

Open Science and Research Infrastructures provide the foundation and pillars necessary to tackle global environmental issues

COVID has highlighted the importance of Open Science and research infrastructures to accelerate the impact of scientific research

COVID has been the dominant topic for more than two years, not just in our daily lives but also in science. There is not a conference, paper, or article that does not set every topic in the context of the pandemic we are currently living through.

Two very positive outcomes have emerged from this crisis: the evidence that Open Science (OS) is critical to overcome global crisis; and the relevance of research infrastructures (RIs) to accelerate the quality, reproducibility, and impact of scientific research.

The rapid sequencing of the virus, data sharing and tracking of viral strains, lead to a fast and global response to COVID that was only possible because researchers, supported by a policy system promoting global and transnational collaboration, were willing to share their practices, methods, and findings across the planet in an Open Science paradigm.

It showed us that to swiftly tackle global issues, a global, OS approach was the only way to follow. In the European Union, the RIs belonging to the ESFRI (1) Food & Health group (2), were rapidly mobilised to support research efforts, facilitating access to viral genomes and fast-tracking access to research platforms and analytical services.

What lessons can be drawn from Open Science?

With hundreds of millions of Euros spent on research and medical studies, it was possible to develop multiple vaccines in less than two years, demonstrating that global issues could be tackled using a scientific approach given sufficient financial means. So, if open RIs were so effective to help tackle the pandemic, what lessons can be drawn from Open Science?

The institutionalisation of OS originated several decades ago as a policy to transform scientific practice to adapt to the changes, challenges, opportunities, and risks of the digital era, and to increase the societal impact of science. To provide a collective understanding of its implications worldwide, the United Nations Educational, Scientific and Cultural Organization (UNESCO) adopted, in November 2021, a set of recommendations (3) for an international framework for OS policy and practice, with shared values, principles and standards. UNESCO defines Open Science as “an inclusive

construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community.”

For the UN Organization, more transparent, collaborative, and inclusive scientific practices are key to reducing inequalities in access to scientific development. Engaging in OS is crucial to enable the world to respond to the current pressing global issues. Our planet is changing rapidly due to human activities, leading to rapid and severe climate change, and the ecosystem services we have been relying on for decades, in particular in the ocean, are now no longer able to cope. We must now act collaboratively on a global scale, which brings a significant challenge on its own.

RIs have been identified by UNESCO as being important enablers of Open Science. European RIs on the ESFRI roadmap provide important virtual and physical support services to research communities, such as research vessels, collections, biobanks, platforms, data repositories and data analyses, both in Europe and beyond. ESFRI RIs (4) adhere to the EU open access policy, ensuring that anyone can access and use their facilities.

Built by and for research communities, which is crucial for their long-term sustainability, they develop protocols and scientific practices and aid them in becoming global standards in their field of research, thus ensuring reproducibility and quality. The FAIR (5) principles which has emerged from the data community is now embedded in RIs, safeguarding traceability of material and data between them and contributing to building the European Open Science Cloud (EOSC), a shared environment for storing research digital objects (publications, data, software).

Improving scientific quality

OS is also important in raising the bar on scientific quality. It drives better and more reliable science for scientists, for peers, but also for policy and the public due to its openness and transparency. RIs that embrace this open approach are the cornerstone of this scientific revolution by providing sustainable, interoperable, coordinated, and standardised services to researchers, supported by EU member states and national operators.

They contribute to defragmenting, sustaining and simplifying scientific practices and services and are key players in research integrity and science diplomacy. These factors are the facilitators of international scientific cooperation, enabling excellent science, grounded in shared principles that ensure research across the planet is comparable, compatible and of benefit to all. It is here that the OS RIs become important, because in this environment they can serve everyone: their repositories, resources, databases, and services become relevant to scientists on a geographical scale beyond the region in which they are located and thus they contribute to capacity building on a global scale.

The European Marine Biological Resource Centre (EMBRC-ERIC) is a European RI for marine biological resources and biodiversity, and an example of an OS RI. It operates as a European Research Infrastructure Consortium (ERIC), a legal entity granted and assessed by the European Commission. It has an open access policy and functions as a support structure for the marine biological and ecological research and innovation communities. EMBRC-ERIC promotes OS and open innovation, together with FAIR principles “from sampling to data”.

As part of its activities, EMBRC has established a DNA-based observatory, the European Marine Omics Biodiversity Observation Network (EMO BON) at 16 of its sites to strengthen biological observation within Europe. The initiative is built upon shared, simple (inclusive) protocols, internationally recommended and metadata standards. All protocols, data log sheets, and data management plans are open to encourage collaboration and uptake of the protocol by other observatories. All management aspects and DNA extraction and sequencing, as well as obtaining relevant sampling permits and access and benefit sharing (ABS) (6) agreements have been centralised, allowing the ERIC to act on behalf of its member states to ensure the smooth operation and open access to the observatory, thus acting as a catalyst for collaboration in Europe and beyond.

Overall, it is clear that OS practices have been a real enabler of scientific collaboration by putting in place the necessary framework for excellent, reproducible, and comparable science. Embedding them in a global framework ensures scientific methods are sustained and shared.

The United Nations Decade of Ocean Science for Sustainable Development has provided a catalyst for achieving the necessary collaborations to establish such a global framework for ocean science. The UN Decade Programmes such as OBON (7), Marine Life 2030 (8) and Ocean Practices (9) bring together researchers, observatories, and marine stakeholders from across the planet to work together to achieve SDG14, one of the 17 goals of the UN 2030 Agenda for Sustainable Development aiming at conserving and sustainably using oceans, sea and marine resources. It is important that the RIs become hubs of capacity building, cooperation, and collaboration where scientists worldwide can work on an equal footing and are not reduced to mere data providers. As stated by the United Nations Sustainable Development Goals: no one should be left behind. With the UN Ocean Decade, ocean scientists become one world community.

Inclusivity is crucial

However, although OS has shown its worth for researchers and RIs provide the necessary framework to support them, it is crucial to be vigilant and remember the need for inclusiveness. RIs must be mindful of technological and financial discrepancies between different regions, and as many of the world’s biggest challenges today are disproportionately impacting Least Developed Countries (LDCs), RIs must remain not only accessible and usable for their scientists, but open to contributing to building services that meet their needs. RIs should, in this respect, become platforms where

Global North current technological investments and Global South needs meet to further develop knowledge. To realise this, RIs must also foster regional collaborations and embrace the participation of stakeholders from other countries in their development.

By urging its 193 member countries to adopt a global model for the benefits of science and society, the UNESCO recommendation anticipates Open Science to go beyond open scientific data and free access to scientific publications, but to be more inclusive, balanced, accessible, open to citizen science and embedded in cultural diversity. The recently established RIs in Europe now face the challenge of transforming their community-construct services to embrace this construct and, along with the historical research operators in public research, find new routes for Open Science to thrive and bring it to bear on the global environmental issues that we face today.

Written by Anne Emmanuelle Kervella and Nicolas Pade

References

- [1] ESFRI stands for the European Strategy Forum on Research Infrastructures, supporting “a coherent and strategy-led approach to policy-making on research infrastructures in Europe, and (facilitating) multilateral initiatives leading to the better use and development of research infrastructures, at EU and international level”: <https://www.esfri.eu/forum>
- [2] <http://www.lifescience-ri.eu>
- [3] <https://www.unesco.org/en/natural-sciences/open-science>
- [4] This article focuses predominantly on those RIs on the ESFRI roadmap. This distinction is made as they are particular constructs, with a broad range of missions, including scientific excellence, implementing SDGs and science diplomacy. 41 ESFRI RIs are operating in Europe, 22 are being set up: <https://www.esfri.eu/>.
- [5] FAIR stands for Findable, Accessible, Interoperable, and Reusable and is the framework for data stewardship in science.
- [6] ABS stands for the framework for access to genetic resources and the fair and equitable sharing of benefits arising for their utilization as adopted by the Nagoya Protocol to the Convention on Biological Diversity: <https://www.cbd.int/abs/>
- [7] <http://www.obon-ocean.org/>
- [8] <http://www.marinelife2030.org/>
- [9] <http://www.oceandecade.org/actions/ocean-practices-for-the-decade/>

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