PRINCIPLES OF OPEN SCIENCE MONITORING

Open Science
Monitoring
Initiative

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Version 1

BACKGROUND

The global landscape of open science is evolving rapidly, with policies being developed in countries, universities, research-performing organizations, and funding agencies to enhance openness, inclusivity, and the societal impact of research. However, tracking the adoption and progress of open science across various regions, institutions, and disciplines, as well as evaluating its academic, economic, and societal impacts, remains challenging, as current monitoring initiatives tend to be fragmented, heterogenous and difficult to compare.

The 2021 UNESCO Recommendation on Open Science underlines the importance of monitoring systems to track progress in implementing open science. It highlights the need for inclusive, transparent, and robust monitoring frameworks that enable stakeholders to assess open science practices and their impacts. It calls on Member States to monitor open science policies and mechanisms using a combination of quantitative and qualitative approaches, tailored to specific conditions, governance structures, and resources and supported as much as possible by open, non-proprietary and transparent infrastructures. These monitoring systems should reflect the core values and principles of open science outlined in the Recommendation, such as diversity, collective benefit, inclusion, fairness, and equity, ensuring that all communities and disciplines are considered and that no one is left behind.

As highlighted in the UNESCO Open Science Outlook, it is crucial to avoid the "streetlight effect", where easily measurable indicators take precedence over more complex but equally important dimensions of open science. Indicators should be technically sound, politically meaningful, and used as guiding tools rather than narrow metrics that risk reinforcing dominant practices at the expense of diversity and inclusivity.

Furthermore, many essential aspects of open science, such as its societal impacts, the openness of scientific culture, and engagement with diverse knowledge systems, are still not adequately assessed and necessitate targeted efforts to develop appropriate and inclusive monitoring frameworks.

ABOUT THE PRINCIPLES OF OPEN SCIENCE MONITORING

To take full advantage of the adoption of the 2021 UNESCO Recommendation on Open Science, transparent and representative monitoring must be put in place to drive and support the intended change as well as to identify effective actions and priority gaps.

In this context, the Principles of Open Science Monitoring provide an aspirational framework to develop good practices and guidelines for monitoring that encourage pooling, comparison, and reuse of monitoring results. They are not tied to any specific monitoring service or technical solution.

The Principles have been developed by the Open Science Monitoring Initiative (OSMI) based on an initial draft prepared by a group of experts participating in an international workshop held at UNESCO in December 2023 and finalized through a consultative process led by UNESCO and OSMI from June 2024 to June 2025.

The Principles of Open Science Monitoring are aspirational and should be interpreted flexibly, considering stakeholders' contexts, capacities, and resources. Importantly, the principles are not prescriptive, nor are they intended for assessing individual researchers, given the ethical, legal, and practical complexities involved. They should serve as a foundation for ongoing discussion and further refinement by open science monitoring initiatives.

Aligned with the 2021 UNESCO Recommendation on Open Science, these principles emphasize quality and integrity, equity, inclusion, collective benefit, fairness, inclusivity, and recognition of diverse open

science practices, outputs, and outcomes. They aim to help stakeholders, including national governments, research organizations, funders, open infrastructures, data providers, and research communities, develop and implement monitoring approaches suited to their unique contexts.

The long-term goal is to converge towards a core set of quantitative and qualitative indicators that facilitate comparability and collective learning. While there is value in numerical indicators and estimates of scientific inputs and outputs there is opportunity with open science for a more people-focused and purpose-driven framework for assessment. This requires shifting attention away from quantity and rankings and toward the values and impacts of science, the processes of conducting research, and the people who engage with, benefit from, and contribute to science.

Ultimately, monitoring open science is both a technical and cultural challenge. It should foster inclusivity, diversity, and public engagement, avoid over-standardization, and empower all stakeholders to contribute to the collective vision of making science a global public good—accessible, inclusive, and beneficial to all.

Part 1: Relevance and significance

All open science monitoring initiatives should be well-defined, relevant, and adaptable to diverse research contexts. They should support evidence-based policies and decisions, be developed through inclusive and participatory collaborative processes, and reflect the diversity of disciplines and stakeholders. Ensuring modularity, transparency, and consistency allows for reliable assessment while accommodating different needs and practices. Hence, to the extent possible, open science monitoring indicators should be:

1. **Applicable and clear in scope**: Indicators should be applicable and relevant to the specific monitoring tasks. Their scope and meaning should be explicitly defined, and any limitations or constraints on their applicability should be clearly communicated.

2. **Meaningful for planning and policy**: Indicators should align with broader public and global priorities and be accessible and useful for a wide range of stakeholders. They should enable the relevant stakeholders to design and evaluate context-specific monitoring systems, fostering evidence-informed policies, decisions and actions over time.

3. **Co-created**: Indicators should be co-created with the research communities involved and, where appropriate, with the relevant non-academic communities, through public consultation and dialogue, ensuring the inclusion of underrepresented groups. The development and adoption of indicators should be driven by active participation from relevant stakeholders, grounded in community-driven activities and priorities.

4. **Inclusive**: Indicators should reflect the diversity of stakeholders, academic disciplines, languages, and the economic, sociocultural contexts and geopolitical constraints of the research landscape being monitored. They should account for gender equality, region-specific, and infrastructural needs. Additionally, they should embrace the richness of diverse knowledge systems, epistemologies, and knowledge producers, and explicitly address potential biases and historical inequities in knowledge production.

5. **Modular**: Indicator frameworks should be modular, enabling different communities to assemble indicator sets that best suit their specific needs. To support diversity and inclusion while ensuring both global comparability and local adaptability, these frameworks should incorporate a mix of quantitative and qualitative approaches, including case studies.

6. **Reliable:** The level of scientific consensus around the reliability of each indicator needs to be made explicit. To ensure transparency, any indicator that is experimental or still under development should be clearly identified and labelled as such.

7. **Consistent**: Indicators should be consistent to facilitate comparability between institutions, countries, regions, research areas and disciplines over time.

Part 2: Transparency and reproducibility

Open science monitoring should, wherever possible, prioritize the use of open, transparent, and reproducible information, including metadata. It should further draw on infrastructures and methodologies that adhere to shared, agreed-upon principles and rely on publicly accessible data sources. In this context, to the extent possible, open science monitoring systems should prioritize:

1. **Openness:** Monitoring initiatives should rely on open scholarly infrastructures with open input and output data as defined in the 2021 UNESCO Recommendation on Open Science. All software used throughout the monitoring process should be open source, versioned, and published openly with clear, comprehensive documentation on platforms that facilitate collaboration, contribution, and reuse. Output data, when not protected for copyright, privacy, contractual terms, or other legal or ethical reasons, should be open by default and distributed under an open licence.

2. **Quality of sources**: Input data for each indicator should be of high accuracy, comprehensive coverage, and up-to-date timeliness. As appropriate these aspects should be evaluated and publicly documented for each indicator, ensuring transparency and reliability. In addition, all indicators and their underlying data should be updated regularly and in a timely manner to enable effective monitoring of changes over time.

3. **Public documentation of sources and methodology**: All indicators should be accompanied by publicly available documentation detailing data collection methods, provenance, processing steps, and implementation choices. This documentation should rigorously specify the origin, version, and licensing of each data point to ensure clear and reliable provenance. Additionally, any indicators generated using artificial intelligence must be explicitly identified.

4. **Reproducibility and reusability**: To ensure reproducibility, each indicator should be fully traceable, with versioning and a clear record of any modifications over time, ensuring data integrity and understandability. Furthermore, all monitoring results and indicator outcomes should be as reusable as possible.

5. **Comprehensive metadata:** Monitoring outputs should be annotated with detailed and, where possible, standardized metadata to ensure data findability and usability for humans and machines. When relevant and appropriate persistent identifiers should be used to identify research outputs and resources as part of the monitoring process, to improve openness, provenance, citability, and transparency.

6. **Consideration of community-defined and recognized principles**: To the extent possible, monitoring outputs should be compliant with the FAIR (Findable, Accessible, Interoperable, Reusable), CARE (Collective Benefit, Authority to Control, Responsibility and Ethics), TRUST (Transparency, Responsibility, User focus, Sustainability and Technology) and other relevant principles. Furthermore, a greater focus on data justice could help counteract global power imbalances and ensure equitable data access for all, including marginalized communities.

7. **Contextualized communication:** The communication of open science monitoring outcomes should be carefully tailored to prevent oversimplification and misinterpretation, ensuring clarity and relevance for all stakeholders. This includes providing clear, accessible explanations of indicators and conclusions to promote understanding and engagement from the general public.

8. **Disclosure of conflicts of interest:** Open science actors should disclose any conflict of interest when monitoring is undertaken.

Part 3: Self-assessment and responsible use

Open science monitoring initiatives should aim for continuous improvement through regular self-assessments and alignment with these Principles of Open Science Monitoring. Importantly, open science monitoring should be used to understand and incentivise open science practices. It should not be used in isolation to evaluate individual researchers but instead as part of a multifaceted approach to assist institutions, stakeholders, academic and non-academic communities in understanding and improving their research practices. Therefore, to the extent possible, open science monitoring initiatives should integrate:

1. **Self-evaluation against the Principles of Open Science Monitoring**: Monitoring initiatives should ideally regularly assess and publicly disclose their compliance with these Principles. Where full compliance has not yet been achieved, initiatives should clearly outline a path towards future compliance, demonstrating a commitment to continuous improvement.

2. **Regular revision**: Indicators should be regularly assessed and revised as conceptual and technical specifications may evolve over time. Since indicators can lead to unintended consequences, it is essential to regularly review and update indicators and methodologies to mitigate such risks. Revision processes should include feedback loops to promote transparency, inclusivity, and responsiveness to emerging challenges. Indicators that are no longer aligned with the initial monitoring objective can be discontinued or replaced.

3. **Environmental responsibility**: Open science monitoring initiatives should evaluate and limit the environmental impacts of monitoring systems.

4. **Long-term sustainability**: Monitoring initiatives should have plans for their sustainability, including commitments to long-term funding, training, and infrastructure support, capacity-building or, in the case of short-term activities, long-term accessibility of their outputs. A long-term vision with clear goals and milestones should guide their ongoing development.

5. **Constructive comparison**: In line with the 2021 UNESCO Recommendation on Open Science and in accordance with internationally-agreed best practices for research monitoring and evaluation[1], indicators should not be used to create rankings or make uncontextualized comparisons of research organizations, researchers, or other individuals or groups. Monitoring mechanisms should ideally emphasize equity-oriented comparisons that reflect contextual nuances and avoid reinforcing structural inequalities.

About the Open Science Monitoring Initiative

The Open Science Monitoring Initiative (OSMI) brings together institutions and individuals involved in monitoring open science. OSMI aims to encourage the adoption of open science monitoring principles and to promote their practical implementation. Learn more about OSMI: https://open-science-monitoring.org/

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[1] The Agreement on Reforming Research Assessment of the Coalition for Advancing Research Assessment (CoARA), the guidelines of the Latin American Forum on Research Assessment (FOLEC-CLACSO), the San Francisco Declaration on Research Assessment (DORA), the Leiden Manifesto for research metrics, the INORMS SCOPE framework for research evaluation, the Hong Kong Principles for assessing researchers, etc.