

Equity in Open Science

**Case studies of Open Science
infrastructures and Open Peer Review**

Independent Expert Report



Equity in Open Science: Case studies of Open Science infrastructures and Open Peer Review

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Executive summary

Open Science, the movement to increase access, transparency and participation in knowledge and knowledge production, has seen widespread uptake in both policy and practice. The role of equity in Open Science has become of renewed focus in recent years, with increasing recognition that it cannot be assumed as a downstream benefit but requires intentional design. The world is marked by profound inequalities, and uneven distributions of resources, visibility, support and social capital continue to shape empowerment in open environments. This report contributes to the development of the European Research Area (ERA) Policy Agenda 2025-2027, particularly the action “Applying Equity in Open Science”.¹ The report is structured around case-study investigations of: (1) Open Science infrastructures, and (2) Open Peer Review.

We explore how ownership and governance arrangements influence community-responsiveness, recognising that community-governed infrastructures often align more closely with the communal values of scholarship, while also facing challenges relating to sustainability, funding and dependence on voluntary labour. We further investigate how uneven levels of infrastructural coverage and maturity across geography, discipline, language and formats can shape meaningful participation in Open Science. Meaningful participation, we argue, is not determined by infrastructure provision alone, but also by personal, social and environmental conditions. To capture these challenges, we introduce the notion of “infradiversity”: the need for Open Science infrastructures that sustain a diverse, pluralistic and interconnected ecosystem that values epistemic pluralism, local agency, multilingualism and flexible interoperability, while also supporting diverse disciplinary traditions, regional needs, community priorities and approaches to openness. Infradiversity acknowledges that equitable infrastructures must focus not just on enabling access to goods and services, but also on how they challenge or consolidate existing distributions of agency and power. This requires infrastructures to centre community-leadership, public accountability and reflexivity.

In examining Open Peer Review models, we find that increases in transparency and participation also introduce tensions and trade-offs. Greater openness can strengthen reviewer accountability, collegiality, and the recognition of reviewers' contributions, fostering more collaborative forms of scholarly communication. However, the challenges and opportunities of publicity and openness – particularly regarding reviewer identity disclosure – are experienced differently across groups, depending on existing distributions of prestige, precariousness, and social capital. Marginalised and vulnerable scholars may face heightened risks when openly critiquing the work of those more-established. While optional disclosure may be a form of judicious closure, it may also lead to unequal distribution of gains in visibility and reputation. In Open Peer Review, as in existing modes of review and curation, there is also continued reliance on voluntary and often invisible labour, raising questions of sustainability and fairness. Limited uptake of forms of Open Participation again underlines that openness alone does not enable participation without parallel investments in capacity. Finally, while Publish, Review, Curate models reconfigure the temporal logics of scholarly communication with potentially positive implications for equity, they remain emergent and need further incubation through sustainable funding and careful assessment of unintended consequences.

Taken together, our findings underline the need for careful and reflexive Open Science policies and implementation strategies that critically engage with both the opportunities and risks of Open Science for diverse groups.

¹ https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CONSIL:ST_8469_2025_INIT

Questions of how Open Science centres or decentres power and control are not abstract concepts. They are felt daily in scholars' real-world praxis – whether it is their encounter with unaffordable charges for Open Access publication, epistemically inappropriate standards, poor infrastructural coverage, or invisible contributions to sustaining Open Science ecosystems. Such considerations point towards what we might call “equity-by-design” in Open Science: improved embedding of inclusion, diversity and capabilities into policies, practices, processes and infrastructures. Based on this analysis, we then close with recommendations that policymakers and other should: (1) Prioritise equity-by-design in Open Science; (2) Foster infradiversity through equitable and sustainable Open Science infrastructures; (3) Foster flexible, context-sensitive implementations of Open Peer Review; (4) Recognise and sustain Open Science labour through equitable models of funding and recognition; (5) Enable robust meta-research and monitoring regarding equity outcomes associated with Open Science.

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List of abbreviations

AI – Artificial Intelligence
APC – Articles Processing Charge
CA – Capabilities Approach
CERN – European Organization for Nuclear Research
CoARA – Coalition for Advancing Research Assessment
CS – Citizen Science
DOI – Digital Object Identifier
DORA – Declaration on Research Assessment
EC – European Commission
ECR – Early Career Researcher
EOSC – European Open Science Cloud
ERA – European Research Area
EU – European Union
FAIR – Findable, Accessible, Interoperable, Re-usable
ICT – Information and Communication Technologies
LLM – Large Language Model
OA – Open Access
OPR – Open Peer Review
ORCID – Open Researcher and Contributor ID
OS – Open Science
OSI – Open Science infrastructure
PCI – Peer Community In
PRC – Publish, Review, Curate
R&I – Research and Innovation
SSH – Social Sciences and Humanities
STEM – Science, Technology, Engineering and Mathematics
UNESCO – United Nations Educational, Scientific and Cultural Organization
VRE – Virtual Research Environment

1. Introduction

Open Science (OS), the movement to increase access, transparency and participation in knowledge and knowledge production, has seen widespread uptake in both policy and practice. However, evidence is growing that the OS' benefits and burdens are not equally distributed amongst different nations, regions, institutions, disciplines and social groups. Putting OS into practice requires implementation and alignment of considerable investments in interoperable infrastructure, awareness and skills, institutional support and effective policy. Such capacities are inequitably distributed within Europe and beyond. In addition, socio-political dynamics of power and hierarchy mean some groups are more empowered to participate than others, not only in putting OS into practice, but also in setting the OS agenda. Increasing equity has long been a key aim of OS, yet such dynamics risk the opposite.

Such concerns have placed equity at the centre of current OS priorities. Equity takes account of structural disadvantages to consider how individual differences and needs, or structural distributions of power or resources, must be addressed to ensure fairness and equality of outcomes. Importantly, equity is not the same as *equality*, which focusses rather on equal treatment according to common rules. Equity is also distinct from *diversity*, meaning the fair representation of individuals from different backgrounds, identities and perspectives, and *inclusion*, the sense of belonging and support within an environment that enables full participation. Together, these concepts provide a crucial lens for analysing fairness and equity within contemporary research systems.

This report aims to contribute to the development of the European Research Area (ERA) Policy Agenda 2025-2027.² ERA aims to align research policies and programmes “to create a single, borderless market for research, innovation and technology across the EU”.³ The current ERA Policy Agenda contains 11 structural policies and 8 distinct actions, covering a range of capacity building and harmonisation measures. The action “Applying Equity in Open Science” targets increased equity in OS through commitments to (1) identify barriers and challenges, (2) expand not-for-profit Open Access (OA) across disciplines, (3) build skills and infrastructure capacities, and (4) develop policy approaches for greater OS equity.

The report is structured around detailed case-study investigations of two OS areas of strategic interest: (1) OS infrastructures, and (2) Open Peer Review. The case-studies collect evidence to identify barriers and enablers to equity in these contexts. They are book-ended by a background discussion of relevant general theory and evidence, and a final summing of lessons-learned and possible policy recommendations. The report is structured as follows:

- Section 2 provides context regarding the role of equity in OS, as a basis for the rest of the report. It first discusses the ways in which equity has been historically prioritised, then outlines major challenges for equity identified in the literature and, finally, summarises proposals for ways in which equity can be better addressed.
- Section 3 then analyses equity in OS infrastructures, examining the extent to which repositories, publishing platforms, workflow/collaboration tools, linking services and other infrastructures are “fit for purpose” in terms of equity and inclusion. Adopting sociotechnical and capability-based theoretical perspectives, we analyse how questions of design, coverage and access affect the ability of individuals and communities to effectively use, contribute to, and benefit from OS infrastructures in diverse settings.

² https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CONSIL:ST_8469_2025_INIT

³ https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/our-digital-future/european-research-area_en

- Section 4 examines issues of equity in the application of OS principles to peer review, namely forms of Open Peer Review (including Open Identities, Open Reports and Open Participation), as well as the emerging “publish, review, curate” model of scholarly communication. We investigate the extent to which these models can strengthen equity, transparency, participation, rewards and inclusion, while exploring challenges related to reviewer labour, power inequalities, reputational risks, publication charges and technological access for research communities and different levels of researcher career stage.
- Finally, section 5 synthesises these findings, and then formulates targeted and actionable policy recommendations that integrate the most effective and equitable elements of current infrastructures and open review models.

2. Background: The Role of Equity in Open Science

This section provides context regarding the role of equity in Open Science,⁴ as a basis for the rest of the report. It first discusses the ways in which equity has been historically prioritised, then outlines major challenges for equity identified in the literature and finally summarises proposals for ways in which equity can be better addressed.

2.1. Issues of equity in Open Science

Increasing equity and fairness is a core value of OS according to the UNESCO *Recommendation on Open Science* (UNESCO, 2021), where it is linked to broader global goals of sustainable development and human rights. The Recommendation defines equity and fairness as "enabling fair and reciprocal sharing of scientific inputs and outputs and equal access to scientific knowledge to both producers and consumers of knowledge regardless of location, nationality, race, age, gender, income, socio-economic circumstance, career stage, discipline, language, religion, disability, ethnicity, migratory status or any other grounds".

Since its inception, equity has been seen as a central aim of OS (Chtena et al., 2025; Fecher & Friesike, 2014; Ross-Hellauer et al., 2022). For example, the Budapest Open Access Initiative (Chan et al., 2002), a foundational text in Open Access vividly evoked a world in which greater sharing of knowledge would "share the learning of the rich with the poor [...] and lay the foundation for uniting humanity in a common intellectual conversation and quest for knowledge." OS is, however, a multifaceted movement, aiming (according to the UNESCO definition) to foster open scientific knowledge, OS infrastructures, open engagement of societal actors and open dialogue with other knowledge systems. These varied practices are underpinned by an equally diverse range of values: equity, fairness, quality, integrity, collective benefit, diversity and inclusion. And those values are in turn complemented by a long list of principles including transparency, responsibility and sustainability (UNESCO, 2021). Depending on how these various aims, values and principles are prioritised, they may not always be in harmony (Crespo López et al., 2025). Especially since it is also made up of, and put into practice by, a highly heterogeneous coalition of stakeholders⁵ with diverse, and potentially conflicting, interests and motivations.

Against this background, it has been argued that equity has at times been severely undervalued in OS. Chtena et al. (2025), for instance, noted in their analysis of policy documents that although equity (along with diversity and inclusion (EDI)) were "often mentioned and even embraced", there was a remarkable mismatch between their stated importance and the presence of concrete commitments to action. A pressing need to more proactively centre equity within OS has emerged over the last decade or so, as a growing body of research has shown the ways in which structural barriers can influence OS and the distribution of its benefits. Key lessons include:

⁴ The word "science" in "Open Science" has the unfortunate connotation in English of excluding the arts, humanities and more qualitative aspects of the Social Sciences. Hence, in the interests of inclusion other terms such as "Open Research" or "Open Scholarship" are sometimes preferred. Given that it is the term adopted by the European Commission, we here use the term "Open Science" but make clear that by the term we refer to scholarship of all kinds across the disciplinary spectrum. Similarly, in discussing "Open Science infrastructures" in the next chapter, that term should also be read inclusively to refer to infrastructures supporting openness across scholarship of all kinds.

⁵ Including researchers, policymakers, managers and administrators based in academic institutions, funding organisations, disciplinary bodies (scholarly societies), industry players (including publishers), amongst others.

- *Open Science implementation requires resources (including access to infrastructure, support services and training) whose unequal distribution may result in dynamics of cumulative advantage* (Ross-Hellauer et al., 2022). Sharing and re-using Open Data, for instance, relies heavily on the availability of infrastructure and on data literacy (Bezuidenhout, Kelly, et al., 2017; Rappert & Bezuidenhout, 2016; Shanahan & Bezuidenhout, 2022). As another example, unequal financial capacities to cover Article Processing Charges (APCs) can lead to stratification of authors in Open Access (OA) publishing (Demeter & Istratii, 2020b; Klebel & Ross-Hellauer, 2023; Olejniczak & Wilson, 2020; Siler et al., 2018).
- *Requiring openness of outputs or transparency of processes may influence dynamics of participation, especially amongst traditionally disadvantaged communities.* For example, Alborno & Chan (2018) found that when surveyed, some Indigenous participants expressed “strong resistance” toward openness due to historical experiences of knowledge appropriation and colonialism. As another example, in Open Peer Review, women and more junior researchers seem more reluctant to sign their reviews, possibly due to increased concerns of retaliation from authors (Bolek et al., 2020; Fox, 2021).
- *Extra work involved in Open Science may fall disproportionately on certain demographics.* OS, done well, often requires extra upfront effort such as in the careful research data management associated with enabling open or FAIR data. This potentially disadvantages those conducting this work (of whom junior researchers and women are disproportionately represented; Larivière et al., 2020). Such dynamics are visible in other areas, such as participatory research methods engaging diverse stakeholders, knowledge systems or communities (Wittrock et al., 2021).
- *Inequities in governance and decision-making structures have downstream effects on the equity of Open Science.* OS is both a grass-roots movement of researchers, as well as a top-down policy agenda. The resourceful nature of OS transition means that political will is needed from leaders in government, research funding- and research performing-organisations. Issues of equity may emerge in terms of who is empowered to participate in this agenda-setting across various contexts. Governance frameworks can sometimes fail to prioritise inclusion in decision-making processes, with often piece-meal decision-making that is nationally or regionally-focused (Kaye et al., 2018). For example, the extent to which the OS agenda has been led by technocratic conceptions of openness from Europe and the US, has been critiqued by Alborno and Chan (2018) who argue it raises “red flags in terms of who is really being represented by these policies and who will be able to enjoy its benefits”. This extends to governance of research infrastructures, which often originate from the US or Europe and can hence reflect the concerns of hegemonic communities (Bezuidenhout & Havemann, 2021).
- *One-size-fits-all approaches may undermine epistemic justice by favouring dominant modes of knowledge production over more interpretative, participatory or non-traditional approaches.* OS policies are frequently oriented towards quantitative or hypothetico-deductive approaches, potentially marginalising more qualitative approaches associated with the humanities and some social sciences (Leonelli, 2018, 2022; Penders et al., 2019), or the inclusion of indigenous knowledges (Zwart et al., 2024).
- *Open Science’s primary focus on the sharing of outputs via digital platforms has been criticised for insufficiently challenging existing power structures.* A final line of critique holds that, far from being a radical reinvention of research, OS (when narrowly defined as the circulation and accessibility of content) reinforces trends of commodification and platformisation of research. Critics note the alignment of content-sharing with industry agendas and criticise how OS’s reliance on digital infrastructures remains susceptible to “platform-logics” of data extraction, aggregation, monetisation, and “surveillance capitalism” (Leonelli, 2023; Mirowski, 2018; Pinto & Manuela, 2020).

2.2. Theoretical approaches to fostering equity in Open Science

Several theoretical approaches have been suggested for how OS should be reoriented to better achieve its aims of improving equity and fairness in global research.

A keystone in renewed recognition of equity as a key theme for OS was the OCSDnet (Open and Collaborative Science in Development) project which undertook participatory research with researchers and practitioners in 26 Latin American, African, Middle Eastern and Asian countries between 2014 and 2017. The project's stated aim was to understand "the values at the core of open science in development".⁶ At its conclusion, OCSDnet published its manifesto, to reflect these core values and the project's key insights that "there is not one right way to do open science. It requires constant negotiation and reflection, and the process will always differ by context." The manifesto accordingly advocated commons-based approaches that prioritise local agency in governance and decisions to share. It also highlighted the importance of respect for epistemic diversity through values of cognitive justice, equitable collaboration between researchers and societal actors, and inclusive infrastructures that empower people of "all abilities". Finally, the manifesto linked all this to the overall aim of enabling sustainable development "to improve the *well-being* of our society and planet".

The OCSDnet was theoretically informed by the capability approach first suggested by Amartya Sen (Chan et al., 2019), and then further developed by others including Martha Nussbaum (Chan et al., 2019; Cf. Nussbaum, 2011; Sen, 2000). The applicability of the capability approach for OS has been developed in greater detail by the social scientist Louise Bezuidenhout (Bezuidenhout, 2025; Bezuidenhout, Leonelli, et al., 2017). Capability approaches focus on the real freedoms people have to pursue the activities ("doings") and ways of life ("beings") that are valuable to them. They go beyond distributive notions of justice by considering not only whether people possess certain rights or resources, but also whether they are able to "convert" those rights and resources into desired material outcomes ("functionings"). Functionings, and the opportunity freedoms to pursue them, are in turn influenced by various *conversion factors*, including individual abilities, material resources, social norms, institutional arrangements, and environmental features. Bezuidenhout identifies a range of conversion factors that shape people's possibilities for meaningful participation in OS, including: access to infrastructures for data, computing or the internet; laws or regulations regarding censorship or sanctions; skills and abilities such as science or data literacy; design challenges related to the accessibility or interoperability of ICTs and infrastructure; engagement with communities of practice; and existing marginalisations as a result of historical power imbalances or discrimination. For Bezuidenhout, tackling challenges of equity in OS requires thinking beyond just making resources more available, to deeper considerations of how people actually want to use OS resources to benefit their lives, the capabilities this would require, and how conversion factors could be best addressed to facilitate this in the interests of achieving "meaningful access".

Next, philosopher Sabina Leonelli has proposed an approach she terms "judicious connection". Leonelli's work rejects universalist notions of OS that seek uniform standards or expectations, arguing instead for the importance of respecting epistemic diversity (Leonelli, 2018, 2022), appreciating the local material and social contexts in which data are created, used and re-used (Leonelli, 2016), and understanding the situatedness of decisions related to sharing (Levin & Leonelli, 2016). Leonelli perceives an implicit logic of prioritisation in OS policies, which values first and foremost the mobilisation and commodification of open outputs, then processes of transparency to increase quality, and only then considers inclusion and equitable participation (Leonelli, 2023).

⁶ <https://ocsdnet.org/manifesto/open-science-manifesto/>

This is dangerous, since “the high level of standardization and precise validation practices demanded by some OS initiatives threatens to blindly privilege specific ways of knowing, thus potentially disrupting sophisticated methodologies, inadvertently dismissing well-established research traditions, and exacerbating the already large epistemic and social divides separating research domains and locations” (Leonelli, 2023, p. 5). Hence, Leonelli argues we must reverse this logic and focus first on fostering “judicious connections” between different knowledge actors and practices, i.e., “meaningful communication between the humans involved in research”. Facilitating judicious connections requires greater analysis and consideration of OS practices’ specificity to local conditions, embeddedness within research practices, permeability to new actors, and “demarcation strategies”, including “strategies, training and procedures to assess who is included and excluded from such apparatus, understand why and with which implications, and mitigate eventual instances of epistemic injustice” (Leonelli, 2023, p. 42). Seeking to operationalise Leonelli’s concepts for our purposes, we can point to two interrelated levels where judicious connection can play out. Firstly, in individual decision-making – whether or not to share data, support open infrastructures, or participate in Open Peer Review, for instance. Such decisions depend on participants’ situated, local circumstances, including their individual capacities, as well as relevant conversion factors such as resources, community norms or access to infrastructure. Against this background, individuals have responsibility to consider “who the publics and participants in science may be, which in turn helps to determine which research outputs to disseminate, when and how” (Leonelli, 2023, p. 66). Secondly, this means designing for the enablement of judicious connection in policies, governance and infrastructures. Leonelli identifies three key challenges for the latter: (i) *scale*, i.e., negotiating tensions between generalisability and specificity to enable enough common-ground for judicious connection without alienating or marginalising communities of practice through imposition of universal rules of poor relevance; (ii) *bureaucracy*, i.e., the risk of turning tools for accountability and foresight such as Data Management Plans or pre-registrations into box-ticking managerial control exercises; (iii) *instrumentalism*, i.e., the tendency for OS to serve rather than challenge established corporate or commercialist interests. Designing for judicious connection will always be imperfect, given that limits on human attention require trade-offs between forms of exclusion and inclusion, and since value judgements are unavoidable and foresight regarding (unintended) consequences incomplete. What matters, though, is that design decisions are taken based on explicit and reflexive consideration of who will gain and who will lose, and with commitment to change course in case of failure or unintended consequences.

A final theory relevant for our subsequent analysis is Pierre Bourdieu’s theory of fields, capital, and habitus (Bourdieu, 1975, 1977, 1986). For Bourdieu, science is a relatively autonomous “social field” structured by power-relations, within which actors compete according to historically-stabilised rules and routines. Scientific advantage derives from the accumulation of various forms of capital: economic (grants, endowed positions), but also symbolic (prestige, reputation), social (networks and peer-recognition), and cultural (competences, qualifications) (Bourdieu, 1986, 2004). “Scientific capital”, for Bourdieu, is a “particular kind of symbolic capital, a capital based on knowledge and recognition”, whose distribution “determines the structure of the field” and “governs the distribution of the chances of profit” (Bourdieu, 2004, p. 34). Unequal distribution of capital can be related to the “conversion factors” identified in the capabilities approach and help explain the endurance and reproduction of social stratification. But Bourdieu identifies an additional factor via his notion of “habitus”: individuals’ internalisation of social order as durable, embodied dispositions, which then shape what they perceive as possible or appropriate in a given field (Bourdieu, 1977, p. 164ff.). Habitus is “history turned into nature” (Bourdieu, 1977, p. 78), promoting persistence of social inequalities without explicit enforcement. Bourdieu envisions scientific fields as sites of continuous struggle:

The structure of the scientific field is defined, at every moment, by the state of the power relations between the protagonists in the struggle, in other words by the structure of the distribution of the specific capital (in its different kinds) that they have been able to accumulate in earlier struggles. On the basis of each scientist's position within it, the structure assigns to him his scientific strategies and position-takings and their objective chances of success. These position-takings are the product of the relationship between a position in the field and the dispositions (the habitus) of its occupant. (Bourdieu, 2004, p. 56)

From this perspective, OS reforms should not be expected to automatically level, but rather to reshape and perhaps even reproduce, hierarchies. The question for equity in OS then becomes one of the terms on which reforms can redistribute capital of various kinds or enable new mechanisms for its conversion, as well as the extent to which it challenges current norms towards a fairer, more inclusive habitus (c.f., discussions on the need for a reorientation of research cultures to foster OS).

2.3. Embedding equity in policy

In 2019 UNESCO initiated processes to build an international consensus on OS through a series of regional and global multi-stakeholder consultations. The outcome was the *UNESCO Recommendation on Open Science* (UNESCO 2021), which was the first global normative OS instrument, and was unanimously adopted by the 193 Member State in November 2021. The Recommendation presents a definition of OS, its core values and principles, and outlines policy actions for governments and institutions. It marked a significant development in regard to equity in OS, by placing concepts of justice, diversity and inclusion at its centre, framing OS as a means of realising human rights relating to access and participation in knowledge.⁷ The UNESCO Recommendation defines OS 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.

The Recommendation specified four core values. The first, *Quality and integrity*, relates to enabling methodological transparency to increase scrutiny. The latter three, however, all directly relate to social and epistemic justice: *Collective benefit*, that OS is “a global public good” for the benefit of all of humanity; *Diversity and inclusiveness*, that OS should support epistemic pluralism and be inclusive of societal actors and indigenous knowledge systems, and; *Equity and fairness*, that OS should play a “significant role” in fostering equity among all researchers and enabling equitable sharing and access to knowledge.

The European Commission has played a leading role in the global push for OS. A pilot on Open Access in FP7 (2007–2013) became a full mandate across all funded projects in the Horizon 2020 (H2020) framework programme (2014–2020). Later, a pilot on Open Research Data — introduced in Horizon 2020 and expanded to all thematic areas from 2017 — became a mandate for FAIR (findable, accessible, interoperable, reusable) data, under the rubric “as open as possible, as closed as necessary”, in the following framework programme Horizon Europe (2021–2027).

⁷ E.g., article 27 of the Universal Declaration of Human Rights and article 15 of the International Covenant on Economic, Social and Cultural Rights.

Under H2020 the EC has invested heavily in federated infrastructure for digital research objects through the European Open Science Cloud (EOSC), formally launched in 2018. Equally, it launched Open Research Europe (ORE), a Diamond OA publishing platform — notable also for its use of open post-publication peer review — for EU-funded research, in March 2021⁸ while it also played an important role in the 2022 establishment of CoARA⁹ which seeks in part to support a transition to OS through improved reward and recognition for open practices.

Current priorities include the development of ORE through transition to open-source technologies and broadening of scope to include national research funding organisations.¹⁰ ORE aims to provide a scalable and sustainable, not-for-profit, non-APC based publishing venue, integrating Open Peer Review and supporting diverse forms of output. ORE has rapidly grown into a major OS initiative, with over 1,300 articles published and contributions from more than 6,300 authors globally. Entering a new phase from 2026, ORE will transition to a community-supported, publicly governed, open-source infrastructure hosted by CERN, with a €17 million budget (2026–2031). APC-free publication will be expanded beyond EU-funded researchers to include those from contributing countries and institutions, while strengthening collaboration amongst research-performing and -funding organisations. By combining public funding, community governance, and international cooperation, it seeks to establish a scalable, equitable, and high-quality open access publishing ecosystem aligned with the principles of OS.¹¹

The EC has been overall strongly supportive of Diamond Open Access (non-profit, academic-led publishing model with no fees for authors or readers). Although not an explicit signatory to the Science Europe Action Plan for Diamond OA (Ancion et al., 2022), Horizon Europe funded projects (including DIAMAS, CRAFT-OA, and PALOMERA¹²) helped structure the Diamond OA publishing landscape, and improve capacity and coordination, including the creation of the European Diamond Capacity Hub.¹³

In terms of policy support, the Council Conclusions on "High-quality, transparent, open, trustworthy and equitable scholarly publishing", adopted on 23 May 2023, represent a significant statement of political direction on equity in scholarly publishing.¹⁴ The Conclusions recognise that the increasing costs of paywalls for access to scientific publications and for scholarly publishing cause inequalities and are becoming unsustainable for public research funders and institutions. They encourage Member States to support the further development of ORE into a collective, not-for-profit large-scale open access research publishing service for the public good, and to promote and support other subject-specific and national not-for-profit, open access publishing platforms and models that provide high-quality publishing services to researchers. On peer review, they underline the need to promote transparency through open peer review practices, and to give recognition and reward to researchers for peer review.

⁸ <https://open-research-europe.ec.europa.eu/>

⁹ <https://www.coara.org/>

¹⁰ https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/new-era-open-research-europe-2026-03-26_en

¹¹ <https://open-research-europe.ec.europa.eu/blog/towards-a-collective-and-equitable-open-access-scholarly-publishing-platform-open-research-europe-is-preparing-for-its-next-phase>

¹² <https://diamasproject.eu/>, <https://www.craft-oa.eu/>, <https://operas-eu.org/projects/past-projects/palomera/>

¹³ <https://edch.eu/mission-and-objectives>

¹⁴ <https://data.consilium.europa.eu/doc/document/ST-9616-2023-INIT/en/pdf>

Most recently, as mentioned in the Introduction, the EU has moved to embed equity in OS through its inclusion as a specific Action titled “Applying Equity in Open Science” within its ERA Policy Agenda for 2025-2027.¹⁵ ERA aims to foster the competitiveness and cohesion of the EU and its associated countries.¹⁶ Despite progress, equity challenges across the European research landscape remain pressing. As demonstrated by the most recent ERA Dashboard report (Directorate-General for Research and Innovation (European Commission), 2026), significant disparities remain in research and innovation (R&I) capacity and investment across regions, with concentrations of top-cited publications and ERC grants in a limited number of countries. There are also significant demographic disparities, including underrepresentation of women in senior (Grade A) academic positions and among highly cited authors. Such differences translate into differences in OS uptake, with wide disparities in terms of shares of OA publications, open datasets, number of repositories, and investments in research infrastructures. The Action on OS equity thus explicitly recognises many of the issues identified in this section, especially the unequal distribution of resources for OS implementation and foresees the need for targeted approaches to compensate for this to ensure equitable uptake. The Action aims to take stock of equity challenges, support not-for-profit models of Open Access, build skills and infrastructure capacities, and create policy recommendations for an EU approach to equity.

¹⁵ https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CONSIL:ST_8469_2025_INIT

¹⁶ Section 1, article 179 of the Treaty on the Functioning of the European Union states: “The Union shall have the objective of strengthening its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely, and encouraging it to become more competitive, including in its industry”.

See: <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12008E179:EN:HTML>

3. Equity in Open Science Infrastructures

Infrastructures are recognised as a key pillar of Open Science. This section reviews the landscape of Open Science infrastructures, examining how differences in governance, coverage and access shape outcomes for equity across diverse capacities and contexts.

3.1. Defining Open Science infrastructures

Infrastructures, as the basic systems and services that underlie the effective operation of societies or organisations, are everywhere. Yet their ubiquity and our routinised reliance mean they usually recede to the background of our perception, unnoticed until they fail or are disrupted at which point their essential role in our everyday lives and tasks is suddenly foregrounded (G. C. Bowker & Star, 1999; Heidegger, 1962; Star, 1999; Star & Ruhleder, 1996). Infrastructure is a relatively recent concept – emerging roughly a hundred years ago (Petroski, 2017) and at first referring mainly to public physical structures such as roads and sanitation. Gaining a more abstract dimension to include organisational and institutional systems after the second World War period (Guajardo Soto, 2023), current sociological conceptions emphasise a “relational approach” (Star, 1999, p. 382) encompassing material, social and environmental aspects (Fecher et al., 2021).

The sociologist Susan Leigh Star and colleagues (G. C. Bowker & Star, 1999; Star, 1999; Star & Ruhleder, 1996) characterise infrastructure via eight dimensions: (1) *embeddedness* within an environment of other technological and social structures; (2) *transparency* in reliable usage, standing ready to invisibly support tasks and practices; (3) *reach or scope* in space and/or time, i.e., available for use across time or at more than one site; (4) *learned through membership* as familiarity with artifacts and arrangements become taken-for-granted aspects of belonging to communities-of-practice; (5) *links to conventions*, encoding and supporting community conventions but also actively shaping those conventions through the system’s practical affordances and limitations; (6) *embodiment of standards*, achieving interoperability with other tools and infrastructures through standardisation; (7) *built upon an installed base* of difficult to change previous developments and embedded practices, hence also inheriting historical strengths and weaknesses (“path dependencies”) and displaying “inertia”, i.e., proving difficult to change; (8) *most visible on breakdown* (as mentioned above), and; (9) *proceed via incremental, modular development*, with layers of complexity meaning that change tends to filter upwards from the local level, via rounds of negotiation and adjustment, rather than being imposed suddenly from the global level.

Star’s theory highlights various general implications of infrastructures for equity. First, their incremental building upon the “installed base” means that historical or legacy inequities in design and governance may unknowingly perpetuate unless explicitly examined and challenged. Second, the infrastructural need for standardisation means there is an inherent tension between global interoperability and sensitivity to local conditions, which may mean marginalisation of some actors or practices; moreover, the inertia of standards may resist changes where inequities are identified and action desired. Third, the incremental nature of infrastructure development centres questions of power and governance in shaping which changes, made in whose interests, filter upwards to the global level; in addition, we might question whether Star’s account of the incremental, bottom-up nature of change adequately captures the situation for digital platforms, especially those that are privately-held, where changes in technology and policy can arguably be imposed from above more quickly and easily (Plantin et al., 2016). Fourth, the ways in which infrastructures shape possible pathways for engagement highlights their power for fostering or constraining actions, further spotlighting questions of design and governance in shaping who is included and excluded.

Fifth, the tendency of infrastructures to recede from perception mean these implications may often remain implicit unless explicitly thematised and examined via “infrastructural inversion” (G. C. Bowker, 1994) to foreground and examine their otherwise backgrounded inner workings. Finally, the embeddedness of infrastructures within other technological and social structures means that questions of equity will always be relational and extend beyond the specific infrastructure at hand, which may be seen in the case of how very basic digital divide issues of access to internet can shape engagement with data-sharing infrastructures (Bezuidenhout, 2025; Shanahan & Bezuidenhout, 2022).

Open Science infrastructures (OSIs) are a subset of the broader range of knowledge infrastructures that enable scholarship in general (Mayer, 2026). The UNESCO Recommendation identifies OSIs as one of four pillars of OS alongside open access to scientific knowledge, open engagement of societal actors and open dialogue with other knowledge systems. OSIs are defined as the “shared research infrastructures ... needed to support open science and serve the needs of different communities ... [and] provide essential open and standardized services to manage and provide access, portability, analysis and federation of data, scientific literature, thematic science priorities or community engagement” (UNESCO, 2021, p. 12). These are often, although not exclusively, digital infrastructures,¹⁷ and are assemblages of not just technical or physical apparatus, but also social, institutional, legal and governance arrangements (Mayer, 2026).

A key question, to which we will return throughout this report, is the extent to which OSIs should themselves be “open” across various dimensions. The UNESCO Recommendation signals strong preference for OSIs which are based on non-commercial models, community leadership and open-source technologies (pp. 12, 23). A major touchstone in defining requirements for such open infrastructures is the Principles of Open Scholarly Infrastructure (POSI Adopters, 2025), initially drafted in 2015 by Cameron Neylon, Jennifer Lin and Geoff Bilder, and since twice revised by the “POSI Adopters”.¹⁸ The Principles offer operating guidelines for open infrastructures covering stakeholder-led and transparent governance, sustainability measures and requirements for openness of source code and data.

Although there is no formal typology of OSIs, definitions (Ficarra et al., 2020; UNESCO, 2021) usually include:

- **Repositories:** Infrastructures for storage, curation and sharing of digital objects such as research data, literature, methods, software, and other scholarly outputs. As the UNESCO Recommendation describes (2021, p. 12), repositories are adapted to the objects they contain, as well as the local contexts and communities they serve. Yet they achieve interoperability through the use of shared standards and best practices, including: the FAIR (findable, accessible, interoperable, and reusable) principles; Open Archival Information System (OAIS)¹⁹ for long term preservation, good metadata, identifiers, and open standards) and associated protocols or standards for metadata,²⁰ metadata harvesting,²¹ and

¹⁷ Although not necessarily. The UNESCO Recommendation lists: “Open innovation testbeds including incubators, accessible research facilities, open license stewards, as well as science shops, science museums, science parks and exploratories, are additional examples of open science infrastructures providing common access to physical facilities, capabilities and services”

¹⁸ POSI Adopters are an informal group of those that have conducted self-assessments. Currently 27 organisations have done so, including many of the organisations we discuss in this section. See: <https://openscholarlyinfrastructure.org/adopters/>

¹⁹ ISO 14721:2025 Space Data System Practices — Reference model for an open archival information system (OAIS), <https://www.iso.org/standard/87471.html>

²⁰ E.g., PREMIS: <http://loc.gov/standards/premis/v3/>, METS: <https://www.loc.gov/standards/mets/>

²¹ <https://www.openarchives.org/OAI/openarchivesprotocol.html>

synchronisation;²² Dublin Core for basic metadata interoperability²³ ; and protocols for automated packaging and ingest of content such as BagIt, SWORD or REST/JSON APIs.²⁴ While some repositories are generalist (e.g., Zenodo, Open Science Framework, Figshare),²⁵ others are provided by institutions to host and manage their researchers' outputs, and others focus on distinct types of research object and/or disciplinary communities. Data repositories preserve and curate datasets, usually in line with the FAIR principles and often according to domain-specific standards (e.g., BioStudies for life sciences, ICPSR for social sciences, and in biology GenBank, the European Nucleotide Archive or PRIDE).²⁶ A number of European Research Infrastructures also provide, or enable access to, domain-specific repositories (in addition to other OS-relevant services including workflow tools and linking services).²⁷ Preprint servers are another dedicated type of repository that host pre-review versions of research manuscripts to speed dissemination of findings (e.g., arXiv, bioRxiv). Much alignment and development work relevant to data repositories is currently happening in Europe within the frame of the European Open Science Cloud (EOSC), and for global repositories in general through the Coalition of Open Access Repositories (COAR).²⁸

- **Publishing platforms:** Infrastructure to support the open dissemination of scholarly literature including OA articles and monographs. OA is traditionally divided conceptually into either *Gold* OA, Open Access journals, or *Green* OA, repository-based author self-archiving of manuscripts. Gold OA is often financially supported via Article Processing Charges (APCs); where Gold OA journals operate with no author- or reader-facing charges, this is often distinguished by the term *Diamond* OA. Current definitions often further specify Diamond to be “community-driven, academic-led and -owned” (Ancion et al., 2022). Traditional subscription-based journals which also offer OA for a charge are sometimes referred to as *hybrid journals*. The historical distinction between *Gold* and *Green* OA is blurred by the “Publish, Review, Curate” model (see section 4.6) in which manuscripts are made available in advance of review, often via preprint servers, which may remain the primary version of record (Corker et al., 2024).
- **Workflow and collaboration tools:** Infrastructure to support collaboration and documentation, including: Git-based repositories for code, electronic lab notebooks, and reproducible environments for analyses (e.g., Jupyter Notebooks²⁹); virtual research environments (VREs), integrated disciplinary platforms which combine collaboration and documentation functionalities with access to data, computing resources, and other tools via (e.g., CyVerse,³⁰ Blue-Cloud³¹); containerisation tools like Docker and Singularity for sharing of computational environments;³² project management tools like OpenProject or Trello³³;

²² <https://www.niso.org/publications/z3999-2017-resourcesync>

²³ <https://www.dublincore.org/specifications/dublin-core/>

^{24,24} BagIt: <https://www.digitalpreservation.gov/documents/bagitspec.pdf>, SWORD:

https://www.ukoln.ac.uk/repositories/digirep/index/SWORD_Project, REST/JSON: <https://jsonapi.org/format/>

²⁵ Zenodo: <https://zenodo.org/>, Open Science Framework: <http://osf.io/>, Figshare: <https://figshare.com/>

²⁶ BioStudies: <https://www.ebi.ac.uk/biostudies/>, ICPSR: <https://www.icpsr.umich.edu/sites/icpsr/home>, GenBank: <https://www.ncbi.nlm.nih.gov/genbank/>, European Nucleotide Archive: <https://www.ebi.ac.uk/ena/browser/home>, PRIDE: <https://www.ebi.ac.uk/pride/>

²⁷ E.g. e.g. CESSDA: <https://www.cessda.eu/>, CLARIN: <https://www.clarin.eu/content/repositories>, EPOS: <https://www.epos-eu.org/>, ICOS ERIC: <https://www.icos-cp.eu/>, MIRRI: <https://www.mirri.org/microbial-resources-data/>

²⁸ EOSC: <https://eosc.eu/>, COAR: <https://coar-repositories.org/>

²⁹ <https://jupyter.org/>

³⁰ <https://cyverse.org/>

³¹ <https://blue-cloud.org/blue-cloud-virtual-research-environment>

³² Docker: <https://www.docker.com/>, Singularity: <http://docs.sylabs.io/guides/latest/user-guide/>

³³ OpenProject: <https://www.openproject.org/>, Trello: <https://trello.com/>

collaborative writing tools like Overleaf and Google Docs,³⁴ and; Citizen Science platforms such as Zooniverse and iNaturalist³⁵ which enable broader publics to contribute to data collection, analysis, and monitoring.

- **Linking services:** Infrastructure that provides a common backbone through which researchers and research objects can be identified, discovered and connected. Such services are integral to OS, and are the services to which OSs most commonly interconnect (Ficarra et al., 2020, p. 50). Such services include: persistent identifiers to link research actors and outputs (e.g., ORCID for researchers, DOIs for research objects, ROR IDs for institutions, and RAiD for projects)³⁶, metadata standards, ontologies, and protocols for interoperability and information exchange (e.g., OAI-PMH, DataCite Metadata Schema, Crossref XML, schema.org),³⁷ service registries (e.g., DOAJ for OA journals, Re3data for data repositories)³⁸, and aggregation or indexing services which harvest, synthesise and curate such metadata for discoverability (e.g., OpenAIRE, BASE, Web of Science, Scopus, OpenAlex).³⁹ A key recent development is the *Barcelona Declaration on Open Research Information*, which calls for reduced reliance on proprietary services in favour of research information systems which are open, interoperable, and community-governed (Barcelona Declaration on Open Research Information et al., 2024).
- **Community, skills and governance:** The sociotechnical understanding of infrastructure developed above means we should also consider the initiatives that build OS communities, skills, norms, and governance as crucial infrastructure in its own right (e.g., EOSC, COAR, Research Data Alliance (RDA), The Carpentries, OpenAIRE, Reproducibility Networks, as well as various stakeholder policy and advocacy platforms).⁴⁰

In what follows, we will examine issues of equity in OSs along the dimensions of design, coverage and access. In line with the scope of this report, the aim is not to exhaustively list all instances of specific issues, but to identify the main tensions through reference to key examples.

3.2. Equity and infrastructural design

In this section, we investigate the implications of various dimensions of infrastructural design for equity: ownership; representation and governance; norms, values and standards; and funding, sustainability and labour.

3.2.1. Ownership

Thus far we have considered equity in the sense of equality of opportunity. In financial contexts, however, equity denotes ownership. These two senses are conceptually related insofar as ownership is associated with rights to participate in strategic decision-making and benefit-sharing.

³⁴ Overleaf: <https://www.overleaf.com/>, Google Docs: <https://workspace.google.com/products/docs/>

³⁵ Zooniverse: <https://www.zooniverse.org/>, iNaturalist: <https://www.inaturalist.org/>

³⁶ <https://orcid.org/>, <https://www.doi.org/>, <https://ror.org/>, <https://www.raid.org/>

³⁷ OAI-PMH: <https://www.openarchives.org/pmh/>, DataCite Metadata: <https://schema.datacite.org/>, Crossref XML: <https://www.crossref.org/documentation/schema-library/>, schema.org: <https://schema.org/>

³⁸ <https://doaj.org/>, <https://www.re3data.org/>

³⁹ OpenAIRE: <https://www.openaire.eu/>, BASE: <https://library.doc.gov/LitSearch/BASE>, Web of Science: <https://clarivate.com/academia-government/scientific-and-academic-research/research-discovery-and-referencing/web-of-science/>, Scopus: <https://www.elsevier.com/products/scopus>, OpenAlex: <https://openalex.org/>

⁴⁰ EOSC: <https://eosc.eu/>, COAR: <https://coar-repositories.org/>, RDA: <https://www.rd-alliance.org/>, Carpentries: <https://carpentries.org/>, OpenAIRE: <https://www.openaire.eu/>, Reproducibility Networks: <https://reproducibility.global/global-network>

In commercial enterprises, resources are invested to create marketable goods or services, with profit as the primary goal and metric of success, which means that commercial enterprises usually prioritise the enclosure and monetisation of value through exclusivity. Commons-based approaches, in contrast, emphasise shared value and collective governance, with creation and management of resources according to community interests and typically organised through more open access arrangements (Ostrom, 1990).

These differences in priorities have implications for equity. Firstly, market-driven priorities mean access to services is oriented to ability to pay rather than to users' needs. Next, market-forces drive consolidation and vertical integration,⁴¹ which may increase risk of "vendor lock-in" (Aspesi & Brand, 2020), limiting choice and enabling effective monopolies which may raise prices. Incentives for monetisation of data also leads to concerns of "surveillance capitalism" and the commodification of user data (Zuboff, 2020), or wider concerns for the ways in which platformisation empowers private actors to shape research behaviours (Mirowski, 2018; Rafols, 2025). Finally, private control means that services may be suddenly sold or shut-down without community consultation, as happened, for instance, with the social sciences preprint server SSRN (sold to Elsevier in 2016) or the Microsoft Academic Graph (suddenly discontinued by Microsoft in 2021). Note that in both of these latter cases, communities rallied through the establishment of open infrastructures in the form of the SocArxiv preprint server and OpenAlex bibliographic database.

Commons-based approaches are not immune to these influences, of course, although in collaborative governance and orientation around community values rather than profit, they may have more robust reasons to avoid them. Hence, a preference for open infrastructures has emerged amongst policy-makers and others. The UNESCO Recommendation makes the case as follows: "Open science infrastructures are often the result of community-building efforts, which are crucial for their long-term sustainability and therefore should be not-for-profit and guarantee permanent and unrestricted access to all public to the largest extent possible" (UNESCO, 2021, p. 12). The Recommendation further specifies that OS infrastructures should be "governed and owned by the community and funded collectively by governments, funders and institutions" (p. 23).

Nonetheless, simplistic opposition of for- and not-for-profit in moralistic terms may be counter-productive. Open infrastructures face equity challenges especially related to financial precarity (discussed below) and often need to evolve "business thinking" strategies which "assetise" content and services. As Gregory & Strecker (2026) discuss, such business strategies can assume their own agency, for instance in reorienting governance structures and priorities towards the needs of paying customers rather than all stakeholders. Similarly, challenges may persist within not-for-profits where other community values or activities are prioritised above OS, as may be seen in the historical reluctance of many scholarly societies to transition their journals to Open Access given their reliance on publication profits to fund other activities such as scholarships (Brainard, 2019; Fitzpatrick, 2012). Moreover, the communalistic imperative in the UNESCO Recommendation raises important questions of scope: are private companies to be completely excluded from OSI provision at all levels? If so, how should this work, given current ownership realities or potential conflicts with institutional, disciplinary or regional autonomy in service provider selection. Perhaps the more realistic question is of where the dividing line is to be drawn. Private companies, as discussed below in section 3.2.4, have structural advantages in terms of agility and innovation which may bring valuable benefits.

⁴¹ As has been seen in the scholarly publishing sector, for instance, where just a small number of major publishers both account for an increasingly large proportion of research publications (Larivière et al., 2015; Shu & Larivière, 2024) and have pursued strategies of developing portfolios of tools across research workflows (Posada & Chen, 2018).

A key marker in drawing such divisions is perhaps to look for the areas where private involvement threatens academic autonomy, where infrastructure plays a heavily constitutive role in defining research cultures, assessment criteria and forms of scholarly communication. In such areas, common ownership and community governance should be most vigorously pursued.

3.2.2. Representation and governance

Next, we can raise questions of who is empowered to participate in shaping OSIs, and at which stages. Commons approaches emphasise participatory governance, but here too there are issues of equity and representation. The Principles of Open Scholarly Infrastructure (POSI Adopters, 2025) suggest that governance should be via boards “drawn from the stakeholder community,” that membership should be non-discriminatory “where any relevant group may express an interest and should be welcome”, and operate transparently in its organisation and selection. A 2020 survey of OSIs by SPARC Europe (Ficarra et al., 2020) found tensions in governance around the need to balance community needs with those of clients providing direct financial support, variable levels of involvement amongst stakeholder categories, and issues of scale (i.e., resource constraints amongst smaller organisations and coordination challenges and difficulties in “ensuring inclusive representation” (Ficarra et al., 2020, p. 23) amongst larger infrastructures. Regarding the latter, where there are no formal mechanisms for selecting individuals to represent stakeholder groups, concerns will remain regarding whether individuals offer real or “assumed” representation (Houtzager & Gurza Lavalle, 2009). Hence, to enable meaningful and sustained engagement, OSIs may be advised to adopt a broader range of participatory mechanisms to ensure responsiveness to communities, such as stakeholder fora, co-creation workshops, continuous feedback platforms or so-called “pop-up governance”, time-bound mechanisms that are quickly established for specific purposes (Kaye et al., 2015).

Ensuring inclusion may also involve broader thinking and engagement regarding stakeholders. Kaye et al. (2018) discuss the case of data-sharing policy and infrastructure in the biomedical sciences, where they argue that decision making is often piece-meal and based largely on the interests of hegemonic actors, with scant consideration of the interests of research participants who contribute data, for example. This, the authors say, “can not only lead to inequalities between researchers in low- and high-resourced countries, but also an agenda that does not necessarily embody the concerns of research participants.” Kaye et al. suggest broader participatory mechanisms, including use of ORCID identifiers to govern granular access rights, “Dynamic Consent” applications for modification of consent over time, and systems for ongoing engagement of stakeholder engagement.

Finally, governance may include provisions regarding participation in design from the earliest stages. Bezuidenhout & Havemann (2021) surveyed the landscape of digital tools for OS and found that the overwhelming majority were located geographically in either the U.S. or Europe. They make the point that local origin is important since even services intended for global reach may reflect local values and have restricted input from researchers from other regions at the design and early development phases. As the technology stabilises, fixing design and user communities, later communities will have less opportunity to shape the fundamental architecture and hence risk the imposition of tools unsuited to their research contexts.

3.2.3. Norms, values and standards

The emphasis on participatory design and governance in OS Infrastructures is essential given the ways in which infrastructures, as the “embodiment of standards” (Star, 1999, p. 381), *inscribe* “programmes of action” which can shape community values, norms and forms of social structuration.

The concept of inscription, taken from actor network theory, refers to the ways technologies embody social roles, relationships and patterns of use (Akrich, 1992; Akrich & Latour, 1992). Such inscriptions shape possibilities for action, structure modes of access, encode rules via standards and classifications, and shape the visibility of actors and things. This is not deterministic; users are not powerless to affect developments, as usually some degree of “interpretative flexibility” (Pinch & Bijker, 1984) remains. Hence users may implement so-called “antiprograms” (Latour, 1990) through which the patterns of use can be subverted and programs renegotiated. Yet, as Bezuidenhout and Havemann pointed out above, the greater the degree of stabilisation and “technical closure”, the more difficult it will be to change systems fundamentally.⁴² The practical technological affordances that result from the inscription of norms and values in OSIs help shape user interactions and define the scope of openness in practical terms.

A particularly vivid example is that of the role of standards. Standards are “any set of agreed-upon rules for the production of (textual or material) objects” (G. C. Bowker & Star, 1999, pp. 13–14). Their settlement is, on the view of Ciborra & Hanseth (2009, p. 314), the “crucial issue” in infrastructural design. Standards aim at interoperability across space and time. As such, there can be a tension in balancing universality with sensitivity to local contexts. In the words of Santana (2024, p. 254) “standards standardize”, that is, their very intended effect is homogeneity. However, the diversity of research and researchers may challenge this homogeneity, and equity may be at stake where mismatches occur. A primary solution is to include as many diverse voices as possible at design stages (Lyu et al., 2025). Yet despite all best efforts, it may be impossible to consider and incorporate the needs of all user groups. Alternatively, new needs may emerge over time, where standards are already engrained and change can be difficult due to standards’ “significant inertia” (G. C. Bowker & Star, 1999, p. 14). For example, the aim of the ORCID identifier is to enable “a permanent, clear, and unambiguous record of research and scholarly communication by enabling reliable attribution of authors and contributors”.⁴³ However, this conflicts with the sensitivities of the transgender community regarding the visibility of name changes (Gaskins & McClain, 2021). Since ORCID conforms to the NISO ISO 27729 standard for identifying public names, any policy change requires ratification at that level. ORCID commendably maintains a public record of their progress on EDI actions,⁴⁴ which shows they moved to address this issue in 2022, agreeing to co-chair a NISO working group on the subject. However, reflective of Bowker and Star’s point about “inertia”, the last update (in December 2024) was that this “Continues to be on hold with NISO”, seemingly attributable to organisation constraints within NISO.⁴⁵

Another example may be seen in policy approaches to the licensing of open data. The Principles of Open Scholarly Infrastructure advise that “infrastructure should aim to make all relevant data openly available, following best practices such as applying a CC0 waiver where appropriate” (POSI Adopters, 2025). CC0 is essentially a public domain dedication that allows reuse, modification and distribution without permission or attribution. POSI is not alone in advocating it as “best practice” (Labastida & Margoni, 2020; Wilbanks, 2008). This reflects a prioritisation of values, however – privileging the free circulation of data⁴⁶ over the rights of credit for individuals, especially of issue for researchers in lower-resource environments who fear better-funded researchers may gain at their expense (Bezuidenhout & Chakauya, 2018).

⁴² In the words of Star (1999, p. 393), “In information infrastructure, every conceivable form of variation in practice, culture, and norm is inscribed at the deepest levels of design. Some are malleable, changeable, and programmable—if you have the knowledge, time, and other resources to do so. Others—such as a fixed-choice category set—present barriers to users that may only be changed by a full-scale social movement.”

⁴³ <https://info.orcid.org/what-is-orcid/>

⁴⁴ <https://trello.com/c/bVPupQc6/6-supporting-name-changes-for-woman-and-trans-researchers>

⁴⁵ In the words of Bowker & Star (1999, p. 14), “Standards have significant inertia and can be very difficult to change.”

⁴⁶ In the words of Labastida & Margoni (2020), “Open Science is easier to achieve if less restrictions are present for the reuse of data”.

This tension was revealed during the SARS-CoV-2 pandemic, in the case of the GISAID⁴⁷ database (Leonelli, 2022, 2023). As a response to fears regarding credit, GISAID specifically requires user agreements mandating attribution and restricting some forms of reuse. However, these constraints attracted harsh criticism for stifling interoperability and data mining (Leonelli, 2022).

Other communities have also challenged the narrative of maximally unrestricted reuse. Perceiving that the FAIR Principles take a “data-centric” view, for instance, the CARE Principles for Indigenous Data Governance (Carroll et al., 2020) offer an alternative “people and purpose-oriented” normative framework. The CARE Principles foreground data control and recognition with the explicit aim of avoiding colonial dynamics of extraction and exploitation. The calls for universal openness of data recall what Star (1999, pp. 384–385) terms a “master narrative”, “a single voice that does not problematize diversity ... [and] speaks unconsciously from the presumed center of things”, which operates via the creation of global actors and a monolithic agenda. Leonelli makes the point that by ignoring such socio-political factors in the quest to make data as open and interoperable as possible, advocates of public domain licensing may paradoxically be limiting the diversity of data by inhibiting some from sharing at all.

Finally, we may consider the ways in which systems of classification may also have unintended consequences for equity. Indexes and registries, which exist to filter and categorise, are by their nature exclusionary. Issues may occur, however, when standards are set which are not realistically attainable across contexts, potentially privileging better-resourced and internationally visible services – especially since inclusion influences not only visibility but also acts as a symbolic marker of quality and prestige. For example, major commercial indexes such as Web of Science and Scopus have been long-criticised for systematically underrepresenting scholarship from the Global South, non-English-language publications, and locally oriented research, thereby shaping uneven representations of global research (Asubiaro et al., 2024; Bellen et al., 2025; Rafols, 2025). OpenAlex partially addresses these limitations through broader and more inclusive coverage, although significant regional disparities in representation and metadata quality remain (Chavarro et al., 2025; Simard et al., 2025; Zheng et al., 2025). Another case along similar lines, that of the “DOAJ Seal”, further demonstrates these dynamics, and also acts as a positive example of how open infrastructure’s responsiveness to communities can address unintended consequences.

The Directory of Open Access Journals (DOAJ) is part of the core common infrastructure of OS, highly integrated into many other tools and services (Ficarra et al., 2020, p. 50). DOAJ, as a community-driven index of OA journals, performs an essential function. Open Access journals have been plagued since inception by spurious generalisations regarding quality, not helped by the rise of so-called “predatory publishing” (Tennant et al., 2016). Acceptance of journals into DOAJ is subject to quality assurance checks regarding the transparency and robustness of publication processes, which DOAJ proudly proclaim “a gold standard for open access publishing”.⁴⁸ In addition to their basic criteria governing inclusion, DOAJ until recently also offered the “DOAJ Seal”, an enhanced marker that aimed to “encourage journals to strive for best practices” by acknowledging their meeting stricter criteria related to preservation, identifiers, granular metadata, permissive and machine-readable licensing and author retention of copyright.

⁴⁷ <https://gisaid.org/>

⁴⁸ <https://doaj.org/about/>

While initially effective in driving improvements, the Seal was retired following a stakeholder consultation in March 2025. DOAJ noted that fewer than 10% of indexed journals had obtained the Seal, but that almost 90% of those journals were from the Global North, which was recognised as problematic as the Seal had come to be seen as a proxy for “high editorial quality and prestige” and even a “yardstick” for journal recommendation.⁴⁹

Choices amongst standards and classification schemas are a necessary part of the infrastructural achievement of interoperability, reach and scope. Standards do not develop in a vacuum, however. Shaped by the path dependencies of the installed base and need to fit into the other social and technical systems within which they are embedded, compromises, ambiguities and blind spots should be expected. These choices are not neutral technical decisions; they inscribe values. Standards set pathways for interaction and classifications set criteria for inclusion and exclusion whose symbolic power may extend beyond their original intention (as with the DOAJ Seal example). Standards also display inertia, difficult to adapt once settled in practice, as we saw with the ORCID case. Finally, standards may be expressed at higher levels, but they are always experienced locally, embedded in and made meaningful by local practices. These factors underline the importance of greater inclusion of diverse voices within design decisions, focus on the linkage of locally-working solutions rather than universalist solutions imposed globally (Ciborra & Hanseth, 2009, p. 315), foresight regarding possible unintended consequences, and commitment to change course where problems are identified.

3.2.4. Funding, sustainability and labour

Issues of funding and sustainability are central to OSI design. They fundamentally structure priorities, participation and long-term development trajectories. In their comparison of strategies for infrastructural development amongst OS services, Fecher et al. (2021) found that “differences between commercial services and non-profit services permeated almost every aspect of their responses to their environment”. The authors found that commercial services tend to operate with greater financial and organisational stability, enabling higher investment in marketing, recruitment of highly skilled staff, and agile development practices that respond quickly to user demands. In contrast, non-commercial services are constrained by limited and short-term funding (often via projects), which constrains scope for long-term planning, agility in development due to rigid project-logics leading, and attracting and retaining development staff.

These findings are supported by Ficarra et al.’s (2020) survey of European OSIs, where grants from national government or the European Commission were reported as the most common income sources amongst not-for-profit respondents. A large proportion also advised that without such funding they would be viable for less than a year. Again, in line with Fecher et al., the biggest sustainability challenges were “costs and funding, a lack of resources such as staff or equipment and the ability to keep up with technological development” (p. 5). Services were most commonly run by small core teams (two-five full-time equivalents), with about half of services dependent on volunteer contributions (p.42). These differences pose structural disadvantages for non-profit, open infrastructures as opposed to the commercial counterparts. There are also equity implications for individuals regarding voluntary contributions.

Scholars may be motivated to contribute voluntary work to open infrastructures for a range of reasons. In his examination of “commons-based peer production” in “The Wealth of Networks”, Yochai Benkler finds volunteers motivated by intrinsic motivations like enjoyment or curiosity, skill-building, networking and social dependencies, social signalling and reputation, and normative commitments to the commons (Benkler, 2006).

⁴⁹ <https://blog.doaj.org/2025/01/08/results-of-our-community-consultation-forthcoming-changes-to-our-metadata-part-ii/>

All of these have been found at play in the context of scholar contributions to new models of peer review (Kaltenbrunner, 2025) and Diamond Open Access (Taubert et al., 2024). Voluntary work performed under such motivations arguably reflects norms of “communalism” (Merton, 1973) or the accumulative and relational nature of scientific capital (Bourdieu, 2004). As such it is not necessarily an issue for equity. It may become so, however where contributions are coerced, fall excessively upon disempowered populations, or where work remains “invisible” to structures of reward and recognition.

These ambiguities may be seen in various areas of OS infrastructures. For example, Skinner et al. (2025) investigated sustainability issues in infrastructure for open research software. While some participants saw voluntary contributions as a “sign of health” of the community, others thought that reliance on volunteerism could limit contributions from those with fewer resources of income or time, risk “volunteer burnout” especially amongst those tasked with maintenance, and reduce opportunities for “exposure, training and mentorship” (Skinner et al., 2025, p. 18).

Just as infrastructure itself usually recedes into the background of our perception, much of the work to build and maintain it happens behind-the-scenes. Roughly half of work in open-source software ecosystems, especially non-coding maintenance tasks like content moderation, are invisible (Meluso et al., 2025). This is a particular issue since marginalised populations tend to spend disproportionate amounts of their time on hidden service work (Group, 2017). For example, data curation work, an area where women contribute proportionally more than men (Larivière et al., 2021), is often “invisible” (Pasquetto et al., 2025). Such concerns may also be seen in the case of Diamond OA, where funding is the main challenge (Bosman et al., 2021; Taubert, 2026; UNESCO, 2025). Diamond journals “often depend on a patchwork of in-kind contributions, funding by various types of institutions, and temporary grant money” (Ancion et al., 2022). An international survey found that around 60% of Diamond OA journals rely on volunteerism, with the vast majority (86%) of those indicating at least a medium level of dependence (Bosman et al., 2021). A number of respondents in Hahn et al.’s study of Swiss Diamond OA journal editors framed the issue in terms of “self-exploitation”, with one starkly advising “Our business model is exploitation” and another specifically voicing concern for junior colleagues: “I think one of the major pain points is ... my two colleagues, have their PhD dissertations to write. They’re doing the bulk of the work. And I think that’s sometimes difficult to balance” (Hahn et al., 2023, p. 18). Reliance on voluntary work can also mean unequal distributions of labour. Since contributions cannot be enforced, often tasks are shifted to more committed (often overly-committed) team members (Taubert et al., 2024).

Communities are responding to these challenges of infrastructure sustainability. For example, the Diamond OA Action Plan places great emphasis on cost-transparency and sustainable funding mechanisms (Ancion et al., 2022). More broadly, coalition approaches to funding have emerged in the form of The Global Sustainability Coalition for Open Science Services (SCOSS),⁵⁰ formed in 2017 to coordinate cost-sharing for non-commercial services. To date more than 6.4m EUR have been committed to sustain almost 20 organisations (Treadway & SCOSS, 2025). The US-based non-profit Invest in Open Infrastructure⁵¹ similarly aims to coordinate investments in open infrastructure, with the support of funders and institutions. Finally, we may point to initiatives such as the recent announcement regarding the expansion of Open Research Europe, which details its progression from a Diamond OA platform for EC-funded research based on proprietary technologies to an open-source platform (hosted by CERN) for researchers across the countries who contribute consortial funding and governance.⁵²

⁵⁰ <https://scoss.org/>

⁵¹ <https://investinopen.org/>

⁵² <https://open-research-europe.ec.europa.eu/blog/towards-a-collective-and-equitable-open-access-scholarly-publishing-platform-open-research-europe-is-preparing-for-its-next-phase>

3.3. Equity and infrastructural coverage

OSIs have developed unevenly across regions, disciplines, and institutional contexts, often shaped by agendas originating in well-resourced nations and particularly within the quantitative disciplines. As discussed, the sociotechnically-embedded, iterative and modular nature of infrastructure development means that, even where infrastructures are intended for broad global use, they may nevertheless inscribe the values and assumptions of their originating contexts. In this section, we examine the equity implications of OSI coverage across the dimensions of geography, discipline, language, and resource type.

3.3.1. Geographic coverage

OSIs show strong geographic concentration in a limited number of regions, especially Europe and North America (Bezuidenhout & Havemann, 2021). For example, of the data repositories catalogued by the registry Re3data, the United States alone accounts for 1219 repositories, followed by Germany (574), Canada (416), the United Kingdom (331), and the European Union (292). Repository coverage in majority world countries is comparatively much lower, where even countries with very large populations such as India and China have only 70 and 86 registered repositories respectively. Coverage within the EU is similarly uneven, with numbers in comparatively large countries like France (146), Italy (71) and Spain (67) piling in comparison to Germany, and a long-tail of single or double-digit numbers in “Widening Participation” countries.⁵³ Similar disparities can also be seen, for example, in the distribution of European Strategy Forum on Research Infrastructures (ESFRI) initiatives whose headquarters and distribution of national nodes are heavily concentrated in larger Western European countries, particularly France, the Netherlands, Germany, Italy, Spain, Belgium, and the UK (Hoffert, 2024, pp. 16–17).

The implications of OSIs’ geographic origin depend in part on their geographic scope. Ficarra et al. (2020) found that amongst the European OSIs they surveyed, there was a roughly even split between those operating either nationally (46/118) or globally (57/118). A lack of nationally-focused infrastructure may mean dependence on generalist solutions hosted elsewhere, with potentially detrimental impacts on local autonomy, diversity and innovation. Even where those in underserved regions have access to globally-targeted infrastructure hosted elsewhere, this may come with inscribed norms, values and standards which better reflect the contexts of their development than their usage. Such dependencies assume an increased significance in light of the current growth of concerns regarding research security, data governance and digital sovereignty (Rüffin et al., 2026).

Geographic location can also have implications for the geographic scope of the content OSIs cover. This may be seen readily in the example of indexing databases mentioned above, which have been argued to over-represent Global North contributions. In addition to the cases of Web of Science, Scopus and OpenAlex already mentioned, this can also be seen in other cases such as the emerging proprietary database of policy document citations Overton⁵⁴ (Szomszor & Adie, 2022). As pointed out by Zheng et al. (2025), such unevenness of the geographic coverage of content introduces downstream risks for comparative metaresearch, research assessment and policy analysis since it is unclear whether apparent gaps or trends are artefacts of infrastructural bias or true reflections of research activity.

⁵³ Data gathered from re3data.org on 10th May 2026. Note that these disparities may partly reflect uneven representation within re3data itself. However, this limitation would be unlikely to fully account for the scale of the observed differences. Equity implications of the geographic coverage and representativeness of OSI indexes and registries is discussed further below.

⁵⁴ <https://www.overton.io/>

While much of the above reflects geographic divides regarding relative levels of power and resources, we must avoid conceptualising patterns of infrastructural coverage strictly in such terms. Despite geographic clustering of the very large publishers in Europe and the US, OA publishing also demonstrates the existence of diverse regional infrastructural ecosystems, especially in Latin America where platforms like SciELO and Redalyc⁵⁵ have long made open, non-commercial and community-governed publishing the regional norm. Against a background of concerns for the ways encroaching commercialisation and monopolisation of OA globally may negatively impact this ecosystem, scholars have flagged a further implication for equity beyond gaps in provision or representation, namely the need for greater reflection and action to ensure that dominant actors do not erode locally embedded, community-specific, or non-commercial forms of knowledge dissemination (Alperin, 2022; Córdoba González, 2024; López Aguado & Becerril García, 2019).

3.3.2. Disciplinary coverage

There is also considerable variation regarding infrastructure readiness and interoperability across fields (Knazook, 2023). Perhaps the broadest tension lies between STEM and SSH disciplines, however. Disciplinary divides in OS can be symbolised by its very name, since the English term “science” usually denotes something separate and distinct from the arts, humanities and social sciences. A persistent concern has been for the ways in which OS principles and practices reflect the priorities of STEM disciplines and hence implicitly encode understandings of research as quantitative, experimental, data-intensive or computational (Knöchelmann, 2019; Leonelli, 2018, 2023; Penders et al., 2019). For example, the association of OS with agendas of universal data-sharing or reproducibility have been heavily shaped by the disciplinary communities from which they derive.⁵⁶ But work which is often highly situated, interpretative, or conducted in sensitive settings does not easily map to ideals of universal sharing or total transparency. Communities in SSH are then faced with either adapting these framings to fit their own contexts or expending considerable efforts in pushing back to contest their relevance. Infrastructural development in areas of SSH has hence sometimes been more limited and fragmented than in other areas. The 2021 ESFRI Roadmap for development of European research infrastructures, for example, identified addressing uneven coverage for SSH disciplines, particularly services for data curation and sharing infrastructures, as a priority. Another illustration is given by FAIRsharing registry of standards and guidelines where only 167 of the total 1,954 records apply to SSH disciplines.⁵⁷ Even OSIs aimed at cross-disciplinary coverage may be perceived and experienced differently across contexts. For example, ORCID aims to provide unique identification for all researchers, yet its uptake and perceived relevance are markedly lower in SSH than in STEM (Porter et al., 2025; Schnieders et al., 2022). Continuing the above theme regarding the representativeness of indexing services, the proprietary services Web of Science and Scopus are well-known to under-represent the humanities and social sciences (Larivière & Macaluso, 2011; Mongeon & Paul-Hus, 2016; Simard et al., 2025). Maddi et al. (2025) advise that OpenAlex’s broadened inclusion criteria mean it has a much better balance of coverage in this respect.

⁵⁵ SciELO: <https://www.scielo.org/en/>, Redalyc: <https://www.redalyc.org/>

⁵⁶ The FAIR principles were written largely by life or computer scientists; the reproducibility agenda originally grew from concerns in experimental, statistics-oriented disciplines like psychology and clinical medicine.

⁵⁷ <https://fairsharing.org/search?fairsharingRegistry=Standard>

3.3.3. Linguistic coverage

More than just a practical barrier, linguistic exclusion in scholarship is a form of epistemic injustice that devalues certain perspectives and constrains the intelligibility of local knowledges (Fricker, 2011).⁵⁸ From a capabilities perspective, this means language shapes not only our possibilities for participation in knowledge production but also our freedom to think, communicate and act in locally-meaningful terms. Over 7000 languages are spoken globally (Ritchie et al., 2024). Yet English increasingly dominates scholarship: despite being spoken by less than 20% of the global population, and under 8% being native speakers (Bahji et al., 2023), it is the language used in 85% of publications (Pradier et al., 2026). While use of a common language has advantages for general communicability, its global use disadvantages non-native speakers through added cognitive burden or discrimination related to language fluency (Curry & Lillis, 2007; Lillis & Curry, 2010), threatens local-language communication or disciplines (especially in SSH) where local languages remain the norm (Bock & Stroud, 2021; Kulczycki et al., 2022), and is a barrier to societal uptake amongst policy-makers and others (Amano et al., 2016; Pölönen, 2022).

Multilingualism is explicitly foregrounded in UNESCO definition of OS as a movement intended, in part, “to make multilingual scientific knowledge openly available, accessible and reusable for everyone” (UNESCO, 2021, p. 7). Yet at the infrastructural level, substantial work is needed, as may be seen in various areas. Ficarra et al. (2020) report that English was the primary language for more than 80% of OSIs surveyed. Within publishing, the “Helsinki Initiative on Multilingualism in Scholarly Communication”⁵⁹ spotlighted the importance of multilingualism for accessibility and urged action to ensure local relevance and broader societal impact of research (Helsinki Initiative, 2019). Amongst its recommendations to foster and reward multilingual dissemination, the Initiative explicitly identified protection of “national infrastructures for publishing locally relevant research” as a key area for action. A recent UNESCO consultation on Diamond OA also highlighted the general need for greater “linguistic inclusion” in publishing platforms (UNESCO, 2025, p. 11). At the level of linking-services, 84.5% metadata records in Crossref⁶⁰ are exclusively in English, with just 12.4% containing at least one non-English language (Donathan et al., 2026). Finally, a survey by the COAR Task Force on Supporting Multilingualism (2023) found that for 57% of institutional repositories, English was the main language of repository records (47% if excluding UK-based repositories).

Technical proposals for repositories and publishing platforms include greater focus on inclusive metadata and multilingual interfaces for users and providers (COAR Task Force on Supporting Multilingualism and non-English Content in Repositories, 2023; UNESCO, 2025, p. 11). Enabling multilingualism within OSIs presents not only a technical, but also a coordination challenge, however, especially amongst not-for-profit infrastructures subject to the difficulties of funding, sustainability and labour noted above. For example, Lujano Vilchis et al. (2026) have recently reflected on DOAJ’s twenty-year journey of DOAJ from an original list of almost exclusively English-language journals to today’s index of 22,000 journals from 139 countries in 89 languages sustained through coordination of a team of over 100 volunteer editors. “Time zones, local politics and policies,” they advise, “all contribute to the complexity of building and maintaining a truly global team” (Lujano Vilchis et al., 2026, p. 170).

⁵⁸ Miranda Fricker terms these forms of exclusion “testimonial” and “hermeneutic” injustice respectively.

⁵⁹ <https://www.helsinki-initiative.org/>

⁶⁰ Crossref is an “open infrastructure to link research objects, entities, and actions”, <https://www.crossref.org/>

Advancing infrastructural multilingualism is a clear use-case for AI, especially Large Language Models, including translation of metadata and content (L. Bowker, 2025). However, such tools must be carefully developed and monitored to ensure they do not introduce new equity challenges. Issues include risks of hallucination or error leading to misrepresentation of translated content, differences in language-coverage of training data meaning differential performance or biases in translation of under-represented languages, potential further reliance on closed systems (given the emerging oligarchic landscape of proprietary LLMs), and risks of furthering digital divides given the costs for technological or skills development (Hosseini et al., 2025). Recognising these opportunities and challenges, Hosseini et al. (2025) recommend we prioritise development of transparent, open-source and community-governed tools for such cases, including appropriate safeguards, human oversight and transparent reporting. The authors further urge continuing development of institutional guidance, monitoring mechanisms, and critical reflection as components necessary for avoiding the reinforcement of inequities and misinformation.

3.3.4. Coverage across research processes and resource types

Finally, we may examine the levels of infrastructural coverage for different kinds of research processes and content. OS covers a diverse range of activities, and its development may be seen to have followed a temporal sequence of prioritisation – first Open Access, then open (and later FAIR) data initiatives, with more recent focus on increased sharing of less traditional research outputs (e.g., software and code, workflows, protocols, peer review or research information). This is largely reflected in patterns of infrastructure maturity, with broader or more robust coverage for resource types associated with earlier priorities. This is not to say that significant gaps do not exist even in the more mature areas, especially where focus has changed over time and at the intersections with aspects of geographic, disciplinary coverage. With all this in mind, we first discuss infrastructures for OA, where these dynamics can be readily seen.

OA publications: Since the emergence of the OA movement at the turn of the century, a rich network of Green OA repositories and Gold OA journals has emerged. As reported by the EC (Directorate-General for Research and Innovation (European Commission), 2026), OA now accounts for 66.5% of publications in all EU Member States, although this remains highly variable amongst countries (with the highest achieving OA shares of almost 90%). However, while OA infrastructure may be considered relatively robust, there are significant gaps with equity implications:

- **Diamond OA:** First, growing recognition of exclusionary effects associated with APCs has prompted renewed emphasis on models for Diamond OA. As discussed above, given their close association with smaller-scale, locally-situated and linguistically diverse publishing, Diamond OA models are particularly significant in SSH disciplines. The 2022 Diamond OA Action Plan identifies four priority areas, all of direct relevance here: (1) Alignment and sharing of infrastructure and resources; (2) improvement of quality via an international Diamond OA framework and self-assessment tools; (3) capacity building through new tools and a new Diamond capacity centre;⁶¹ and (4) action to ensure financial sustainability and community governance.
- **OA books and monographs:** The disciplinary dimension is also evident in the case of OA books and monographs, since those formats are a primary mode of dissemination in SSH. A recent report from the Knowledge Equity Network found that “longform OA is widely endorsed in principle, but structurally marginal in practice”, accounting for just 17% of scholarly books published in 2024 (Estelle et al., 2026, pp. 6, 18).

⁶¹ The Diamond Capacity Hub, <https://edch.eu/>, was launched in 2025 as a programme of the OPERAS SSH Research Infrastructure, <https://operas-eu.org/>

Technological needs included improved bibliographic datasets and indexing capacities, more consistent assignment of persistent identifiers, improved metadata and metrics (p.53). But funding was identified as the central constraint: “capped, fragmented, and misaligned” even in well-resourced contexts, and generally unaffordable at the middle- and lower-income levels (although with pockets of OA in some very low-resource environments). In addition to calling for greater shared vision and international leadership, the report recommended increased focus on “sustainable collective funding models and open infrastructure” (p. 9).

- **Preprints:** Preprints are well established in disciplines like mathematics and physics,⁶² where 27% and 20% of published articles have associated preprints respectively, but uptake is much lower in other disciplines. Adoption also varies geographically, with Europe and the Americas leading and Africa and Asia the least developed. Intra-region disparities are also apparent – uptake in Northern and Western European is much higher than in the South and East (Rzayeva et al., 2025). The Directory of Open Access Preprint Repositories⁶³ lists 107 repositories, 30% of which are multidisciplinary, suggesting infrastructure availability alone is not the main barrier. Instead, as identified by a 2022 report by the Invest in Open Infrastructure initiative (Penfold, 2022), key challenges relate to a need for greater orientation to local-needs (including regional ownership and linguistic diversity), investment in capacity building and community leadership, stable funding and sustainability models, and greater focus on shared, open infrastructures.
- **Publish, Review, Curate:** Broader calls to rethink the current scholarly communication system have contributed to the emergence of the “Publish, Review, Curate” model in which manuscripts are shared in advance of review, and then later curated in various ways (Corker et al., 2024; Stern & O’Shea, 2019). We discuss this model and its implications for equity in depth in section 4.6, but here we may briefly note that substantial infrastructural development is still required to mainstream this model. 2026 will see the formation of the PRC Alliance,⁶⁴ a new community initiative to foster such action. Their priorities include open infrastructure and platforms to support review and curation services, standards for metadata, formatting, identification and interoperability support, and sustainable funding models.⁶⁵

Research data: As discussed above, research data infrastructure is also relatively mature, with a robust ecosystem of repositories and diverse metadata standards supporting data curation, preservation and sharing. As seen, however, gaps exist with regard to the geographic location and disciplinary coverage of data repository infrastructure which may impact upon equitable uptake of OS practices relating to data. As highlighted by Hodson & Gregory (2024, p. 15), a particular issue is the uneven development of metadata standards for data interoperability both within and across fields: “While some domains are well organised regarding metadata exchange, others rely on the organic emergence of good practices which remain relatively ungoverned or are dominated by the implementations of major infrastructure players.” Particularly advanced are those fields where collaboration has been made historically necessary by shared reliance on very large infrastructures, such as astronomy, high-energy physics or earth science (Rokem et al., 2025), or in areas where breakthrough research is often predicated on the combination and comparison of very large quantities of data collected in a distributed manner, such as genomics (Field et al., 2011). In other areas, research communities still need support to develop and implement standards appropriate to their fields.

⁶² The arXiv (<https://arxiv.org/>) was founded in 1991 by Paul Ginsparg as an online archive for physics preprints, expanding later to cover mathematics, computer science, and other fields. It built, however, on an earlier analogue culture of the centralised circulation of paper copies, coordinated via CERN since the 1960s (Roth, 2026).

⁶³ <https://doapr.coar-repositories.org/disciplines/>

⁶⁴ <https://publish-review-curate.org/>

⁶⁵ <https://publish-review-curate.org/actions-needed-to-advance-prc/>

Although one EC study found that financial sustainability is reported to be less of an issue where repositories operate with commitments to sustainability from institutions or governments (Directorate-General for Research and Innovation (European Commission) et al., 2022), for many repositories developing sustainability strategies that align with commitments to open infrastructure is a challenge. Strecker et al. advise that 6.2% data repositories indexed in the re3data registry had been shut down, most commonly due to organisational or economic factors (2023). According to the OECD, business models for data repositories require understanding of a repository's level of maturity, stakeholders, product/service offerings, costs, and suitable revenue sources to result in a strong value proposition whose research and economic impact can be measurably communicated (OECD, 2017). Tensions occur, however, in aligning funding and services with stakeholder needs and policy priorities, which may mean the evolution of governance structures. Gregory and Strecker discuss, for example, how “business thinking” at the Dryad data repository led to changes “from community governance representative of researchers to a model based on stakeholder (customer) representation, composed mostly of publishing and institutional representatives”, creating a tension in balancing perspectives (Gregory & Strecker, 2026).

Software and code: As detailed in the recent Invest in Open Infrastructure report “The State of Open Research Software Infrastructure” (Skinner et al., 2025), research software is still underappreciated as a research output in its own right. This is reflected in the maturity of its infrastructures, where despite much progress over the last decade, the landscape remains largely fragmented, underfunded, and reliant on volunteer labour and short-term grants. Key aspects of the current landscape include: file directories for short- to medium-term storage, supporting collaborative file sharing version control and project management such as GitHub and GitLab;⁶⁶ repositories and registries for long-term preservation (e.g., Zenodo, Software Heritage, the Astrophysics Source Code Library (ASCL), and the Research Software Directory);⁶⁷ metadata and citation initiatives like CodeMeta and Citation File Format;⁶⁸ community and governance organisations including the Software Sustainability Institute, Research Software Alliance (ReSA) and the Society of Research Software Engineers;⁶⁹ and curation and publishing initiatives such as the Journal of Open Source Software (JOSS), rOpenSci, and pyOpenSci.⁷⁰

In spite of these commendable, community-led initiatives, the IOI report describes several related structural challenges with implications for equity (Skinner et al., 2025, pp. 17–18). First, challenges of funding and sustainability are particularly acute, stifled by a lack of transparency regarding funding arrangements and a tension with traditional cultures of open source as contributor- or volunteer-led. Second, reliance on often invisible volunteer work, in the words of Skinner et al., narrows the pool to those with “with existing power, income, and reputation”, risks “volunteer burnout” and hampers development of the next generation. Third, there is a lack of participatory representation (note that all of the above-named initiatives are based in North America or Western Europe), with some interview participants voicing concerns about the implications of this for equitable access and usage. Finally, some see a need for greater empowerment of software communities in the creation of standards to avoid policies predicated on practices in other areas.

⁶⁶ GitHub: <https://github.com/>,

⁶⁷ Zenodo: <https://zenodo.org/>, Software Heritage: <https://www.softwareheritage.org/>, ASCL: <https://ascl.net/>, Research Software Directory: <https://research-software-directory.org/>

⁶⁸ CodeMeta: <https://codemeta.github.io/>, Citation File Format: <https://citation-file-format.github.io/>

⁶⁹ Software Sustainability Institute: <https://www.software.ac.uk/>, ReSA: <https://www.researchsoft.org/>, US Research Software Engineer Association, Society of Research Software Engineers: <https://society-rse.org/>

⁷⁰ JOSS: <https://joss.theoj.org/>, rOpenSci: <https://ropensci.org/>, pyOpenSci: <https://www.pyopensci.org/>

The IOI report advises that some participants thought research software is sometimes seen as data's "ugly stepsister" (Skinner et al., 2025, p. 18), and McKiernan et al. (2023) make the point that strategies for sharing research software are not fully analogous with considerations for sharing of publications and data and require tailored solutions.⁷¹ To overcome these and other challenges, the IOI report (pp. 20–29) calls for: (1) greater transparency and openness of data regarding funding, participation, products, usage and engagement; (2) improved coordination and support "scaffolding", including "better opportunities for equitable and inclusive participation"; and (3) maturation of strategies for sustainability to move away from reliance on philanthropic and government funding.

Workflow and collaboration tools: Considering resources enabling OS workflows and collaboration, as we have seen above, coverage is often strongest in computationally- and data-intensive domains. Recent efforts seek to make (computational) research workflows an identifiable, shareable, executable resource in their own right. Building on standards such as RO-Crate (Soiland-Reyes et al., 2022) and workflow description languages, the WorkflowHub,⁷² launched in 2020, is designed to be agnostic regarding disciplines and methods, yet at present the records included heavily reflect its disciplinary origins, with the vast majority deriving from life, health and computer sciences – partly due to a lack of standards and norms for workflow-sharing in other areas (Gustafsson et al., 2025). Considering another kind of collaborative practice, a recent review of the infrastructure literature argues that despite a long history, platforms for Citizen Science (CS) have yet to achieve full integration into established practices (cf. invisibility of infrastructure, Star and Ruhleder, 1996) due to challenges that include: balancing standardisation with contextual sensitivity and flexibility; openness/privacy trade-offs; tensions regarding ownership, credit and decision-making due to asymmetries of power; disparities in levels of access, skills and engagement; continuing negative perceptions of the legitimacy of CS-generated data; and a lack of incorporation of CS data into the routines of decision-makers (Soacha-Godoy et al., 2025).

3.4. Equity and infrastructural access

Finally, we examine equity through the lens of researchers' and others effective access. As we have seen, simply making scholarly contents and services available does not ensure their effective usage. We must also take account of the role of users' own capacities and the contextual factors which can mediate successful or unsuccessful participation. As discussed in section 2.2, Louise Bezuidenhout proposes the Capabilities Approach (CA) as a useful methodological framework for analysing "meaningful openness" in this sense, to enable investigation of OS case studies that "foreground the often-overlooked barriers to engaging with resources" (Bezuidenhout, 2025, p. 13). In this section, we build on Bezuidenhout's work to analyse the factors that enable or limiting meaningful access in OSIs.

In CA, human freedoms are based on the effective availability of real opportunities to choose amongst options of value to us (Sen, 1985, pp. 201–202, 2000). As presented in Figure 1 below, within the capabilities approach we can distinguish between *means* (resources and commodities), *conversion factors* (contextual mediators), *capabilities* (real-world opportunities), and *functionings* (achievements). "Means" here refers to both the base *resources* we possess and the *commodities* (goods or services) we can access and use (Sen, 2000). Infrastructure, conceived as a delivery mechanism for goods and services, is hence a key factor in resource availability. Conversion factors are usually divided into three categories which extend from the individual to the social and then material realms (Robeyns, 2005).

⁷¹ Key differences include its processes of creation, what can be shared and when, and maintenance processes and roles.

⁷² <https://workflowhub.eu/>

Personal conversion factors include physical and mental characteristics of individuals (e.g., sex, intelligence, literacy, disabilities), *social conversion factors* are the societal and institutional arrangements within which we are embedded (e.g., values, norms, hierarchies, roles, forms of discrimination), and finally *environmental conversion factors* relate to the material and built environment (e.g., climate, geographical location, technological possibilities).

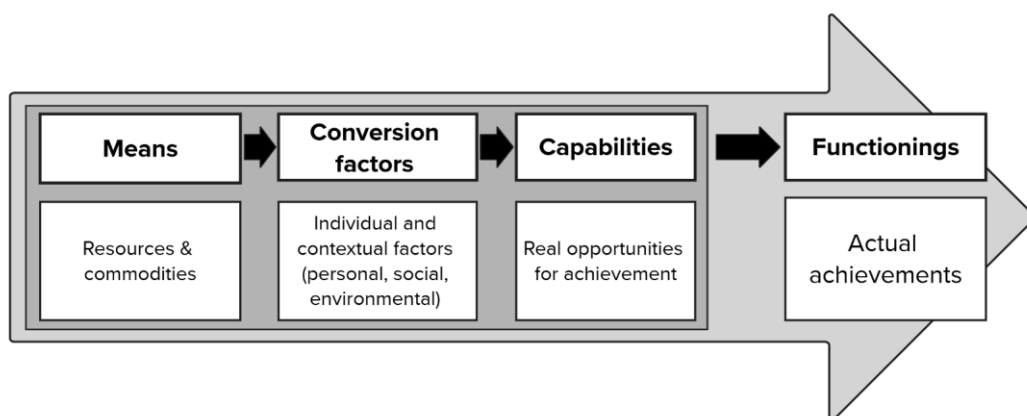


Figure 1. Simplified schema of Capabilities Approach components (adapted from Ahonen et al., 2025; Robeyns, 2005)

In this model, the goods and services made possible via infrastructure are enabling commodities whose general availability is shaped by many of the factors regarding design and coverage examined above. Even where generally available, however, its effective accessibility remains contingent on mediating (personal, social, environmental) conversion factors. Whilst analytically valuable, distinctions amongst these categories can blur (Ahonen et al., 2025). For instance, within academia very often the levels of resources available to us are a function of our social roles within institutions. Infrastructure occupies a dual role in this schema, as both a delivery mechanism for goods and services, whose general conditions of design, coverage and availability can be seen as key environmental conversion factors.

3.4.1. Personal conversion factors

Personal conversion factors of relevance for infrastructural access can be broken into two categories: those that are directly relevant and those relevant due to their interaction with social or environmental aspects. Of direct relevance are:

- **Disabilities:** Infrastructural features are usually geared foremostly towards the needs of the able-bodied, which may impose accessibility barriers to access, use, and effective participation for those with physical, sensory, or cognitive disabilities. Despite widespread availability of robust standards such as the Web Content Accessibility Guidelines⁷³, supported by regulations like the European Accessibility Act (2019),⁷⁴ nonetheless OSIs can be deficient in this regard. For example, OA journals have been found to lack guidelines and structured checks for accessibility of content including images (Stack Whitney et al., 2025; Wentz et al., 2021)

⁷³ <https://www.w3.org/WAI/WCAG2AA-Conformance>

⁷⁴ Directive (EU) 2019/882: <https://eur-lex.europa.eu/eli/dir/2019/882/oj/eng>

- **Open Science skills and awareness:** Putting different aspects of OS into practice depends on general awareness and specific competences. Although rising in recent years, skills and awareness remain unequally distributed across regions and disciplines, tending to reflect patterns of relative investment (Berezko et al., 2021; Buhomoli & Muneja, 2022; Digital Science et al., 2026; Ferguson et al., 2023; Gownaris et al., 2022; Heck et al., 2020; Hodonu-Wusu et al., 2020; Lu et al., 2021). Equally, fluent engagement with infrastructures often requires underlying technical skills and competences which can themselves take years of learning. Intuitive interfaces may alleviate some, but never all, of this barrier. OS skills, domain knowledge and technical skills are all heavily related to the availability of training and support (Directorate-General for Research and Innovation (European Commission) et al., 2021), which we discuss as a social conversion factor below.
- **Domain knowledge:** Institutional professionalisation and specialisation of knowledge production in the modern age has diminished the possibilities for individuals to engage in the wide-ranging scholarly pursuits of the polymaths of old (Burke, 2020). Expertise is hard-won through years of costly education, scientific apprenticeship, and enculturation in opaque scholarly jargons. Engagement with knowledge, or in knowledge-productive practices, is hence often very difficult for wider publics unless mediated via systems for broader dissemination (i.e., science communication) or engagement (e.g., Citizen Science).
- **Linguistic competences:** As we saw above, the use of English as the primary language of scholarly communication can mean increased burdens and bias for non-native speakers and is exclusionary for the more than four-fifths of the world population who do not speak English at all.

Other individual characteristics can be relevant given their interaction with social and institutional arrangements. For example, sex, ethnicity, sexual orientation, socio-economic status or academic age may become relevant due to social discrimination or bias, with disproportionate concerns for negative consequences (Albornoz & Chan, 2018; Ross-Hellauer et al., 2017) or exclusionary communicative norms (Pownall et al., 2021; Qiu et al., 2024) leading some groups feeling less empowered to engage. These groups also disproportionately occupy more junior or precarious academic positions (Sim & Bierema, 2025), meaning less access to discretionary resources or power to shape academic agendas (Allen & Mehler, 2019; Ayeni & Larivière, 2025; Pownall et al., 2021). Time as a resource is also often more limited for women or minorities, due to disproportionate care burdens at home for women (Gupta et al., 2005; Krause et al., 2022), or greater service responsibilities in the workplace for both groups (Cech, 2022; Kulis et al., 2002; Sánchez et al., 2025; Trejo, 2020).

3.4.2. Social conversion factors

As we saw in our discussion of Star's characteristics of infrastructure at the beginning of this section, OSIs are embedded within other social and technological structures (G. C. Bowker & Star, 1999; Star, 1999; Star & Ruhleder, 1996). Social conversion factors are relational and institutional aspects that mediate effective agency in infrastructural use. We here consider the impact of such factors at the levels of financial resources, social networks, institutional capacities for training and support, enabling policy and reward structures, and broader legal and geopolitical aspects.

- **Economic aspects:** Researchers working within well-resourced institutions, nations and regions are at an advantage due to increased financial capacities. This translates into greater capacities to develop and maintain repositories, publishing platforms, and standards, for example. Perhaps the most vivid example here is that of the negative effects of Article Processing Charges in OA, which have resulted in stratification of authorship patterns based on ability-to-pay (Demeter & Istrate, 2020a; Klebel & Ross-Hellauer, 2023; A. C. Smith et al., 2021).

- **Social capital and network centrality:** Researchers' relative positions in professional and epistemic networks, shaped by embeddedness in well-connected institutions, collaborations or communities, are also a factor. Those with higher "network centrality" potentially benefit from higher levels of visibility, trust, mentoring and insider knowledge (Dutilh Novaes & Dede, 2025; Grimme et al., 2026; Hadani et al., 2012; Merton, 1968; Reyhach et al., 2018), which may all affect senses of inclusion and effective infrastructural usage.
- **Training and support:** Better resourced institutions and regions are also better able to both equip researchers with OS skills through awareness building, training and education (Azevedo et al., 2022; Brinken et al., 2019). Providers of free online training resources, such as FORRT, the Reproducibility Networks, or the Carpentries⁷⁵ perform valuable work in mitigating such divides. In addition, better resourced institutions are able to provide increased OS support services for OS practices including data stewards, technical personnel, research support and information professionals (Directorate-General for Research and Innovation (European Commission) et al., 2021).
- **Policy and reward structures:** OS policy can be a key enabler, but it may also be a barrier where insufficient resources or support make it impossible to meet expectations. On the other hand, a lack of support for OS practices in traditional reward and recognition systems (Pontika et al., 2022) may either disincentivise practice or negatively impact researchers' career prospects. Hence, reform of incentive structures via initiatives such as CoARA remains urgent.⁷⁶
- **Legal and geopolitical aspects:** Use of OSIs is also shaped by the broader legal landscape, including regulations regarding copyright, intellectual property, data protection, and (increasingly) AI. At the same time, geopolitical aspects impact on OS – for instance, in rising global concerns for digital sovereignty, or the impact of internet censorship or sanctions in some regions (Bezuidenhout, 2025).

3.4.3. Environmental conversion factors

Environmental conversion factors are physical, material, and technological aspects of our surroundings that shape effective infrastructural access and use. Infrastructuring, *per se*, is a form of environmental restructuring – reengineering our surroundings towards our needs and purposes. Reflecting the embedded nature of infrastructure, OSIs depend upon extensive technological stacks, extending from software platforms and standards to hardware, electricity grids, data centres, fibre-optic cables, and network connectivity. All have implications for equitable, meaningful access. In what follows here, we will firstly review the implications of OSI design and coverage discussed above as conversion factors, before discussing issues related to connectivity, computing resources, technical accessibility and infrastructural resilience

- **Design and coverage:** Above we identified implications for equity in OSIs related to forms of ownership and governance (especially related to differences in representation and inclusion in decision-making), OSIs' inscription of norms and standards as constitutive elements of research behaviours, and issues of funding and sustainability (particularly as they relate to open infrastructures' agility and dependence on volunteer labour). These factors fundamentally shape OSI development, maintenance and modification, with downstream implications for their usability, responsiveness, and trustedness, which may all affect their effective accessibility. Basic availability or maturity is also, of course, a significant enabler or barrier, such that the issues of infrastructural coverage related to geography, language, discipline and resource-type examined above are also important factors.

⁷⁵ FORRT: <https://forrt.org/>, the Reproducibility Networks: <https://www.ukrn.org/global-networks/>, Carpentries: <https://carpentries.org/>

⁷⁶ <https://www.coara.org/>

- **Computing resources:** Participation in many contemporary forms of OS depends upon access to advanced computational resources, including large-scale storage, cloud services, and high-performance computing facilities. However, the distribution of these resources remains highly uneven across institutions and regions. Dependence on commercially provided infrastructure may further reinforce asymmetries where access is shaped by cost, regional availability, or reliance on infrastructures controlled by a small number of dominant actors.
- **Connectivity:** Reliable internet connectivity is a foundational condition of participation in OS. Researchers operating in contexts – especially rural areas or lower-income regions – characterised by unstable broadband connections, limited bandwidth, unreliable electricity, or high connectivity costs may hence face substantial barriers (Bezuidenhout, 2025; Shanahan & Bezuidenhout, 2022; UNESCO, 2021).
- **Infrastructural resilience:** OSIs are additionally shaped by broader questions of infrastructural resilience and environmental stability. Climate-related disruptions, energy instability, hardware shortages, and technical fragility may all affect the continuity and reliability of digital infrastructures. Dependence on international data centres, undersea cables, and transnational connectivity infrastructures may create further vulnerabilities. These material conditions shape not only immediate access to infrastructures, but also their long-term sustainability, reliability, and resilience across different regions and communities.

3.5. Summary: A call for *infradiversity*

Open Science infrastructures are not neutral. They are sociotechnical assemblages that shape not only who can benefit from, or participate in, the production of knowledge, but also the conditions under which this may happen, in accordance with whose norms, values, and assumptions. Therefore, considerations of equity must be expanded beyond questions of purely technical accessibility and include issues of governance, standards, sustainability, labour, language, representation, physical resources, and control over the infrastructure itself. In this case study, we have sought to examine these issues through the prisms of design, coverage and access, with reference to critical examples that shed light on persistent tensions as well as developing modes of good practice. Table 1 presents an overview of the main issues identified.

Table 1. Summary table of main equity issues identified, organised thematically

Aspect	Issue	Explanation
Design	Ownership	Commercial ownership and profit-motivation can prioritise access based on ability to pay, risk vendor lock-in, empower private actors to shape research behaviours, and leaves services dependent on company good-will
	Representation & governance	Lack of diverse representation in decision-making can marginalise actors from less-resourced regions or non-traditional stakeholder groups, resulting in gaps in design or other disparities in infrastructural development
	Norms, values & standards	Infrastructures inscribe values, norms and structure social relations; hegemonies in design and governance can impose unsuited standards and marginalise researcher groups; once in place, standards have significant inertia which makes adaptation difficult
	Funding, sustainability & labour	Non-commercial services are at a structural disadvantage due to short-term and unstable funding, often reliant on volunteer efforts which may risk exploitation
Coverage	Geographic coverage	Uneven geographic OSI distribution exacerbates global inequalities, reducing opportunities for those in lower-resourced settings to participate in and benefit from Open Science

	Disciplinary coverage	Uneven support across disciplines (e.g. social sciences and humanities)
	Linguistic coverage	Overwhelming centrality of English as the language of interfaces, content and metadata excludes non-English-speaking researchers and audiences and therefore limits engagement and discoverability
	Resource type coverage	Prioritisation of certain output-types has led to highly variable levels of OSI maturity, placing researchers whose work does not align with those formats at a disadvantage
Access	Personal conversion factors	Effective infrastructural access is shaped by factors related to individuals including disabilities, levels of skills and knowledge, linguistic competences, or discrimination based on personal characteristics
	Social conversion factors	Effective access is shaped by relational or institutional factors including economic aspects, training and support services, and broader policy, legal and geopolitical environments
	Environmental conversion factors	Effective access is shaped by broader aspects of the physical or built environment, including connectivity, computing resources and infrastructural resilience

Across multiple forms of OSI, including repositories, publishing platforms, software ecosystems, collaborative platforms and linking services, we can distil key lessons regarding the conditions under which OSIs are able to support more equitable modes of engagement and judicious connection:

- *Infrastructures inscribe values and assumptions:* Infrastructure is embedded in other social and material systems, embodies standards which are both shaped by and shape community conventions, and usually recedes from our perception when in use, which often conceals the values and norms that are always inscribed. We have encountered numerous examples of such inscription, from standards and identifiers to metadata, licensing, platform architectures and models of governance.
- *Equitable infrastructures need inclusion and reflexivity in design and governance:* The latter example spotlights a pervasive tension between the global and local, between general interoperability and sensitivity to local context. OSIs need common standards to facilitate interoperability across time and space. But standards can create norms of uniformity which may naturally privilege the priorities of their creators and potentially overlook or exclude the needs or requirements of other communities of practice. While maximising inclusion and foresight at the design stage is certainly to be recommended, it is unrealistic that this tension can ever be eliminated. This then points to a further requirement for equitable infrastructure: not only inclusion in design and governance, but commitments to reflexivity and action to address negative consequences.
- *Commons-based approaches are key to equity, but not a panacea:* Concentrated control of crucial infrastructures by private entities motivated primarily by profit, rather than community responsibility, has come to be seen as detrimental to infrastructural diversity, associated with issues of vendor lock-in, platform capitalism and diminished local agency amongst research communities. Hence UNESCO and others strongly promote commons-based open infrastructure approaches of community-governance and shared ownership. However, the often strongly normative terms on which the distinction between for-profit and not-for-profit is presented risks overlooking the potential contributions of private companies as service providers, the complex implications of business models on both sides, and masking equity issues related to sustainability within not-for-profit initiatives. Sustainable funding is a persistent issue for non-profit OSIs, with many reporting reliance on short-term funding, small staffs, and large voluntary labour contributions.

Examples from Diamond OA and open-source communities suggest that uncompensated, often invisible labour may in some circumstances risk exploitation, especially where it falls disproportionately on disadvantaged demographics. Further focus on coordination of shared funding models that ensure collective, non-extractive models of support for critical community infrastructures, as well as ensuring recognition for infrastructure contributions within reward and recognition schemes, are hence essential for OSI equity.

- *Infrastructural coverage is highly uneven across geographies, disciplines, languages, and resource types*: Infrastructure development is highly concentrated in Europe and North America, focused on quantitative research domains, mainly in English, and highly developed for some resource types but not others. Such gaps in coverage reinforce the idea of action to reevaluate the OSI landscape with infradiversity in mind, to ensure that is not overly shaped by the values, assumptions and needs of predominant regions, epistemic traditions, linguistic communities, or traditional formats.
- *Access is not enough*: Finally, infrastructural access must be viewed more broadly through a lens of capabilities. Mere formal openness does not equate to meaningful participation; there are many mediating conversion factors which shape real opportunities, including: *personal factors* such as levels of skills and knowledge or discrimination based on personal characteristics; *social factors* including economic aspects, network centrality, training and support structures, and broader policy and legal environments; and *environmental factors* such as connectivity, computing resources and infrastructural resilience. Hence, good practice in OS infrastructure must go beyond focusing on openness itself to address those circumstances which enable effective use.

As we conclude this section, I would like to suggest that the emerging picture may be best captured through a concept of *infradiversity*. The term “bibliodiversity” emerged in Latin America towards the end of the last century to refer (through analogy to “biodiversity”) for the need for greater diversity within increasingly homogenised publishing ecosystems (Chan, 2019). It was globalised in academic discourse through a 2014 International Declaration from independent publishers supported by UNESCO (International Alliance of Independent Publishers, 2014), and explicitly linked to Open Access in the European context through the 2017 “Jussieu Call for Open Science and Bibliodiversity.”⁷⁷ Key motivations were the need to avoid further consolidation and control of scholarly communication amongst a small number of very large commercial providers through pluralistic and communalistic forms of infrastructure, funding structures, ownership models, and support for diverse epistemic traditions, languages and publication formats.

The work outlined above implies potential utility in extending this concept beyond the specific context of scholarly communication, to the OSI ecosystem in general. As we have seen repeatedly, no single model of infrastructure will suit the variety of communities of practice, languages, and local circumstances which constitute global scholarship. What is needed is an infradiverse network of interconnected infrastructures capable of facilitating different kinds of engagement, for different kinds of communities, at different times, in different places, and according to different norms. *Infradiversity* may then serve to guide understanding of the need for geographic, linguistic and disciplinary sensitivity to local, situated contexts across forms of OS infrastructure, including inclusive and reflexive governance and standards, communalistic ownership where possible, equitable coverage and support for diverse practices and outputs, and dedicated attention to the conversion factors which mediate meaningful access.

⁷⁷ <https://jussieucall.org/jussieu-call/>

4. Equity in models of Open Peer Review

Open Peer Review (OPR) is an umbrella term for various innovations which aim to increase transparency or participation in scholarly evaluation processes. In this section, we review approaches to OPR, as well as the ‘publish, review, curate’ model, to discuss the relative advantages and disadvantages of these new review models with respect to equity.

4.1. Defining Open Peer Review

Peer review is the evaluation of scholarly work (including articles, books, conference papers, and grant applications) by others with similar competences, usually those working in the same field. Traditional peer review is generally (1) *anonymous*, that is, either single anonymised, with reviewers unknown to authors, or double anonymised, with both authors and reviewers unknown to each other,⁷⁸ (2) *opaque*, with neither the process nor the reviews made public, and (3) *selective*, with editors or others deciding who qualifies as a peer and thus who is invited to review. OPR is a broad term used in diverse ways (Ross-Hellauer, 2017). At its root, however, it can be understood as the application of Open Science principles of transparency, access and participation to peer review through innovations targeting one or more aspects of anonymity, opacity, and selectivity. The three core traits of OPR are:⁷⁹

- **Open identities:** Authors and reviewers are aware of each other’s identities, and/or reviewer names are made public alongside published articles. Increasing transparency of processes in this way is intended to increase reviewer accountability and reduce conflicts-of-interest, while fostering more responsible and constructive reviews.
- **Open reports:** Review reports and other records of editorial processes are published alongside the relevant work. Their aims are greater external scrutiny of evaluation processes, avoiding wasted effort by enabling re-use of valuable critique, and (when combined with Open Identities) enabling greater recognition and credit for reviewers (whose reviews then become open outputs citable in research assessment).
- **Open participation:** Broader communities can contribute to review processes. The aims are to address limitations of gatekeeper-selected reviewers such as bias, elitism or closed networks by crowdsourcing review from wider pools of self-selecting reviewers, and thus diversifying perspectives, reducing gatekeeping and increasing review inclusivity.

Each are distinct innovations which can be implemented alone or in combination. While there has been experimentation with OPR in review of monographs or grant applications, uptake is most mature in scholarly journals – although even here OPR remains far from the norm, implemented in some form at between 1 to 5% of journals (Ross-Hellauer & Horbach, 2024). Adoption is far more prevalent in natural sciences and medicine/health than in social science or humanities (Wolfram et al., 2020). However, uptake continues to grow with recent developments such as the announcement that OPR will be extended across the Nature portfolio of journals (anon., 2025).

⁷⁸ These are sometimes termed “single-” or “double-blind” review. Note that here and throughout we use the terms prescribed by the NISO Standard Terminology for Peer Review (ANSI/NISO Z39.106-2023). See: <https://www.niso.org/publications/z39106-2023-peerreview>

⁷⁹ Note that in (Ross-Hellauer, 2017) I identified other traits which have sometimes been considered part of OPR, including: Open Interaction (“Direct reciprocal discussion between author(s) and reviewers, and/or between reviewers, is allowed and encouraged”) and Open final-version commenting (“Review or commenting on final “version of record” publications”). For reasons of scope, since these are not normally understood within most definitions of OPR, we do not consider these elements here.

These forms of OPR are often combined in various ways in systems of what is termed ‘**publish, review, curate**’ (PRC). Although such systems need not use OPR, given their association and the EC’s interest in exploring such models, we consider them here. PRC subverts the traditional order of publishing processes, where curation is in-built from the beginning (submission is to journals which are in effect curated collections), and publication comes only after an often-lengthy review process. In PRC, review takes place on top of publicly available manuscripts, which can then later be curated in various ways (including publication in journals). PRC aims mainly to speed publication processes and decouple evaluations of quality from decisions about the suitedness of a work for a particular venue.

All these innovations have deep implications for equity in research. The variety of approaches encompassed here underlines Leonelli’s rejection of universalist models of OS. OPR emerges not as a single reform, but a pluralist set of proposed solutions for differing perceived problems. Their appropriateness, as we shall see, varies across disciplinary, institutional and cultural contexts, and their implications relate in unexpected ways to existing distributions of symbolic capital and capacities. Before moving on to examine these implications case-by-case, let us first briefly examine the traditional functions of peer review, as well as its challenges, to better understand the problems for which the forms of OPR are intended solutions.

4.2. Peer review: purposes and problems

Peer review, the systematic circulation of scholarly works for critical feedback from domain experts, is a central means of scholarly scrutiny and quality control. However, its centrality to academic life belies a relatively brief history. Scholars have always relied on critical dialogue to hone arguments and test ideas. It is only over the last century or so, however, that peer review has risen to formalised ubiquity in the review of outputs (e.g., articles or books) or inputs (e.g., funding proposals). The journal *Nature*, for instance, did not make external peer review mandatory for all research articles until the 1970s (Baldwin, 2018).

Although highly valued by researchers, as a fundamentally human process peer review is subject to several recurrent criticisms. Firstly, there are issues of unreliability and inconsistency, with low levels of reviewer agreement, inconsistency in acceptance decisions, and limited ability to detect errors or fraud (Kravitz et al., 2010; Peters & Ceci, 1982; Schroter et al., 2008). Next, reviewers are subject to various forms of bias regarding both the content of manuscripts and characteristics of their authors (Lee et al., 2013). It is also slow and inefficient, often delaying dissemination of findings by up to a year and incurring substantial labour costs (usually hidden since reviews are unpaid) which can be compounded if the same manuscript is reviewed and rejected across multiple journals before its eventual publication. There is also an issue of lack of incentives, since reviews are not directly rewarded and peer review activities play only a weak part in current research assessment programmes, exacerbating issues of “reviewer fatigue” (Breuning et al., 2015).

Peer review serves various functions within academic life. Firstly, it has a *summative function*. Critical opinions regarding, for example, the quality of a work (say, rigour or originality) but also its suitedness for specific venues (e.g., fit for a specific journal or funding call) have traditionally been sought first and foremost as a quality control mechanism to aid in administrative decision-making regarding the distribution of scarce resources. Those resources may be financial, in the case of funding, but can also be symbolic or reputational, as in the case of acceptance for publication in journals or at book publishers with high rates of rejection. Secondly, peer review also serves a *formative function*. Even where works are rejected as a result, reviews are still passed to authors who may use the criticism to address shortcomings in the work. In the case of publications, many rounds of revision and resubmission may precede eventual acceptance. A rejected funding proposal may also be revised in light of criticism for submission to a future funding call. Finally, peer review serves a *legitimizing function* related to academic self-governance.

Melinda Baldwin describes the rise of peer review to gold standard of scientific legitimacy in the mid-to-late 20th Century as a direct response to cold war-influenced political pressure and U.S. congressional challenges to funding allocations. In response, scientific communities institutionalised self-regulation through peer review to preserve autonomy while demonstrating accountability.

Peer review's importance as a governance mechanism is underlined by its prevalence in sociological and philosophical accounts of scientific norms. Robert Merton notably argued that modern science (modern at his time of writing, in the 1940s) is structured by institutional norms of 'communalism', 'universalism', 'disinterestedness', and 'organized skepticism' (Merton, 1973). Peer review is the systematisation of the latter, enacted to ensure that arguments not reputations are the basis for success (universalism), disinterestedness (at least in theory) embodied by the figure of the impartial peer, and communalism (as the essential sharedness of knowledge) served by community evaluation and public dissemination of findings.

Peer review is also a central example of what philosopher Helen Longino calls 'transformative criticism', the collective critical interaction through which scientific communities scrutinise, revise and ultimately validate knowledge claims. For Longino, such criticism enables objectivity but it requires specific conditions, namely the presence of recognised avenues for critique, uptake of criticism, shared standards and a tempered equality of intellectual authority (Longino, 2001). Again, peer review can be understood as a key institutionalisation of these conditions – an "obligatory passage point" (Callon, 1986) for those seeking publication or funding, a site of intersubjective critique, where adequate responses are required, standards are upheld, and there is an assumption of equal authority amongst 'peers' (though tempered by the requirement of expertise).

The case of peer review also underlines the fragility of such theoretical norms, however. Whether peer review, or science itself, works purely in the ways Merton describes is highly dubious. As discussed by Hosseini et al. (Hosseini et al., 2024), even in the institutional context of Merton's time of writing, the norms were probably highly idealistic rather than strictly representative of reality. Certainly, within a modern academia characterised by precarity of contracts, hypercompetition and a culture of 'publish-or-perish', we may readily recognise the prevalence of 'counter-norms' proposed by others (M. S. Anderson, 2000; Mitroff, 1974): particularism, competition, self-interestedness and organised dogmatism. The physicist turned philosopher of science John Ziman argued in the mid- to late 1990s that science had indeed shifted from a more communal, curiosity-driven and autonomous enterprise, towards a "post-academic science" shaped by the growing importance of links to industry, political priorities and managerialism. Ziman saw peer review as a "key institution of scientific culture" (Ziman, 2000, p. 246), but one under threat as it shifted from a means of epistemic filtering towards a mechanism of administration.

The literature on bias in peer review shows it remains far from ideal in a Mertonian sense. As reviewed by Lee et al. (2013), reviewers may demonstrate bias regarding the scientific content, including confirmation bias, conservatism and 'cognitive cronyism' to favour familiar theories, methods or positive results while disavowing interdisciplinary or null/negative findings. At odds with norms of universalism, they can also show social biases with judgements influenced by prestige, institutional affiliation, gender, nationality, and language, leading to systematic inequalities in evaluation. To counter-act the latter, peer review is sometimes double anonymised, with manuscripts stripped of identifying information to limit social bias amongst reviewers.

The social aspects of peer review also impact upon who selects reviewers and is selected to review. Editorial and review boards show concentrations of power amongst established, institutionally privileged and demographically homogenous groups (Bancroft et al., 2022; Manan et al., 2023, 2024). There are also disparities amongst who is invited to review, with exclusion related to, for example, gender and geography (Garcia-Costa et al., 2022; Lerback & Hanson, 2017). Multiple studies have shown that author demographics are a clear predictor of review outcomes, especially in the case of geography (O. M. Smith et al., 2023).

Taking such analyses a step further, researchers have studied the role of author-reviewer homophily in peer review and found higher rates of acceptance in cases where gender or country were the same (Murray et al., 2019; Zumel Dumlao & Teplitskiy, 2025). More junior researchers have also been suggested to be excluded as reviewers are often sourced via editors' familiarity with well-known figures in the field, although these effects may be somewhat mitigated by support tools for reviewer selection. Early career researchers (ECRs) often receive no formal training, and in some cases learn by "ghost-writing" reviews for their more senior colleagues – an issue for the equitable distribution of credit (McDowell et al., 2019). This despite research finding that younger reviewers tend to produce higher quality reviews (Callaham & Tercier, 2007; Evans et al., 1993; Otero et al., 2022). The moral case for greater equity and diversity in peer review that emerges here is further strengthened by the cumulative nature of success in academic, the so-called "Matthew effect" (Merton, 1968). Given the "credibility cycle" of academic work (Latour & Woolgar, 2013), where resources enable the production of data, turned into publications that generate recognition, which in turn attracts further new funding and resources (starting the cycle anew), it is no surprise that past success is a consistent predictor of future gains in publication and funding (Bornmann & Daniel, 2007; Severin et al., 2020; Squazzoni & Gandelli, 2012).

Editor and reviewer diversity is not only a moral issue but is also argued to be epistemically necessary. For Helen Longino, transformative criticism requires diverse viewpoints since different backgrounds bring the different assumptions, experiences and sensitivities needed for robust scrutiny (Longino, 2001). Too much homogeneity risks group-think and lack of critical questioning of widely shared assumptions. In this sense, limited diversity undermines "tempered equality of intellectual authority" since it implies systematic stratification according to personal characteristics. Expanding diversity is thus, on Longino's view, necessary for enabling the most robust forms of transformative criticism. Research on decision-making outside the peer review context has shown positive effects on the range of information shared, depth of thought, creativity and quality of outcomes (Antonio et al., 2004; Burt, 2004; Dezsö & Ross, 2012; Elsass & Graves, 1997; Hong & Page, 2004; Nemeth, 1986). Studies of effects of diversity on peer review outcomes also seem to support Longino's theory. Firstly, Langfeldt et al. (2020) have described how diverse communities bring diverse notions of research quality. Luo et al. (2021) studied the effect of including non-academics on review panels and found that whereas academic-only panels reviews focussed much more on the science, mixed panels produced reviews that were not only longer, but also included more concrete and expansive considerations of the potential impact of the research. Goyal et al. (2024) found that reviewer diversity regarding topic expertise, seniority and publication networks increased the range of elements addressed by peer review, although they found no such effect regarding diversity of reviewer organisations or geographical location. Diversity also seems associated with different focus regarding the function (summative vs. formative) of peer review, with reports from women and junior colleagues (although not from those working in academic institutions outside Western regions) found to be more "developmental" in nature, i.e., contain more substantive suggestions for improvement (Garcia-Costa et al., 2022).

In sum then, peer review performs functions essential to scholarship, but it remains far from perfect both in general, and regarding equity in particular. Like democracy, it may be our "least worst system", but this still leaves substantial room for improvement. The various forms of OPR aim at tackling different aspects of these problems. We next examine each, and their implications for equity, in detail.

4.3. Equity and Open Identities

In systems of Open Identities, authors are usually made aware of reviewer identities when first receiving review reports, although in some cases identities are revealed only at the time of publication.⁸⁰ While mandated by some journals, others make it optional, at the discretion of the reviewer. The aim is mainly to increase quality through accountability and transparency, although motivations are sometimes couched explicitly in terms of equity and fairness. For example, discussing the grounds for trials of OPR at the British Medical Journal, van Rooyen et al. (1999) said: “most importantly, it seems unjust that authors should be “judged” by reviewers hiding behind anonymity”. Shaw (2015) has even argued that given the power imbalance of single-anonymised systems, “blinding authors to the identities of reviewers is unethical”, since they are unable to fully understand the contexts for decision-making or challenge potential conflicts-of-interest.

The implications of Open Identities for equity are complex however, especially since reviewer anonymity has traditionally been employed to mitigate effects of power and prestige. Anonymised review was intended to enable reviewers to give full and frank critique, free from fears of potential repercussions or retaliations from aggrieved (especially senior and influential) authors.⁸¹ Surveys of attitudes towards Open Identities have generally found it disfavoured by the majority of researchers, largely due to persistent concerns for such reprisals from authors, or that associated perceptions of risk might inhibit reviewers and thus compromise review quality (Besançon et al., 2020; Fontenelle & Sarti, 2021; Ross-Hellauer et al., 2017). Early-career researchers in particular have been found to view Open Identities as “dangerous” and “risky” (Rodríguez-Bravo et al., 2017). Karhulahti and Backe (2021) found that concerns were particularly pronounced amongst communities and journals of smaller regional or disciplinary scope, where anonymity is felt vital to mitigate conflicts of interest and avoid issues of community cohesion. Gownaris et al. (2022) also flag possible cultural implications in their suggestion that “OPR may suit ‘Western values’ better than regions where ‘saving face’ is an important cultural value”. In Bourdieu’s terms, signing seems hence to be perceived differently depending on researchers’ habitus or status in accumulated symbolic capital; for those in weaker field positions the same practice can be seen as bearing reputational risk which outweigh potential rewards of recognition.⁸²

Given such concerns, guidance often suggests that where Open Identities are considered to be implemented, that they be made optional rather than mandatory (Ross-Hellauer & Görögh, 2019; Schmidt et al., 2018). Such systems, where the decision to disclose is led by the reviewer themselves, can be considered a form of what Leonelli has termed “judicious connection”, a tempered openness that respects the context-dependent nature of open practices and promotes local agency regarding what is shared.

However, this empowerment may also have negative downstream effects on equity. When made optional, studies generally find that a minority (generally less than ten percent) choose to sign reviews (Bolam & Foxe, 2017; Bravo et al., 2019; Fox, 2021), although this rate may be much higher if signing is made “opt-out” rather than “opt-in” (Bolek et al., 2020).

⁸⁰ This is the case with journals from the publisher Frontiers, see: <https://www.frontiersin.org/guidelines/peer-review-guidelines>

⁸¹ Double anonymised review goes a step further, seeking to mitigate social biases mentioned above regarding, e.g., gender, institutional prestige, geographical location, by removing identifying information from the work in question. Since we are only considering the effects of unmasking reviewer identities, not author identities, we consider the effects of double anonymised review out of scope for our purposes here.

⁸² Such dynamics are complex, however, as emerging, as yet unpublished, results from the DISAPEER project seem to suggest that some marginalised community members see strategic value in publishing their identities as reviewers in order to gain community visibility. Via Serge Horbach, personal correspondence. DISAPEER project: <https://www.rmz.hu-berlin.de/en/research/disapeer>

Rates are generally higher when reviews are positive rather than negative (Bravo et al., 2019), although this does not necessarily mean that Open Identities causes more favourable reviews overall (Bolek et al., 2020). The role of dynamics of power and status in such decisions is revealed by analyses of who chooses to sign. ECRs are much less likely to sign than senior researchers, as are women in comparison to men (Bolek et al., 2020; Fox, 2021). These inhibitory effects may be more pronounced in small or close-knit communities (Baždarić et al., 2021). While protecting individuals, enabling them to make their own decisions regarding disclosure, optional Open Identities could thus still have a negative effect on equity by reinforcing cumulative advantage, enabling those who feel empowered to sign to reap downstream benefits of increased visibility, credit and recognition valuable to research assessment and professional advancement which would not accrue to those who do not disclose. Such potential effects signal a key tension between vulnerability and visibility, surfacing difficulties in designing for equity and protecting vulnerable populations where transparency is the general assumption, as it is under a rubric of “as open as possible, as closed as necessary”.

4.4. Equity and Open Reports

The publication of review reports is much less controversial, broadly welcomed by researchers for making review processes transparent and providing additional information to readers (Besançon et al., 2020; Fontenelle & Sarti, 2021; Ross-Hellauer et al., 2017).

Open Reports are seen as a way of building trust by allowing independent assessment of the rigour of review processes (Parker et al., 2021). Open Reports have also been envisioned, in combination with Open Identities, to bring greater collegiality and constructiveness to peer review. The UNESCO Recommendation emphasises the need for greater shared responsibility and mutual recognition as a normative basis for equitable and inclusive research (UNESCO, 2021). Anonymous, closed peer review is sometimes criticised for being unjustly harsh (R. Smith, 2006), or, enabling an environment where “comments can be overly critical and wilfully obtuse without being held accountable” in the words of Verma et al. (2022, p. 925). Studies of the effects on reviewer behaviour of diminishing the disinhibiting effects of anonymity (Suler, 2004) or increasing accountability by creating a public record of review comments show mixed to positive results. Le Sueur et al. (2020) found that open reviews are somewhat more constructive and less harsh. Thelwall (2022) found that Open Reports with Open Identities tended to be longer than unsigned reviews, attributing this to reviewers’ intent “to be more careful or polite”. Álvarez-García et al. (2026), meanwhile, found that published peer review reports tend to be more informative, more readable, and have a greater emphasis on constructive suggestions. For such reasons, Knöchelmann (2019) has argued that Open Reports are especially valuable in the humanities, where reviews are based less on matters of fact and more on judgment and interpretation, as transparency makes “terms of inclusion” clearer, and shift the focus of review from its summative, gatekeeping function toward its formative function of collective improvement. Despite broad support, there remain some concerns that Open Reports may reduce participation in reviewing (Fontenelle & Sarti, 2021; Ross-Hellauer et al., 2017), although empirical studies show no significant impact upon acceptance of review invitations (Bravo et al., 2019; Cosgrove & Cheifet, 2018).

In addition, Open Identities and Open Reports have implications for equity in recognition and rewards. Peer review is not usually directly rewarded and remains, for the most part, invisible. While some grant or book reviewing activities are rewarded with modest honoraria, and some publishers offer small rewards such as APC-reductions for future articles, for the most part peer review is not financially rewarded.

Estimates of the total global costs of peer review put it in the billions per year.⁸³ This “billion-dollar donation” (Aczel et al., 2021) provides an essential service that underpins a global publishing industry where some of the larger traditional publishers like Elsevier, Springer Nature, Wiley, and Taylor & Francis, report profit margins of up to 40% (Shu & Larivière, 2024). This misalignment between reviewer effort and rewards is tolerated since motivation to review is primarily framed by researchers in terms of community service, reciprocal contribution to research communities, or establishing reputation (Kaltenbrunner, 2025; Zaharie & Osoian, 2016). Making peer review visible and directly attributable through opening reports and identities thus can be argued to enhance equity by more directly demonstrating community service and reputational. Open reviews, assigned DOIs, can now be added to ORCID profiles or directly cited in research assessment exercises (Hanson et al., 2016; Tennant, 2018), creating new opportunities for the conversion of review labour into symbolic capital. However, the differences in who chooses to publicly sign reviews mean that these benefits might accrue most to those who already feel most empowered. In addition, studies have found that attitudes to OPR are strongly related to conversion factors like training and awareness of OS (Baždarić et al., 2021; Ross-Hellauer et al., 2017), which may pose an equity issue if those not yet exposed are less inclined to participate. Such concerns might be attuned, however, by limiting our expectations for this more formal recognition of review activities, which research shows are already formally mentioned in about half of career advancement criteria (Pontika et al., 2022). Given the multitude of other achievement indicators in research, teaching and community service, it is questionable whether peer review could ever play more than a marginal role in such decision-making.

Finally, there is an issue of equity for publishers themselves. Implementing workflows for publication of Open Reports often requires costly system development to adapt infrastructures, or else require manual workarounds that otherwise add to expenses (Ross-Hellauer & Görögh, 2019). Such costs are more easily absorbed by the larger publishers than by smaller publishers which are often community-run or rely on volunteer-effort. (Although note that even some of the larger publishers still do not have automated workflows for Open Reports).

4.5. Equity and Open Participation

Open Participation⁸⁴ peer review aims to enable wider communities to contribute to peer review processes. Whereas traditionally reviewers are selected and invited by editors, Open Participation processes usually make pre-review manuscripts publicly available (as, for example, preprints or discussion papers) and invite community members to self-select based on their interests. Platforms may allow anyone to contribute or may set minimum requirements.⁸⁵ Open Participation can also be used as a complement alongside traditional review.⁸⁶

⁸³ Aczel et al. (2021) estimated that in 2020 costs for US-based researchers were 1.5 billion USD, 600 million USD in China, and 400 million USD in the UK. LeBlanc et al. (2023) estimated per total wage-cost per person, per year in the US at 1,272 USD, totalling 1.1–1.7 billion USD for the US in total, and 6 billion when extrapolated to the global cost of peer review.

⁸⁴ Sometimes referred to as “crowdsourced peer review” (Ford, 2013), “community/public review” (Walker & Rocha da Silva, 2015) or “public peer review” (Bornmann et al., 2012).

⁸⁵ For instance, ScienceOpen requires reviewers to have at least five publications associated with their ORCID account. See: <https://about.scienceopen.com/peer-review-guidelines/>

⁸⁶ The publisher Copernicus uses such a system, making “discussion papers” available for public comments while also conducting traditional peer review with invited reviewers (Pöschl, 2012). Note that, as explained at the beginning of this section, we do not here examine post final version commenting platforms such as PubPeer, which use mechanisms of Open Participation. Although such platforms certainly have interesting implications for equity, since they are not traditionally included as core aspects of OPR, we here consider them beyond scope.

We discussed above (section 4.2) that fostering diversity in reviewer pools is desirable not only on moral grounds, but also to strengthen the robustness of what Helen Longino calls ‘transformative criticism’, by expanding the range of perspectives involved, including those traditionally less likely to be invited, as well as scholars from related disciplines or even from broader publics. Yet broadening reviewer pools requires conscious effort to overcome effects of homophily, network closeness, and implicit bias (Teplitzkiy et al., 2018). Dutilh Novaes and Dede (2025) use network theory to discuss how structures of social connection and discrimination can shape who appears as a legitimate partner for intellectual exchange, using peer review as an example. Firstly, there needs to be *attention and exposure*, that is, the potential reviewer needs to show up within the editor’s network of potential exchange partners. Epistemic communities are, of course, shaped by power laws where certain actors are more visible and connected, while others are more marginal and likely to be overlooked. Some potential partners might not even show up at all if the scope of who constitutes a peer is narrowly defined. Relevant interdisciplinary expertise may be overlooked if the search is confined to specific fields or epistemic traditions, for example, or if what constitutes expertise is thought in a narrow academic way and ignores the potential for patients to bring the perspectives of their lived experience to peer review of health research (K. Anderson, 2018). In practice, editors often rely on publisher recommender tools, which offer a chance to expand the potential network but come with their own equity issues, not the least of which is that they are usually proprietary, closed systems whose opaque inner-workings may also encode bias. Next, comes a *choice to engage* which Dutilh Novaes argues is heavily shaped by perceptions of competence and trustworthiness, which are deeply susceptible to epistemic and social biases (Lee et al., 2013). Only after these stages is the interlocutor (the reviewer in our case) engaged. Dutilh-Novaes and Dede argue that while some of these issues may be partially addressed by “suitable design interventions”, they may also be inevitable given the nature of expertise, attention and academic networks: “the effects of attentional networks and of perceptions of trustworthiness can simply not be fully mitigated; they are arguably *constitutive* of the structure of epistemic exchanges, especially in large-scale communities” (Dutilh Novaes & Dede, 2025, p. 744).

Systems of Open Participation are one such proposed “design intervention”, aiming to mitigate effects of biases, closed-networks and elitism by enabling reviewer self-selection. In network theory terms, they potentially subvert the model of interaction by putting both attention/exposure and decision to engage in the hands of the self-selecting reviewer, rather than the gatekeeper. In principle, they extend the potential pool of reviewers to include not only those researchers not traditionally invited to review, such as ECRs, but also to wider publics including industry representatives or publics with special interests (Ross-Hellauer, 2017). The latter challenges our notion of what “expertise” means with regard to scholarly knowledge – for example, in involving patients in peer review not for their academic credentials but for the relevance of their lived experience in shaping health interventions and policy (Salmi & Blease, 2021; Schroter et al., 2018). In this sense, systems of Open Participation can be understood as “technologies of humility” in the sense articulated by Sheila Jasanoff, insofar as they institutionalise reflexivity, broaden whose knowledge counts, and render visible the limits, contingencies, and social embeddedness of expert judgment (Jasanoff, 2003, 2007).

In principle, researchers seem to endorse such mechanisms. Surveys consistently find that that over half of respondents believe Open Participation could improve peer review systems (Fontenelle & Sarti, 2021; Polka, 2018; Ross-Hellauer et al., 2017). In response to more targeted questions, a majority agreed that “close circles of reviewers hold back innovative research”, and opinions were roughly even regarding whether “everybody, regardless of qualifications or background, should be able to participate in the review process” (Ross-Hellauer et al., 2017).

However, their practical efficacy as a solution is undermined by poor uptake. Firstly, there are issues of the fulness of such reviews. Content analysis comparing community reviews with invited reviews found the latter better supported the summative and formative functions of peer review (Bornmann et al., 2012).

Secondly, across multiple experiments and platforms, participation is often low. A 2006 trial at Nature was discontinued for lack of engagement from authors and reviewers, with almost half of papers receiving no comments (Skains, 2020), while only one in five “discussion papers” at the publisher Copernicus receive comments (Pöschl, 2012). In addition, there are legitimate concerns that self-selecting reviewers will tend to choose to review works by prominent authors or topics such that review could become a “popularity contest” (Besaçon et al., 2020), furthering cumulative advantage. In such circumstances, it seems that Open Participation mechanisms will remain a somewhat marginal complement to, rather than realistic replacement for, invited peer review.

Although Open Participation processes open up epistemic networks in principle, clearly there are persistent effects of “attentional networks and of perceptions of trustworthiness” of the kinds identified by Dutilh Novaes & Dede (2025, p. 744). Thinking in terms of the capabilities approach outlined in section 2.2 (Bezuidenhout, 2025; Nussbaum, 2011; Sen, 2000), we can ask what are the possible “conversion factors” limiting such uptake? Firstly, there are issues of time and attention. Traditional peer review systems already groan under the strain of the ever-increasing number of publications each year, making finding invited reviewers an issue. We already discussed issues of missing incentives in invited review. Arguably even more so. Skains (2020) identifies incentives as “a significant barrier”, pointing also to fears of “blowback” and “domineering commenters” (thus echoing the concerns for risk and vulnerability regarding status effects we discussed earlier in relation to Open Identities). There may also be issues relating to platform usability or more basic access to digital infrastructure (Bezuidenhout, 2025). In addition, the dominance of English may deter non-native speakers, while the specific communicative norms of specialised scientific communities may also have effects of exclusion. Finally, peer review is a distinct and specialised form of communication that requires enculturation and familiarity with its aims and processes. For researchers, this is usually acquired through “learning-by-doing” rather than formal training (Willis et al., 2023), meaning that fewer opportunities to participate mean less learning. Finding that reports from researchers from non-western institutions had lower “informative content” and were less readable than those from their western-affiliated counterparts, Álvarez-García et al. (2026) suggest this is due either to linguistic bias or “lack of socialisation with high peer review standards”, which may suggest a need for more formal training for specific populations to increase inclusion. For those outside the academy, the hurdles are arguably even greater, involving a need to learn the aims, purposes and languages of review (Luo et al., 2021). While such learning may be enabled by guides or templates for non-academic reviewers (Salmi & Blease, 2021), or even by paying such publics for their time (British Medical Journal, 2026), still structural barriers related to factors like ethnicity, education level or socio-economic background mean that certain populations will feel better able to participate than others (Reynolds et al., 2021). Linking back to Leonelli’s notion of “judicious connection”, we might note that just enabling new technological means of participation without due consideration of the ways in which existing capabilities interact with economies of attention and credibility to limit real possibilities risks adding a veneer of inclusion that obscures the underlying persistence of epistemic hierarchies.

Given this picture, efforts to broaden equity, diversity, and inclusion in peer review might arguably be better focused on reforming invited review. Such measures can include training in bias awareness and inclusive practices for editors and gatekeepers (Jack, 2023), mentorship schemes for underrepresented researchers, increasing transparency in reviewer recruitment criteria or encouraging greater representation in editorial boards (and monitoring this effectively),⁸⁷ encouraging “co-reviewing” to increase the visibility of early-career researchers (ECRs) and support on-the-job learning (McDowell et al., 2019), broadening initiatives to include and invite reviewers from stakeholder-groups (as in the case of patient review) where relevant, and further investigating the role of recommender systems in shaping equity, diversity and inclusion in reviewer

⁸⁷ Through initiatives like the Royal Society of Chemistry’s “Joint commitment for action on inclusion and diversity in publishing”, <https://www.rsc.org/policy-and-campaigning/science-culture/joint-commitment-for-action-on-inclusion-and-diversity-in-publishing>

selection. This is not to say that systems of Open Participation have no place. Although unlikely to replace invited review, they may still be helpful complements to it.

4.6. Equity and Publish, Review, Curate models

Finally, we consider equity considerations in the “publish, review, curate” (PRC) model of scholarly communication. PRC inverts the traditional publishing sequence, where curational decisions are made in advance through submission to specific journals, which then also oversee gatekeeping and the making public of knowledge. Instead, PRC models make manuscripts publicly available first, oversee transparent review, and only subsequently curate them into collections or venues.

As summarised in Table 2 below, PRC can be centralised or de-centralised (Corker et al., 2024). Centralised systems use a single platform to host manuscripts, manage peer review and enable curation. De-centralised approaches, on the other hand, distribute these functions over different platforms: manuscripts may be hosted via preprint servers, reviewed via independent services like PREReview,⁸⁸ Review Commons⁸⁹ or MetaROR,⁹⁰ with later curation via various avenues. As also seen in Table 2, PRC platforms that perform review all use OPR of some kind, with all publishing Open Reports, usually offering at least optional Open Identities and in rarer cases Open Participation. Most currently operate on non-profit or cost-neutral models, with many reliant at this stage on grant funding or community-support. Note that although PRC systems need not use OPR, given their association and the EC’s interest in exploring such models, we hence explore their equity considerations here.

Table 2. Overview of PRC review platforms, their use of OPR and financial models

Platform	Discipline	Centralised/de-centralised	Open Identities	Open Reports	Open Participation	Financial model
Biophysics Colab	Biophysics	Centralised	No	Yes	No	Non-profit, charges APC (no amount listed, but cost-neutral)
eLife	Life sciences, biomedicine	Centralised, although accepts submission via preprints (bioRxiv, medRxiv)	Optional	Yes	No	Non-profit, charges APC (\$3,000)
F1000 Research	Multi-disciplinary (heavy life-sciences focus)	Centralised	Yes	Yes	No, but allows community comments	For-profit, charges APC (\$1000-\$1750)
Gigabyte	Life sciences, data-intensive research	Centralised	Yes	Yes	No	Non-profit, charges APC (\$535)

⁸⁸ <https://prereview.org/en-us>
⁸⁹ <https://www.reviewcommons.org/>
⁹⁰ <https://metaror.org/>

Platform	Discipline	Centralised/de-centralised	Open Identities	Open Reports	Open Participation	Financial model
MetaROR	Multi-disciplinary (meta-research)	De-centralised, allows preprint servers incl. arXiv, bioRxiv, medRxiv, MetaArXiv, OSF Preprints, PsyArXiv, SocArXiv, Zenodo	Optional	Yes	No	Non-profit, no APC (grant/community supported)
Open Research Europe	Multi-disciplinary (EU-funded, other funder-supported research)	Centralised (formerly F1000 technology, in transition to new open-source solution hosted by CERN, launching Autumn 2026)	Yes	Yes	No	Non-profit, no APC (cost covered by funder)
Peer Community In	Multi-disciplinary	De-centralised, allows preprint servers incl. bioRxiv, HAL, Zenodo, arXiv, OSF Preprints	Generally optional, but varies by community, e.g., PCI Org Studies is double anonymised	Yes	No	Non-profit, no APC (grant/community supported)
PRE review	Multi-disciplinary (life sciences focus)	De-centralised, allows any preprint server	Optional (open or pseudonymous)	Yes	Yes (self-selected community reviewers)	Non-profit, no APC (grant/community supported)
Review Commons	Life sciences	De-centralised, allows bioRxiv or medRxiv	Optional	Yes	No	Non-profit, no APC (grant/community supported)
SciPost	Multi-disciplinary (but heavy natural-sciences focus)	Centralised	Optional	Yes	Yes (registered Contributors)	Non-profit, no APC (grant/community supported)

The proposed benefits of the PRC model relate closely to issues of equity. First, PRC models may reduce structural disadvantages linked to delays in publication. By making manuscripts publicly available in advance of peer review, PRC speeds dissemination. According to Björk and Solomon (2013), average submission to publication times at traditional journals are around 12 months.⁹¹

⁹¹ Although with significant disciplinary variation (fewer than 10 months in chemistry, engineering and biomedicine; 14 months in social sciences and humanities, and almost 18 months in business and economics)

Given average acceptance rates of 30-40% (Herbert, 2022), many manuscripts undergo multiple rounds of submission and rejection, meaning delays in dissemination can amount to years. Such delays not only pose an “opportunity cost” for the timely advance of knowledge (Stern & O’Shea, 2019, p. 2), but also especially disadvantage ECRs, for whom timely publication can be crucial for career progression (Felisi et al., 2026).

Second, by reviewing once, in advance of curation, the PRC model can potentially avoid wasteful rounds of submission and rejection, potentially lowering overall costs of publishing (including Open Access costs whose negative implications for equity we examined in the previous chapter).

Third, preprint review has also been framed as a useful training ground for ECRs and underrepresented researchers. Building on the tradition of journal clubs, participatory and open review practices within PRC models can foreground learning, mentorship, and capacity building. For instance, PREreview is an open-source platform dedicated to the review of preprints using a model of Open Participation, whose mission explicitly centres equity: “PREreview gives systematically disadvantaged scientists better ways to find a voice, train, and engage in peer review” (PREreview, 2026). By helping mainstream disadvantaged researchers through peer review enculturation and visibility, the PREreview case is hence a good example of how Open Participation may be incorporated alongside traditional review structures to further the aims of equity.

Fourth, advocates argue that PRC may help overcome negative impacts of journal prestige and selectivity, which are widely seen to pressure researchers towards questionable research practices. In the words of Stern & O’Shea (2019, p. 3), “In this hypercompetitive publishing environment, researchers are tempted to exaggerate their work’s impact, to choose research topics deemed suitable for top journals, and to refrain from open sharing of data and other research outputs.” In this way, PRC could be argued to contribute to a more equitable system by reshaping incentives and levelling the playing field for those less-inclined to compromise on research integrity.

Finally, Avissar-Whiting et al. (2024, p. 7) argue that by removing considerations of suitedness for particular venues, PRC may help reorient peer review toward evaluation of the work itself while strengthening its formative function by encouraging reviewers to be more collegial and constructive. Although peer review is not wholly altruistic, bound up in systems of reputation and accumulation (Kaltenbrunner, 2025), it is nonetheless a strikingly communalistic practice, motivated to a large degree by norms of community service and reciprocity (Zaharie & Osoian, 2016). Persistent concerns that peer review cultures can be “toxic,” epitomised by the trope of ‘Reviewer 2’⁹², are widespread, and unprofessional reviewing has been shown to disproportionately harm traditionally underrepresented researchers, with negative effects on productivity, career progression, and self-perception (O. M. Smith et al., 2023). Such behaviour may be partially explained by the structural conditions under which peer review is performed, often in the margins of academic life (Barnett et al., 2019) and under conditions of time pressure and anonymity that facilitate disinhibition. Advocates hence argue that PRC may foster greater care, collegiality, and collaboration in review by shifting away from narrowly summative judgements toward a more constructive, formative practice, with stronger emphasis on collective intellectual development.

Moving on to consider potential negative implications of PRC for equity, we must first flag a potential conflict with systems of double anonymised review. Such systems, while imperfect, are widely regarded as at least partially effective in limiting social bias (Huber et al., 2022; Ross et al., 2006; Sun et al., 2022), and are especially prevalent in areas like arts, humanities and social sciences (Karhulahti & Backe, 2021).

⁹² The Facebook group “Reviewer 2 Must Be Stopped!” has over 200,000 members at time of writing.
<https://www.facebook.com/groups/7104166046>

By requiring public availability of pre-review manuscripts, which are usually published with author names attached, PRC models may limit usage of double anonymised review (Horbach et al., 2022). One possible solution is the anonymisation of preprints, as happens in some *Peer Community In* communities.⁹³ But while this maintains rapid dissemination, it undermines benefits of early credit and recognition and may be antithetical to accountability and coordination in contested or quick-moving contexts such as the COVID-19 pandemic. These tensions highlight equity trade-offs which may be inherent to transforming systems of scholarly communication. *Peer Community In* offers a constructive example in this regard, however. Its community-driven and flexible framework enables communities to shape review practices, avoiding top-down universalism by empowering local agency to balance openness with other factors in alignment with situated epistemic norms. In this sense, PCI also exemplifies how infrastructures might support Leonelli's notion of judicious connection through context-sensitive design.

A further concern for equity relates to the current rewards and recognition for editorial and infrastructural labour in PRC platforms. We discussed earlier that traditional review activities are generally poorly directly rewarded, typically reduced to a line or two on a CV listing review venues. Despite the problems associated with journal prestige discussed above, journal titles remain important markers of academic belonging. Consequently, reviews for newer or non-traditional venues are likely to be undervalued in assessment processes. This creates a potential barrier, especially for early-career and underrepresented scholars, for whom precarity and marginality can influence the decision of where best to invest their limited time and energy most important. A parallel issue concerns the labour supporting PRC systems. As we saw in Table 2 above, many PRC-aligned platforms and infrastructures currently rely heavily on community goodwill, volunteerism, and short-term grant funding, raising questions about long-term sustainability and the equitable distribution of effort. Without stable funding models, there is a risk that the burden of maintaining open scholarly infrastructures falls disproportionately on already stretched academic communities or those most committed to reform. These considerations underline the importance of holistic and coordinated reform efforts, including those targeting research assessment (e.g., DORA⁹⁴ and CoARA⁹⁵), and support for the financial sustainability of open infrastructures (as discussed in the previous chapter).

Finally, questions arise regarding potential unintended consequences of reshaping the curational layer of scholarly communication. Limits of attention, the role of trust in decisions to engage with knowledge and epistemic actors, and growing potential for information overload and misinformation in an era of hyper-publication and paper mills, underline the ongoing need for filtering and validation mechanisms – a role traditionally served by journals.⁹⁶ As discussed above, the focal importance of such venues, reinforced by metrics like the Journal Impact Factor, has been widely criticised for privileging venue over intrinsic quality of the work, distorting incentives, and entrenching inequities. Yet, given the fundamental role of curational markers in allocation of credit, the central role of the credit economy in academic motivations, and the complex dynamics of trust, attention and network effects involved, attempts at its reform must proceed with foresight and caution regarding the wide-ranging potential for unintended consequences as such metrics assume their own “epistemic agency” (Müller & de Rijcke, 2017).

⁹³ Most PCI communities use single anonymised review alongside optional Open Identities, but some use double anonymised, e.g., *Peer Community In Organisation Studies*: https://orgstudies.peercommunityin.org/help/help_generic

⁹⁴ <https://sfdora.org/>

⁹⁵ <https://www.coara.org/>

⁹⁶ Gierveld (2002) identifies ‘awareness’ and ‘certification’ as two of four traditional journal functions (the others being ‘registration’ of claims to establish priority and credit and ‘archiving’, i.e., the preservation of knowledge).

Remember that the Journal Impact Factor started life as an innocuous metric designed to help libraries decide to which journals to subscribe. In PRC, curation may occur through a variety of mechanisms, including endorsements and recommendations (via services like Sciety⁹⁷ or preLights⁹⁸), metadata enrichment or badging, and even formal publication (in overlay or traditional journals). The key question is whether these alternatives redistribute recognition for the better. As Dutilh Novaes and Dede (2025) note, despite reproducing hierarchies, traditional journals at least in principle enable work by lesser-known authors to gain recognition if it passes established thresholds – a *Nature* paper can make careers. Without careful design, curatorial layers may amplify “rich-get-richer” dynamics or incentivise strategic visibility-seeking or gaming rather than research quality. Such risks should be a central consideration in design of these new curatorial layers to ensure equitable epistemic filtering aligned with research integrity and inclusion, not new instruments of disadvantage.

4.7. Summary: Capabilities, visibility, vulnerability, labour

In this section we have reviewed models of peer review that in various ways align with OS principles of accessibility, transparency and participation. What emerges is a complex web of innovations with often ambiguous implications for equity. Echoing recurrent themes from earlier sections, equity does not flow from openness alone in OPR; coordinated action is also required on measures for governance, incentives, infrastructure, and training that enable capabilities for effective participation. Table 3 summarises the key benefits and risks we have encountered.

Table 3. Summary of equity implications of Open Peer Review models

Innovation	Equity-relevant benefits	Equity risks / trade-offs
Open Identities Reviewer identities are disclosed to authors and/or made public	- Increases accountability and transparency - Reduces hidden biases and conflicts of interest - Enables recognition of reviewer labour	- Disproportionate risk of reprisals or reputational harm for those in more vulnerable positions - May privilege Western norms - Cumulative advantage of visibility and credit for more empowered researchers
Open Reports Review reports are published alongside manuscripts or final publications	- Enables scrutiny, supporting fairness and trust - Broadens access to knowledge production for wider publics - Fosters more constructive and collegial review behaviour, benefiting underrepresented groups - Potentially improves credit and recognition	- Benefits of visibility accrue unevenly - Infrastructure and labour costs disadvantage smaller or community-led publishers

⁹⁷ <https://sciety.org/>

⁹⁸ <https://prelights.biologists.com/>

Open Participation Wider communities are invited to self-select into review processes	• Avoids gatekeeping effects, shifting control from gatekeepers to communities • Broadens formal access to participation • Potentially diversifies perspectives and supports epistemic inclusion (in principle)	• Low uptake due to structural barriers (time, incentives, language, training) • Questionable utility as a mainstream solution • Potentially introduces new inequalities through network effects (e.g., popularity bias)
Publish, Review, Curate (PRC) Dissemination occurs in advance of review, with curation across a range of means beyond the journal	• Reduces publication delays • May weaken journal prestige effects • Supports formative and collaborative review culture	• Potential conflict with double-anonymised review • PRC review/curation not yet recognised and rewarded • Questions regarding sustainability and reliance on community/volunteer efforts • New curatorial layers may reproduce prestige hierarchies and shift labour burdens

From this picture, several cross-cutting considerations emerge. *Firstly, we need greater focus on a capabilities-based understanding of participation.* Just as access to outputs does not assure meaningful possibilities for re-use (Bezuidenhout, 2025), simply enabling new routes for engagement does not ensure equitable participation. Even where researchers are empowered to make such choices, for instance in Open Participation's shift from gatekeeper-invited to self-selected review, such decisions are still shaped to a large degree by their existing capacities including linguistic factors and familiarity with review cultures, as well as attendant conversion factors including time, training, digital literacy, institutional support and expectations regarding risk and rewards (cf. Bourdieu's *habitus*). Equity gains therefore require both focus on making opportunities available, as well as investing in the capacities required to use them. In the case of increasing equity in participation, this may mean that resources are better invested not in OS solutions (new systems of Open Participation), but in more prosaic means such as educating gatekeepers regarding bias, or training reviewers from marginalised populations. The case of PREreview suggests, however, that these might be usefully combined in some circumstances. Importantly, this also perhaps cautions limits on our expectations for equity gains under OS. Greater equity has emerged as a central concern for OS in recent years; yet simpler, more effective solutions may be available – as in the case of Open Participation, where attempts to reconfigure review structures might be seen as a technosolutionist answer to a problem better addressed through training and education for reviewers and gatekeepers.

Second, there is a recurrent structural tension between vulnerability and visibility. Capacities to engage in review with Open Identities, for instance, are not distributed equally. Marginalised scholars, or those embedded in small or hierarchical communities, often perceive heightened risks of reputational harm or retaliation and restrict participation accordingly. But protection measures of anonymity restrict gains in symbolic capital of credit and visibility. We pointed out above that making Open Identities optional or designing modular systems which enable communities to configure models in accordance with local norms, can be considered infradiverse forms of designing for “judicious connection” by tempering openness with respect for local agency. Yet where transparency is made the norm, with the credit economy reshaped around it, then opting out will still incur losses. At the policy or governance levels, where designing for judicious connection is at stake, effects of this tension between vulnerability-visibility should be a key consideration, especially in discussions regarding reform of research assessment to more directly reward sharing.

Finally, there are structural tensions regarding sustainability and fairness in peer review. Review itself is largely based on volunteer labour, and many of the community-led, open infrastructures overseeing operations face the issues of funding, sustainability and labour identified in section 3.2.4. As we have discussed, the communalistic aspects of academia and the circulation of various forms of scientific capital largely underpin such systems and are not necessarily of issue for equity. However, care must still be taken to avoid exploitation, and thus we may call for more work to understand the place of peer review in academic life and models for its sustainability.

5. Conclusions and recommendations

5.1. Conclusions

The role of equity in Open Science has rightly become of renewed focus in recent years. Rather than assuming that equity will automatically flow from greater access, transparency or participation, there is increasing recognition that it requires intentional and reflexive design. The world is marked by profound inequalities, and uneven distributions of resources, visibility, support and social capital continue to shape empowerment in open environments.

This report has sought to explore these dynamics through two case studies of Open Science infrastructures and Open Peer Review. Our analysis of Open Science infrastructures demonstrated their sociotechnical agency in embodying values, norms, assumptions, while knowledge-production practices and possibilities for participation. We explored how ownership and governance arrangements influence community-responsiveness, recognising that community-governed infrastructures often align more closely with the communal values of scholarship, while also facing important challenges relating to sustainability, funding and dependence on voluntary labour. We further explored how uneven levels of infrastructural coverage and maturity across dimensions of geography, discipline, language and formats can shape the possibilities to participate meaningfully in Open Science. Meaningful participation, we argued, is not determined by infrastructure provision alone, but also by personal, social and environmental conditions that affect researchers' real capacities to engage with and benefit from Open Science practices.

To capture these challenges, we introduced the notion of “infradiversity”: the need for Open Science infrastructures that sustain and foster a diverse, pluralistic and interconnected ecosystem that values epistemic pluralism, local agency, multilingualism and flexible interoperability, while also supporting diverse disciplinary traditions, regional needs, community priorities and approaches to openness. Infradiversity acknowledges that equitable infrastructures must focus not just on enabling access to goods and services, but also on considering the ways in which they challenge or consolidate existing distributions of agency and power. This requires infrastructures which centre reciprocity, community-leadership, public accountability and reflexivity in decision-making.

In examining Open Peer Review models, we found that increases in transparency and participation also introduce important tensions and trade-offs. Greater openness can strengthen reviewer accountability, collegiality, and the recognition of reviewers' contributions, fostering more collaborative forms of scholarly communication. However, the challenges and opportunities of publicity and openness – particularly regarding reviewer identity disclosure – are experienced differently across different groups, depending on existing distributions of prestige, precariousness, and social capital. Marginalised and vulnerable scholars may face heightened risks when openly critiquing the work of those more-established. While optional disclosure may be a form of judicious closure, it may also lead to unequal distribution of gains in visibility and reputation. In Open Peer Review, as in existing modes of review and curation, there is also continued reliance on voluntary and often invisible labour, raising continued questions of sustainability and fairness. Limited uptake of forms of Open Participation again underlines the message that openness alone does not enable participation without parallel investments in capacity, institutional support and capacity building. Finally, while Publish, Review, Curate models reconfigure the temporal logics of scholarly communication with potentially positive implications for equity, they remain emergent and need further incubation through focus on sustainable funding and careful assessment of potential unintended consequences.

Taken together, our findings underline the need for careful and reflexive Open Science policies and implementation strategies that critically engage with both the opportunities and the risks of open Science for diverse groups. Questions of how Open Science centres or decentres power and control are not abstract concepts for academic debate. They are felt daily in scholars' real-world praxis, as we have seen through this report – whether it is their encounter with unaffordable charges for Open Access publication, epistemically inappropriate standards, poor infrastructural coverage, or invisible contributions to sustaining Open Science ecosystems. Such considerations point towards an urgent need for what we might call “equity-by-design” in Open Science: improved embedding of inclusion, diversity and capabilities into policies, practices, processes and infrastructures from the outset. We will explore what this might mean as we present our final recommendations for future policy and practice amongst research actors in the European Research Area and beyond.

5.2. Recommendations

Recommendation 1: Prioritise equity-by-design in Open Science

Actions

- Raise awareness and understanding amongst Open Science policymakers, infrastructure providers and others of the role played by personal, social and environmental conversion factors in shaping participation in Open Science. Encourage explicit attention to differences in opportunities and challenges for different groups.
- Consideration should be given to addressing not only accessibility but also the mediating factors which influence meaningful participation (especially amongst traditionally marginalised groups).
- Promote transparent and inclusive governance structures with diverse stakeholder representation to facilitate responsiveness to communities.
- Target investments towards sustainable, community-controlled infrastructures and shared support services.
- Foster locally relevant approaches via collaboration, peer learning and community-led development to avoid imposing uniform models which may be ill-suited to different research contexts.

Recommendation 2: Foster infradiversity through equitable and sustainable Open Science infrastructures

Actions

- Address infrastructural gaps relating to geographic, disciplinary, linguistic and resource-type coverage, where poor provision presents risks to equitable participation. In particular, build infrastructural capacity in EU “Widening Participation” countries, in social sciences and humanities, for non-English content and metadata, for emerging modes of publication (Diamond OA, Publish, Review, Curate models), and for research software.
- Prioritise community-led, publicly governed infrastructure to ensure responsiveness to community needs, especially in areas where private ownership may conflict with academic self-governance.
- Support regional and local infrastructures where possible.
- Empower research communities to develop standards which adhere to their norms and values, while fostering interoperability through collaboration and knowledge-sharing.
- Encourage ongoing reflection on unintended consequences and effective action to address equity risks.
- Improve reward and recognition for infrastructural work (see also Recommendation 4).

- Further develop coordinated, long-term funding models for not-for-profit infrastructures to support the sustainability of critical Open Science infrastructures and services (see also Recommendation 4).

Recommendation 3: Foster flexible, context-sensitive implementations of Open Peer Review

Actions

- Encourage diverse approaches to Open Peer Review and support their context-sensitive implementation in line with community norms. Be especially aware of risks associated with de-anonymising reviewers (Open Identities).
- Invest in building capacity for peer review inclusion in general, including expanding representation on editorial boards, provision of peer review training and guidance, mentorship and co-reviewing schemes, and more inclusive reviewer invitation tools and practices.
- Improve reward and recognition for review, editorial, and curatorial work (see also Recommendation 4).
- Support continued experimentation and mainstreaming of Open Peer Review and Publish, Review, Curate models, accompanied by metaresearch and monitoring to investigate equity implications (see also Recommendation 5).
- Investigate uses of Open Peer Review for research formats beyond the article (e.g., books, funding proposals, data), including their implications for equity.

Recommendation 4: Recognise and sustain Open Science labour through equitable models of funding and recognition

Actions

- Further develop collaborative funding mechanisms for non-profit and community-led Open Science infrastructures and services to move away from short-term project funding and voluntary work.
- Foster transparency regarding costs and sustainability challenges, and encourage self-assessments of equity challenges.
- Further work to recognise contributions to infrastructure, peer review and community-building within research assessment.
- Further invest in recognised career pathways and professional development for infrastructure management and Open Science support services.

Recommendation 5: Enable robust metaresearch and monitoring regarding equity outcomes associated with Open Science

Actions

- Further enable funding and support for ongoing metaresearch programmes to investigate dimensions of equity in Open Science.
- Continue work to refine indicators and reporting mechanisms to track aspects of equity including inclusion, accessibility, multilingualism, representation, and costs/benefits across communities, institutions and regions. In line with the above considerations, such indicators should themselves be built upon open, community-led infrastructures.
- Embed equity impact assessment and accountability mechanisms into infrastructural funding mechanisms. Encourage reflexive and timely responses to emerging issues and unintended consequences.
- Perform infrastructure landscape analyses which monitor infradiversity issues related to infrastructural design, coverage and access. Identify gaps in provision and assess risks related to overreliance on proprietary platforms on an ongoing basis.
- Promote cross-stakeholder knowledge-sharing regarding equity risks and best practices.

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This report explores how equity can be embedded into Open Science. It argues that unequal capacities and dynamics of cumulative advantage mean that openness alone cannot be assumed to increase equity. Based on case studies of Open Science infrastructures and Open Peer Review, the report explores the advantages and disadvantages of openness for different groups. It proposes the notions of "infradiversity" as an agenda for community-driven, inclusive Open Science ecosystems and "equity-by-design" as an orienting principle for the development and implementation of policy and practice.

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