FAIR Data Accelerator Pilot

Cultivating Cultures of Data Sharing

Project Overview

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Contents

Introduction

The FAIR Data Accelerator, "Cultivating Cultures of Data Sharing", is one of four pilot projects for the DSIT/UKRI Research Data Cloud Pilot Commission which are testing the need for a national research cloud through a series of interventions designed to address data sharing barriers.

The challenges of implementing FAIR principles extend beyond technical and policy issues. Researchers' practices with digital technologies are driven by disciplinary traditions, values, social norms and etiquette (Tsatsou, 2016). These factors affect how a research community handles data throughout the research lifecycle, from data generation and processing to publication, management, and reuse (He and Fang, 2024). The increased promotion and adoption of open science and data sharing will give rise to new forms of collaboration, communication and reflection within a discipline (Armeni et al., 2021). In addition, adoption of open science and FAIR principles enables data from one discipline to be more easily accessed by other research communities. This creates a more distributed approach and wider network of knowledge generation/circulation and can lead to a broader "macro-epistemic" culture (Knorr-Cetina, 2007).

The FAIR Data Accelerator aimed to identify social and cultural barriers and explore approaches that could contribute to address them in order to cultivate *Cultures of Data Sharing* across research communities. The project brings together expertise from sociology of scientific knowledge, science and technology studies, professional learning, and Digital Research Infrastructure (DRI). This pilot focuses on addressing the human/social aspects including professional practice, professional identity and agency, or the actions humans take in response to changes in their situation and context.

This overview outlines key aspects of the project, such as theoretical and methodological framework, co-design methods, case studies, and recommendations. Additional information regarding these issues is available in the following reports:

- Report 1: "Identifying, understanding and reframing social and cultural barriers to data sharing"
- Report 2: "Co-designing, testing and evaluating social and cultural learning experiences"
- Rerpot 3: "Applied Learning Programme Framework: Concepts, tools and methods"
- Report 4: "Recommendations"
- Glossary

Identifying, understanding and reframing social and cultural barriers to data sharing

Policy reports and research suggest that open science and data sharing is fundamental to advancing scientific investigation and knowledge, resulting in new forms of collaboration, communication and reflection. However, these changes also bring about *uncertainties,* reshaping how researchers deal

with new demands. Despite ongoing efforts to promote data sharing within and across research communities, there is still limited understanding of how researchers respond in different ways to changes at work and the opportunities that they bring.

This project established a theoretical and methodological approach to identifying, understanding and reframing social and cultural issues that influence the digital transformation of science, with a focus on the role of Digital Research Infrastructures (DRIs) in reshaping research practices and scientific cultural values, such as data sharing.

Theoretical approach

Drawing on insights from the sociology of scientific knowledge, philosophy of science, and science and technology studies, and professional learning, this approach develops a nuanced understanding of three foundational concepts: *social structures*, *cultural dynamics*, and *individual agency*. By deepening these perspectives, it provides a framework for informing practical strategies and solutions that address complex challenges in research (Report 2).

Firstly, the *social* is defined as the relationships between *infrastructure/objects* (e.g. High Performance Computing, metadata, university), *practices* (e.g., research integrity, data sharing) and *people* (e.g. data stewards, researchers, academics, DRI professionals, funders and data custodians). The social is not treated as a secondary aspect of regulations, management, institutions, or digital objects. Instead, it is seen as emerging from the complex web of relationships across insfrastructures/objects, practices, and people (Latour, 2007). Since the social emerges from these interactions, social order and social change are not opposing forces; rather, social change is a constant, while social order occurs within change.

Secondly, *culture* goes beyond the development and preservation of shared values, identity and norms. By contrast, this approach recognises that communities (and their cultures) are also defined by a lack, and this lack serves as the glue that holds an epistemic culture – i.e., individual and group interactions are sustained by the continual necessity for *negotiating* key aspects of their existence, such as data quality standards, cultural values, methods of recognition, and more. These forms of *negotiation* make a community possible, rather than merely fostering a shared identity, values or common language that facilitates group functioning.

Finally, this approach considers individual agency as *subjectivity* – a key site of political struggle within the frameworks of specific power dynamics (Ball, 2016). This means that each individual is viewed as the locus where power and knowledge intersect. By taking this perpective, two fundamental principles are acknowledged. First, scientific professional identity (e.g., values, commitments, ethical standards, etc.) is shaped by the power dynamics of epistemic cultures, the rise of new sociotechnical imaginaries i.e., symbols and visions of a shared future like federated DRIs, and other factors. Second, researchers redefine their professional identity and expertise through self-formation practices that produce effects in their epistemic cultures.

By conceptualising social structures, cultural dynamics, and individual agency in this way, the approach leverages two key analytical concepts to bridge theory and practice: *agency cultivation* and

professional identity negotiation. The former examines how individuals and groups develop the capacity to navigate, challenge, and reshape institutional and epistemic barriers, fostering more transformative and inclusive forms of knowledge production. The latter explores how researchers balance personal values, disciplinary norms, and external pressures in their evolving roles, shaping both their self-identity and engagement with broader scientific and technological landscapes. Together, these concepts provide a framework for understanding how researchers exert their agency, respond to shifting conditions, and drive meaningful transformations within research environments.

Methodological approach

To identify social and cultural issues of digital transformation of science, such as data sharing within the DRI ecosystem, an ethnographic approach was proposed. Ethnography is particularly well-suited for understanding the social and cultural dimensions of the digital transformation of science because it enables an in-depth and contextualised analysis of how researchers navigate, negotiate, and sometimes resist changes at work. Given the increasing adoption of DRIs, ethnographic methods allow for the exploration of researchers' agency in response to shifting power dynamics. By focusing on lived experiences and daily practices, ethnography captures how researchers actively shape emerging digital environments. Ethnography, therefore, provides the granularity needed to understand how digital transformation is reshaping knowledge production, collaboration, and the social organisation of science. Methods include document analysis, interviews, participant observations, focus group, etc.

Case study: social and cultural barriers to data sharing across DRIs ecosystem

The study involved 18 semi-structured online interviews with participants across the UK DRI landscape, representing diverse projects such as UKSRC, BioFAIR UK, UK Energy Data Centre, and others. The participants held various roles, including leadership positions, data stewards, and researchers at different career stages. Conducted between February and April 2024 via Zoom, the interviews explored how DRIs have influenced data sharing practices over time. Participants were asked to reflect on past, present, and future approaches to data management, highlighting how DRIs have reshaped research data practices. Additionally, observations at key community events, such as the UKSRC All Hands and NetDRIVE workshop, provided further insights into researchers' and DRI professionals' perceptions of data sharing and the challenges they face.

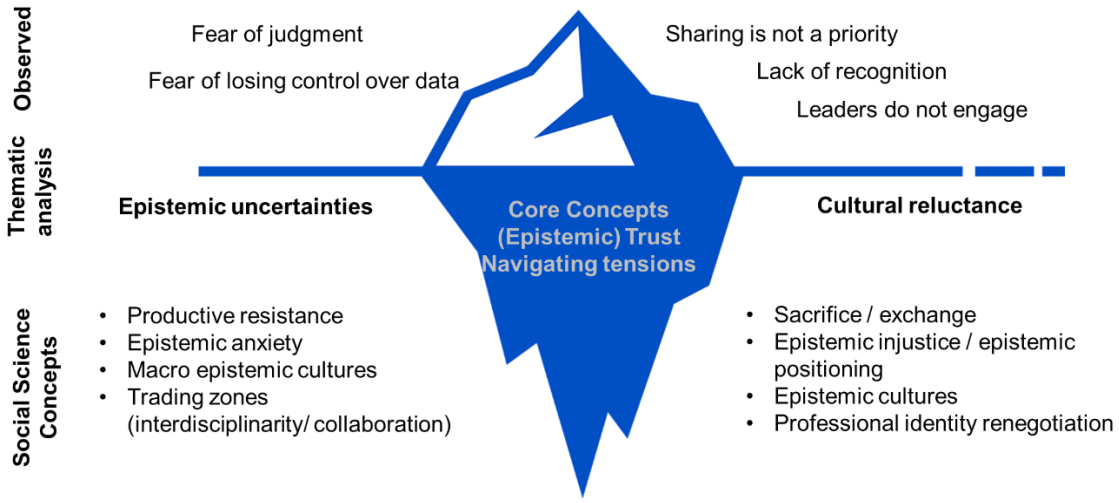

Figure 1: Ethnography thematic analysis led to a new conceptual framework that enables reframing of social and cultural barriers to data sharing

Thematic analysis revealed two key intertwined themes: *epistemic uncertainties* and *cultural reluctance* (Figure 1). Epistemic uncertainties refer to the concerns, fears, and ambiguities researchers experience due to changes in work and research practices. These uncertainties manifest as a *fear of judgement* (worrying about the quality of data or the potential for errors) and a *fear of losing control over data*, particularly in relation to AI and automated systems.

Cultural reluctance, on the other hand, stems from ingrained academic norms and values that deprioritise data sharing. Researchers often prioritise traditional academic achievements such as publications and peer approval over making their data openly accessible. Additionally, the lack of recognition or tangible benefits for data sharing and disengagement from leadership further hinder cultural shifts toward openness and sharing.

Reframing social and cultural barriers

The project provided insights into reframing social and cultural barriers (Report 1), shifting the focus from familiar challenges to potential opportunities and actionable solutions. A crucial starting point in this reframing process is recognising that exchanges within research communities are driven not only by economic incentives but also and, most importantly, by deeper *symbolic exchanges* – i.e., interactions shaped by social norms, professional values, and identity. We outline three opportunities that can support the reframing and aid further exploration of the data sharing barriers identified:

- Enabling and empowering individuals
- Harnessing data across disciplines and traditional boundaries
- Maximising value through the lifecycle of DRIs

This perspective highlights the importance of agency and professional identity in shaping data sharing practices and fostering change. By integrating key concepts such as epistemic diversity, epistemic injustice, productive resistance, and sacrifice, the project problematises these barriers in a way that opens pathways toward more inclusive and sustainable forms of support for research communities.

Co-designing, testing and evaluating social and cultural learning experiences

Methodological approach

The project provided an approach, practical steps and examples to cultivating *Cultures of Data Sharing* through co-designing, testing and evaluating social and cultural learning experiences within and across research communities. The approach integrates insights from contemporary theories of professional learning and the sociology of scientific knowledge and expertise. It emphasises that scientific expertise, such as data sharing, is shaped by social and cultural learning processes, requiring experiential learning, discussion, and collaboration. Learning occurs not only through formal training but also through non-formal and unintentional experiences within the workplace. Therefore, the reconfiguration of *tacit knowledge* – knowledge that we have but we cannot explain (Collins & Evans, 2009) – is a key aspect of this process, as professionals engage in learning activities that influence their professional identity and agency. Data sharing, for example, generates new values implicitly, requiring researchers to embody and negotiate evolving epistemic norms through their professional practices.

To support the cultivation of *Cultures of Data Sharing*, the project provided a learning co-design methodology (ABC Conversational Framework) that can be used to ensure that learning experiences align with the realities and motivations of research communities. Using the ABC workshop and the Learning Designer app, this approach facilitates structured yet flexible learning design, drawing from the Conversational Framework's six learning types. These workshops create shared spaces for engagement, where diverse participants contribute to the co-development of learning strategies tailored to their communities. By leveraging co-design principles, the approach fosters trusted environments for novel professional development activities, enabling researchers to collaboratively navigate and shape evolving epistemic landscapes in data sharing and beyond.

Co-designing pathways to address social and cultural barriers to data sharing

The project conducted a workshop to co-design pathways for addressing social and cultural barriers to data sharing. The workshop explored two primary approaches: integrating insights from sociology and professional learning, and applying a learning design framework to develop professional development strategies.

The co-design workshop brought together 21 participants from diverse research communities, including life sciences, physical sciences, environmental sciences, and social sciences. Attendees reflected on their experiences and collaboratively developed strategies to mitigate key barriers to data sharing. Using a professional learning co-design approach, the workshop produced four initiatives aimed at overcoming three major cultural challenges. These initiatives were later made accessible online via the *Learning Designer* digital tool to encourage broader engagement, editing, and reuse.

In the morning session, participants prioritised five identified social barriers, such as fears of judgement and loss of data control, as well as lack of recognition for data sharing. In the afternoon, they co-designed learning interventions to tackle these barriers. The proposed initiatives included leadership communities of practice, narrative CVs to recognise data sharing efforts, peer-support workshops to address fear of judgment, and interdisciplinary seminars promoting data sharing best practices. These initiatives aimed to balance system-focused interventions, such as policy changes and incentives, with culture-driven strategies like community building.

The workshop highlighted the need for an integrated approach to addressing data sharing challenges, recognising both systemic and cultural factors. The learning co-design methodology proved effective in rapidly generating high-quality, collaborative solutions. Participants acknowledged the necessity of strengthening the Digital Research Infrastructure (DRI) community by fostering shared language, support mechanisms, and coordination among various research initiatives. Ultimately, the workshop reinforced the idea that addressing data sharing barriers requires not just technological solutions but also cultural shifts and sustained professional development efforts to cultivate cultures of data sharing.

Adapting and testing the learning designs

The project also held a series of follow-up meetings aimed to assess participants' interest in implementing learning designs and approaches discussed in a prior workshop. While all contacted participants expressed enthusiasm, some faced challenges to continue the work. Six meetings were held with representatives from major research investments, including DAFNI, PSDI, HDRUK, ARC UCL, UKSRC, and UKCEH. Discussions explored potential collaborations, with two communities focusing on modifying learning designs and three adapting the approach for different objectives. This engagement led to three distinct cases where learning designs were either adapted, co-developed, or used to inform broader community activities.

The first case involved ARC UCL, which piloted a workshop on narrative CVs to address the lack of recognition for data sharing efforts. The in-person session targeted organisational leaders, emphasising the benefits of FAIR principles in evaluating research contributions. The workshop, attended by six participants, fostered discussions on integrating FAIR practices into job descriptions and performance assessments. Feedback was overwhelmingly positive, with attendees appreciating the interactive nature and reconsidering their own application of FAIR principles.

The second case, a collaboration with HDRUK, adapted a learning design to address researchers' fears of judgment around data sharing. The newly developed workshop, *To Share or Not to Share*

provided a structured space for participants to discuss the benefits, tensions, and practical strategies for responsible data sharing.

The third case involved UKSRC, where discussions led to a live survey conducted at the STFC SKA Science Community Town Hall. The survey examined cultural and social barriers to data sharing, gathering input from 37 participants across various roles. Key themes included concerns over loss of professional identity, diminished control over data, trust issues in distributed collaborations, lack of recognition, interdisciplinary communication barriers, and unequal access to resources. Participants provided valuable insights, highlighting issues such as information overload, transparency in data processes, and the challenges faced by marginalised groups. The findings facilitated a broader conversation within the UKSRC community on shaping future policies and engagement strategies.

Evaluation

The learning designs focused on the different ways researchers learn and develop expertise and communities cultivate *Cultures of Data Sharing*. These activities were co-designed to test local contexts and help communities, including both researchers and research support professionals, focus on learning processes that promote data sharing and other collaborative practices. To evaluate the impact of these efforts, the Value Creation Framework (VCF) was employed, emphasising the value generated by networks and communities engaged in social learning activities. The VCF identifies five cycles of value creation, ranging from immediate outcomes (e.g., enriching discussions) to more long-term effects such as reframing perspectives and applying new knowledge in practice.

The framework was used to assess the success of UCL Advanced Reserach Computing's workshop, particularly through a post-event survey that aimed to capture immediate value, changes in perspectives (reframing), and plans for applying the knowledge gained. In the *Narrative CV workshop*, participants indicated a shift in their views on promoting and recognising FAIR data principles. Many expressed plans to integrate FAIR practices into their work, such as helping researchers understand FAIR beyond just data or making their impact data more open. The survey results demonstrated that while changing perspectives on FAIR is a gradual process, the workshop effectively provided a space for professionals to reflect on and plan for the adoption of FAIR principles within their respective organisations.

Enabling communities to cultivate new cultures of data sharing

The Applied Learning Programme

The **Applied Learning Programme** (Figure 2) is a framework that can be used to understand, reframe and address social and cultural barriers to data sharing. The five key phases can be used to develop the conditions for more inclusive and effective **Cultures of Sharing** across research

communities. As research communities apply the framework, there will increase the number of resources (e.g. learning designs and facilitation plans, evaluations), and if shared, they could be used by others for inspiration or adaptation. The cycle supports the development of an evidence-based approach that encourages communities to continue to reflect on their culture as the ambitions (and barriers) of the research community evolve.

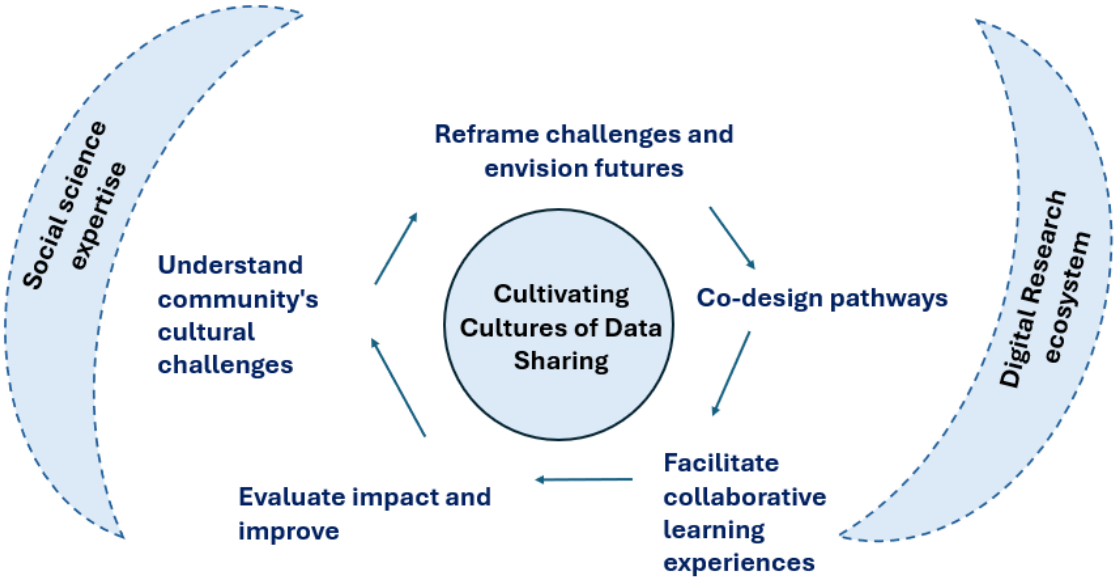

Figure 2 – The five phases of the Applied Learning Programme Framework

Applied Learning Programme's five key phases:

1. **Understand Community's Cultural Challenges**. This phase includes exploring the current social and cultural barriers in the community by using social science research concepts, ethnography or other approaches.
2. **Reframe Challenges and Envision Futures.** This phase incudes reframing the challenges, barriers and opportunities using the new conceptual framework (Figure 2) and imagining different scenarios or data sharing cultures that could better support the research community achieve their research and innovation ambitions. Senior leadership championing and prioritising activities that would support the development of a new data sharing culture addresses one of the barriers identified.
3. **Co-Design pathways**. This phase includes participatory approches for the co-design of concrete strategies to achieve these ambitions, thus addressing challenges and barriers, and harnessing opportunities that support development of the envisioned culture of data sharing.
4. **Facilitate Collaborative Learning Experiences.** This phase involves tailoring and implementing strategies to address social and cultural barriers that fit local contexts.

5. **Evaluate Impact and Improve.** This phase includes the evaluation of the strategies implemented and their impact on cultivating Cultures of Sharing.

This framework can be used by a range of users including academics and researchers, research community managers and facilitators, training professionals, digital research infrastructure professionals, research software engineers, data stewards, open science and research culture professionals, industry partners as well as funders and policy makers. It has the potential to support change within the research ecosystem including funder policies and funding calls, departmental or institutional services and facilities, research discipline and interdisciplinary challenges.

Enabling relational and community infrastructure

The evolution of data sharing cultures will depend on the connections, interactions, trust, and shared identity that exists (or not) within a community. This can be refered to as **relational infrastructure** (Rye, 2023) which underpin a community's ability to collaborate, solve problems and drive change. Relational infrastructure can be observed for example as communities of practice, research communities and professional networks. Strategic community engagement and programming can facilitate communication, activities, involvement of members, which can foster relationships and deliver shared priorities (Woodley & Pratt, 2020). Collaborative communities can provide a focus point for the Applied Learning Programme and can suppport its members as the culture evolves. Facilitating knowledge exchange between research communities provides the opportunity to develop capacity in evolving cultures of data sharing across disciplines.

The promotion of FAIR Data principles and open science is not the only change impacting the DRI landscape and research culture. Other changes relate to increased diversity regarding both computational architectural designs and workloads (Mzukwa, 2024), and becoming more environmentally sustainable (e.g., UKRI's Net Zero DRI, NetDrive[1]). The increasing volume, velocity, and variety of data, deployment of new large-scale compute facilities (McIntosh-Smith et al., 2024) and moving towards federated provision of UK computational resources[2] provides a range of sociotechnical and cultural challenges and opportunities. These different changes may drive opposing behaviours, for example, reducing energy consumption while storing research data long-term. The intersection of these challenges and opportunities provides a chance to shape DRIs and future research practices. DRI leaders across UKRI share the common need to navigate this landscape. Facilitating knowledge exchange across the DRI leaders provide opportunities to develop capacity in addressing these challenges, strengthen connections, and build trust across traditional silos and boundaries. However, the specific choices that would enable a particular DRI to maximise outputs would depend on their respective context and research and innovation priorities.

[1] https://eng.ox.ac.uk/netdrive/
[2] https://www.archer2.ac.uk/community/nfcs/

Recommendations

The proposed recommendations are intended to foster conditions that will enable the DRI ecosystem to address *social* and *cultural* barriers to *data sharing* at scale. They are structured across two levels, each addressing different challenges and opportunities for a more inclusive and effective research and innovation ecosystem.

1. Strengthening UK DRI's capacity to shape research culture at scale

1.1 **Develop a strategic DRI leadership forum**: to strengthen relationships and build capacity to navigate common challenges. This provides the opportunity to bring together DRI professions leading strategic investments to develop relationships across investments and potentially new collaborations. Provides a space for peer learning and knowledge exchange across types of facility or project and to leverage experience from different disciplines and discuss how to apply insights developed from (Meta)Science of DRI projects (see recommendation 1.2). Collectively it can build capacity for leaders to navigate the evolving DRI landscape.

1.2 **(Meta)Science of Digital Research Infrastructure Research Theme** to accelerate the generation of evidence on "what works" regarding the development of effective DRI ecosystem. The theme provides opportunities for experts who are traditionally outside of the DRI community to contribute, such as qualitative social science researchers. The aim is to create and support an interdisciplinary community focused on developing more effective ways for the DRI ecosystem to conduct and support research and development (R&D).

1.3 **QUICK WIN: Provide recommendations regarding organizational and governance structures of communities** that could be adapted by emerging groups, e.g. sharing the Research Data Alliance Interest's or DARE UK's Group and Working groups framework.

1.4 **QUICK WIN: Develop a repository of DRI communities to** make it easier for individuals to find and join relevant communities.

1.5 **QUICK WIN: Establish and signpost to UK DRI knowledge base** e.g. zenodo community.

1.6 Support **training in Community Engagement** to increase capacity in strategic community development across the ecosystem. For example, Scientific Community Engagement Fundamentals.

2. Cultivating Cultures of Data Sharing

2.1 **Fund collaborative research data communities** to foster responsible sharing and reuse of data through developing collaborative communities which is required to harness data resources to address a cross-disciplinary research challenge or government mission (e.g.

raising living standards) or to support users harness existing data assets. Similar to Collaborative Computational Projects that support software communities.

2.2 **Provide UKRI-wide funding opportunities that promote reuse of data** e.g. adapt the ESRC funding opportunity for "secondary data analysis" supports research that exploits existing ESRC data resources.

2.3 Expand the **social science-informed Applied Learning Programme (ALP)** to increase the capacity across research communities to create and implement novel professional development approaches to cultivate cultures of data sharing. The ALP is a framework that enables the development of capabilities of DRI and research communities that can create Cultures of Sharing tailored to their needs and contexts.

Conclusion

This project brought together expertise spanning sociology of scientific knowledge, professional learning, co-design methodologies and DRI development to address complex sociotechnical and cultural challenges such as data sharing in science.

As the DRI ecosystem continues to evolve in response to social, technological, environmental and policy changes, the capacity of research communities to reflect on and reshape their cultures will be essential. This work provides a **framework**, the so-called **Applied Learning Programme**, for enabling that critical process, supporting research communities in cultivating **Cultures of Data Sharing** through collaborative, meaningful, inclusive and human-centred strategies. In other words, inclusive cultures of data sharing cannot be imposed but cultivated through dialogue, shared values, and trusted spaces for negotiation.

This framework reframes data sharing barriers as a sociotechnical and cultural challenge that requires epistemic culture transformation. It provides practical pathways and insights for strengthening the research and innovation ecosystem, that is, enabling it to become not only more open and interoperable, but also more inclusive, reflective, and critical as technologies, practices and values evolve.

For the DRI ecosystem, this means that fostering cultures of data sharing requires more than new tools or infrastructures; it demands an investment in people, relationships, and the cultivation of shared values and practices across diverse research communities. The findings demonstrate that researchers' willingness to share data is shaped by complex factors including fears of judgement, loss of control over data, and a lack of recognition. Addressing these issues requires integrated approaches that combine co-designed learning interventions with support for leadership and community engagement.

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Appendix

Glossary

Key concepts	Meaning
Epistemic cultures	Epistemic cultures refer to the diverse ways of knowing, methodological approaches, reasoning styles, criteria for establishing evidence, object relations, and the dynamic interplay between theory and practice (Knorr-Cetina, 1999). These cultures shape how researchers construct knowledge and interpret reality within their fields, leading to distinct epistemological frameworks across disciplines. For instance, the research strategies, experimental designs, and validation processes in particle physics differ fundamentally from those in biochemistry, reflecting the unique epistemic commitments and operational norms of each field.
Macro epistemic cultures	Macro epistemic cultures are defined as locations for distributed knowledge production that reshape disciplinary boundaries and knowledge flows (Kirmayer, 2024; Knorr-Cetina, 2007). These macro epistemic cultures share principles that permeate and transcend traditional disciplinary boundaries, thereby reflecting specific forms of mobility, scalability and translatability of practices and values (Kirmayer, 2024). For example, the Open Science movement, including its transnational institutions, networks and communities, can be regarded as a macro epistemic organisation that seeks to observe, promote and validate practices related to openness, such as data sharing. This may lead to knowledge being shared with a far wider than individuals have experience of before adopting FAIR data sharing priniciples.
Agency	The ability of individual and collective groups to respond to a change in their context and exercise control over this response (Vallor & Vierkant, 2024). Agency can be instrumental, practical, normative, transformative, relational or distributed, depending on whether it is primarily individual or collective. Yet what is essential is that agency is not merely about adjusting to external pressures; it involves *deliberate and reflective engagement* with evolving practices, thereby enabling each individual and community to shape their own epistemic and professional trajectories, and the social structures of science. Researchers do not simply accept new practices as given; instead they critically evaluate, actively adopt, modify, or resist changes (transformative agency) that impact their work identity.
Productive resistance	In circumstances where researchers believe a transformation creates a cultural tension, they may agentically exert their academic freedom and respond with acts of resistance. However, resistance is not merely a negative response

	aiming to block or stop change but rather a practice that opens up opportunities to think and behave differently. Resistance may lead to small-scale reconfigurations or changes in systemic practices, thereby impacting culture at work.
Professional identity	Professional identity refers to individuals' perceptions of themselves as professional actors, including their professional commitments, ideals, interests, beliefs, values, and ethical standards (Eteläpelto et al., 2014). It includes what individuals regard as significant at work. If something that professionals within academia deem relevant at work changes, their professional identity is reconfigured. Projects and initiatives which support and recognise a wider variety of professions (Research Software Engineers, Research Data Stewards, Research Cloud Engineers) within academia could also impact how indivudals percieve themselves e.g. Software Sustainability Institute, Step-UP, UNIVERSE-HPC.
Symbolic exchange	It refers to forms of exchange, such as actions and ideas like data sharing, that are embedded in meaningful cultural relationships and extend beyond purely economic transactions. For instance, data sharing among researchers is often driven by values such as openness, critical inquiry, and the pursuit of objective knowledge through the testing of hypotheses and research reproducibility. These exchanges are underpinned by core scientific cultural values, including academic reputation, authorship, collaboration, and intellectual freedom.
Sacrifice	A key aspect of symbolic exchanges that relate to the transformation of work is the sacrifice of elements (practices or values) ingrained in scientific work identity – e.g., the sacrifice of prestige, freedom, interests, ideals, legacy, etc. This sacrifice is necessary to allow a new configuration to emerge. However, this cultural shift depends on how a diverse group of actors perceive the benefits of their sacrifice. Consequently, sacrifice is always mediated and prompted by envisioning futures that may present potential individual and collective benefits. For example, project leads may need to sacrifice some aspects of freedom, if they decide to work with a data steward to manage and curate their data according to internationally agreed metadata schema. However, the benefit would be increased quality of data and for the data to have potentially have increased impact.
Epistemic diversity	It refers to the variety of knowledge-making practices, cultures, theories and agents that make knowledge creation possible within and across research communities. For example, it is argued that new practices like open science and data sharing may lead to privilege specific types of data and expertise over others, thus impacting epistemic diversity (Leonelli, 2023).
Epistemic injustice and	Research communities are shaped by formal and informal social structures, norms, and practices that create their culture. These structural arrangements lead to different forms of exclusion and inequality within and across

epistemic positioning	communities. Epistemic injustice occurs when the ability of specific individuals to make knowledge claims is undermined or rejected based on perceptions of the individual and their characteristics (Fricker, 2007). Epistemic injustice occurs when differnet types of data and expertise (epistemic diversity) are privilaged other others. Epistemic positioning refers to how *informal* acts of judgement link the identity of the actor with the value of their knowledge claims in ways that make it easier to deny them recognition or credit. Bacevic (2023) proposes four types of epistemic positioning: 1) bounding (reducing a knowledge claim to elements of personal identity); 2) domaining (reducing a knowledge claim to discipline or field associated with identity); 3) non-attribution (using the claim without recognizing the author); and 4) appropriation (presenting the claim as one's own). These forms of epistemic positioning can help understand what forms of exclusion may emerge when openness and sharing are promoted.
Boundary work	It refers to the efforts of professional groups to influence the boundaries between disciplines when work is disrupted – efforts to maintain and create new distinctions between groups and to protect existing and/or acquire new resources (Faulconbridge et al., n.d.). Literature has proposed three types of boundary work: *competitive*, *collaborative,* and *configurational* (Langley et al., 2019). Competitive boundary work refers to how people defend or extend boundaries to distinguish themselves (defending, contesting and creating); colalborative boundary work relates to how people negotiate or realign boundaries in interaction with others (negotiating, embodying and downplaying); configurational boundary work considers how people work from outside existing boundaries to design or rearrange the sets of boundaries influencing others (arranging, buffering and coalescing).
Meta-work	Recent technological developments have given rise to forms of work that may be invisible (Hatton, 2017; Star & Strauss, 1999), marginal (Giustini, 2022), and not valued in contemporary work settings. The invisibility of work has also been referred to as *meta-work* – i.e., 'the work that enables work' (Aroles et al., 2022). For instance, demands for data sharing can give rise to new forms of work that may become invisible and hard for others to recognise. Meta-work may hinder the adoption of data sharing if its invisibility and lack of recognition continue to exist.
Trading zones	Trading zones are spaces created for negotiating key aspects of reserch, such as communication, data practices and professional identity, as scientific paradigms evolve (Gorman, 2010). These zones can provide an space for social communication, socialisation or cultural learning that help develop, for example, "in-between vocabularies" through which communication can be achieved. The creation of new macro epistemic cultures requires the development of trading zones to solve communication issues.

Interactional expertise	It is "the ability to converse expertly about a practical skill or expertise, but without being able to practice it, learned through linguistic socialisation among the practitioners." (Collins, 2004, p. 125). This expertise traverses the space between formal and tacit knowledge. It is the in-between formal knowledge and tacit language. This expertise emerges from spending enough time talking, working or sharing with researchers of the relevant domain without actually practising the practices – i.e., "What you get from immersing yourself in the linguistic culture pertaining to a practical domain rather than the practice itself is what I call 'interactional expertise'" (Collins, 2004, p. 127).
Relational agency and expertise	Distributed knowledge-making practices that involve new forms of collaboration require the development of relational agency and expertise. Relational agency refers to the capacity of professionals to develop common knowledge – through negotiation processes and dialogue – across interprofessional work. This involves cultivating a relational expertise that is required for working across disciplinary boundaries and making it possible to work with others on complex tasks. That is, relational expertise is the "capacity to recognise and respond to what others might offer in local systems of distributed expertise." (Edwards, 2011).
Stewards of trust	Different actors, such as policymakers, public and private research funders, academic institutions, civil society, and the media, affect the public's trust in science. Therefore, they bear the responsibility of fostering trust in science, particularly in times of uncertainty and shifting public opinion. In other words, they are stewards of trust whose direct or indirect role is to convey science to a diverse range of audiences and guide trust in science (Varda et al., 2024).
Social and cultural learning	It refers to how people learn through non-formal activities or experiences at work, thus promoting the development of various types of agency (e.g., relational or transformative). Professionals often learn in a non-formal way while working, rather than solely through formal or structured activities or formal training. If professionals learn as they are working, for example through non-formal or unintentional learning, the learning might be directly applied to work (Littlejohn, 2023).
Tacit knowledge	Learning involves the reconfiguration of tacit knowledge – i.e., tradition, inherited practices, implied values, and prejudgments. For example, when data sharing produces new values, it creates them tacitly, by implication – i.e., professionals cannot explicitly select a set of new values around data sharing; instead, they must embody them through a creation or adoption process (Polanyi, 2009).
Agency cultivation	The degree of engagement and involvement in cultural change relies on the active agency of both individuals and communities, as noted by Burkitt (2016). This concept of agency involves the ability of people to make choices and take actions that influence their environment and societal structures. To foster a more significant sense of agency, individuals can actively cultivate it by emphasising forward-looking experiences that inspire personal and collective

	growth. By focusing on aspirations and possible futures, people not only enhance their personal agency but also contribute to the broader cultural transformation within their communities. Such forward-thinking approaches encourage participation, creativity, and innovation, ultimately leading to impactful cultural shifts.
Professional identity negotiation	As pointed out by Eteläpelto et al. (2014), it refers to situations that require people to change some aspects of their professional identity (e.g., practices, values, commitments) as work material and symbolic conditions evolve. For example, changes in work due to new technologies and organisational reforms require the renegotiation of identity work.
Relational infrastructure	The intricate web of social connections, interactions, and relationships that underpin a community, which , facilitates collaboration, and enhances the capacity of research communities to respond to emerging challenges, generate new knowledge, and create social and cultural value (Rye, 2023). A strong relational infrastructure fosters trust, facilitates collaboration, and enhances the capacity of research communities to respond to emerging challenges, generate new knowledge, and create social and cultural value. Without such a relational infrastructure, even the most sophisticated technical systems risk becoming underutilised, misaligned with researchers' constellations of meaning, or subject to power asymmetries that hinder inclusive participation.