors and act to ensure that responsible OS practices promote equity, inclusiveness, and diversity.



- 8.2. RPOs should recognise potential global inequities in access to OS infrastructure and act to promote global justice and support the needs of researchers in low- and middle-income countries (LMICs). There is a great need for policymakers, RFOs, RPOs, and researchers from high-income countries to provide support to institutions from LMICs in building their capacities, exchanging good practices, and establishing infrastructure conducive to OS.
- 8.3. RFOs and publishers need to consider unequal opportunities that researchers from LMICs have in accessing and contributing to OS and take measures to promote inclusivity, such as expanding OA publication privileges to more countries.
- 8.4. The rights and participation of marginalized groups and individuals with vulnerabilities, including individuals with disabilities, the elderly, individuals from LMICs, indigenous populations, among others, should be ensured in an OS environment.
- 8.5. To support research dissemination, results of research could be in local languages, with appropriate high-quality translation in English or vice-versa.

