Supporting FAIR Practices In Scholarly Publishing with the Editorial Reference Handbook

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ABSTRACT

The *Editorial Reference Handbook* assists scholarly publishers in supporting the sharing of digital research objects and in operationalising FAIR research practices by addressing gaps in editorial workflows, policy implementation and stakeholder alignment. The Handbook comprises three interrelated components—a checklist, detailed guidance documentation, and a flowchart—intended primarily for in-house editorial staff while also providing value to reviewers, authors, and service providers. Developed collaboratively, the Handbook was also piloted through a structured intervention across 190 manuscripts, with outcomes evaluated using both surveys and performance metrics. This article reports on the contributions of 35 participants representing 19 journals and 11 publishers, describes the rationale and development of the Handbook, and presents the outcomes of the intervention, offering a reusable framework adaptable across diverse publishing contexts.

INTRODUCTION

Findable, Accessible, Interoperable, and Reusable (FAIR) publishing practices[1] are increasingly recognised as fundamental to research integrity, transparency, reproducibility, and reusability, and constitute a cornerstone of credible and open scholarship[2]. Although these principles have been widely endorsed by funders, institutions, and scholarly publishers, their consistent implementation continues to present significant challenges[3]. In particular, ensuring the availability and sharing of datasets, software, and other digital research objects associated with research publications remains a persistent barrier.

Open and FAIR research policies significantly impact when and how these digital objects are shared by researchers. Data sharing policies implemented by scholarly publishers and academic journals are particularly effective as they are encountered by researchers at a point in the research lifecycle when they are highly motivated to comply[4]. Enforcement of journal policies leads to substantial, quantifiable increases in data sharing and the use of data availability statements[5]. Although initiatives including the Research Data Alliance's journal policy framework[6] and STM Association's Research Data Program (https://www.stm-assoc.org/research-data-program) have supported uptake of data sharing policies for academic journals, nearly half of journals assessed did not yet have a data policy in place by 2018[7] or even by 2020[8].

Some of the challenges associated with implementing Open and FAIR research sharing policies, summarised in **Box 1**, were highlighted during a publishers' workshop held in May 2023[9]. The event convened representatives from 20 major publishers and journals to examine systemic barriers to FAIR data practices and reproducibility within their stakeholder communities, and to explore potential solutions that could be implemented collaboratively.

Box 1: Summary of systemic barriers to good data practice identified by journals and publishers.

- **Capacity and resource constraints**: Limited time, staffing, and infrastructure to support checks for good data practices without increasing the burden on authors, reviewers, or editorial staff; concerns about scalability and cost.
- **Ineffective data sharing practices and policies**: Insufficient Data Availability Statements (DAS), particularly when permitting vague or non-committal language such as "data available upon request"; good practice requirements in data policies not always checked or mandated.
- **Lack of incentives**: Insufficient motivation or recognition for researchers, editors, and reviewers in engaging in good data practice; current reward structures prioritise novelty and impact of results over transparency and rigour of the data.
- **Knowledge gaps and training needs**: Uneven understanding of and available training in good data practices across career stages, roles and regions; not just for authors but also for editors and reviewers.
- **Editorial and peer review limitations**: Difficulties in enforcing community reporting standards and any good data practice, and obstacles in recruiting qualified reviewers familiar with such practices.
- **Disciplinary diversity and stakeholder engagement**: Expectations around good data practices vary widely across disciplines, making it difficult to implement uniform policies; lack of a concerted, consistent mobilisation of all relevant stakeholders - from institutions and funders to tools and services providers - limit the availability of resources that enable researchers to put into action the data practices expected by the policymakers.
- **Equity concerns and unintended consequences**: Caution against imposing Global North standards without considering the infrastructural contexts of other regions; risks of disadvantaging authors who may face legitimate barriers to data sharing and other good practices.
- **Bad actors**: Paper mills and peer review/citation cartels. Additionally, undeclared or incorrect usage of Large Language Models that, in more appropriate ways, could become an enabler of the development and uptake of improved good data practices.

The workshop was co-organised by TIER2 (https://tier2-project.eu) and FAIRsharing (https://fairsharing.org)[10]. TIER2 is a project funded by the European Commission and UK Research and Innovation that aims to advance knowledge on reproducibility, develop tools, foster community engagement, and support policy implementation across diverse research contexts. Participating publishing organisations were drawn from those already active in promoting good data practices and engaged with the FAIRsharing Stakeholder Community (https://preview.fairsharing.org/communities#governance), a service and network that connects standards, repositories, and policies across disciplines.

Although reforming incentive structures was recognised as having the greatest potential impact, participants acknowledged that such systemic changes are long-term in nature and unlikely to be achieved in the near term. By contrast, strengthening policies, providing training for in-house staff, and fostering greater cross-sector collaboration were identified as key short- to mid-term strategies for improving the uptake of good practices for sharing both data and other research objects. While many publishers expressed a genuine interest in advancing these practices, the variability of policy requirements and the

absence of standardised checks across journals hinder both authors, who struggle to navigate expectations, and editors, who find it difficult to provide effective guidance. A small number of journals and publishers have introduced editorial checks, but these efforts have typically been developed in isolation and for internal use only. Consequently, a consensus emerged that such initiatives could serve as a foundation for co-developing a practical starter framework to guide and operationalise good research practices in a consistent manner across publishers and journals. This approach was also viewed as both feasible and capable of delivering meaningful impact within the timeframe of the TIER2 project.

Throughout 2024 and 2025, the *Editorial Reference Handbook* (https://publishers.fairassist.org; hereafter "the Handbook") was developed and piloted to inform and support journals in operationalising a set of checks designed to enhance the FAIRness of research objects and promote good sharing practices. Rather than prescribing a rigid process, the Handbook was conceived as a flexible framework adaptable to diverse journal contexts. This consensus-driven resource is intended primarily to assist in-house editorial staff in systematically implementing a core set of checks during manuscript handling prior to external peer review. At the same time, these checks serve an educational function by making requirements transparent and comprehensible for authors, reviewers, and service providers. The Handbook consists of three interlinked components: a checklist of 13 elements, a flowchart that visualises the checks, and accompanying guidance on their application and implementation.

The Handbook was co-created through a series of workshops with publishers and was further informed by a review of existing community frameworks and standards. It was subsequently piloted through a structured intervention involving 190 manuscripts, encompassing both journals seeking to integrate the checks into their internal workflows and those already implementing such practices (serving as positive controls). In total, 35 participants contributed to the Handbook activity, representing 19 journals and 11 publishers, as detailed in **Table 1**.

***Table 1**: Publishers and journals contributing to the Handbook. The 11 publishers and 19 journals self-organised into one or more of four roles: (i) co-creation members; for the intervention phase (ii) intervention, (iii) positive controls and (vi) advisory groups. Participants at a publisher level are indicated with a row that contains the publisher name only; participants at a journal level are indicated with a row that also contains a journal name.*

Publisher	Journal	Roles in the Handbook activity
American Psychological Association		co-creation
Cambridge University Press		co-creation, advisory
"	Data and Policy	intervention
"	Data Centric Engineering	intervention
"	Language and Cognition	co-creation, intervention
"	Research Directions: Biotechnology Design	co-creation
"	Research Directions: Cyber-Physical Systems	co-creation
"	Research Directions: Depression	co-creation
"	Research Directions: Mine Closure and Transitions	co-creation
"	Research Directions: One Health	co-creation
"	Research Directions: Quantum Technologies	co-creation
"	Research Directions: Sleep Psychology	co-creation
Cell Press		co-creation
"	Patterns	co-creation, positive control, advisory
Elsevier	Journal of Clinical Epidemiology	co-creation
"	Lancet	co-creation
EMBO Press		co-creation, advisory
GigaScience Press		co-creation, positive control, advisory
Oxford University Press		co-creation, advisory
"	Journal of Applied Microbiology	intervention
"	Journal of Petrology	co-creation
PLOS		co-creation, positive control, advisory
Springer Nature	Genome Medicine	intervention
"	BMC Medical Genomics	intervention
"	Scientific Data	co-creation, positive control, advisory
Taylor & Francis		co-creation, positive control, advisory
"	F1000	co-creation, positive control, advisory
Wiley		co-creation

Questionnaires administered to both the intervention and positive control groups provided valuable insights into the changes and improvements required for the successful implementation of the Handbook.

These needs were categorised in terms of in-house capability (e.g., greater knowledge of the Handbook), opportunity (e.g., support in applying the Handbook), and motivation (e.g., prioritising the Handbook within editorial processes).

In the following sections, we outline the methods used to co-create the Handbook, describe its structure and operationalisation, and present the design and execution of the intervention, together with the insights gained from its implementation across diverse publishing contexts.

METHODS

Participants and overall design

In total, 35 participants contributed to the Handbook activity, representing 19 journals and 11 publishers. First, we engaged publishers already participating in the FAIRsharing Stakeholder Advisory Board (https://preview.fairsharing.org/communities#governance), and then asked them to expand the invitation along their networks to ensure additional journals at varying stages of adopting good research sharing policies and practices were involved. The overall Handbook activity was structured in three stages, as summarised in **Box 2:** (i) co-creation of the Handbook, (ii) intervention to test its application within real-world editorial workflows, and (iii) evaluation to assess the effectiveness of the intervention and to identify areas for improvement.

Box 2: Overview of three stages of the Handbook activity.

Stage 1: Co-creation (January–December 2024). Engagement with project participants to assess the readiness of existing journal policies and to identify support needs; review of good practice frameworks within publishing organisations and across communities; and, ultimately, the definition and development of the Handbook components.

Stage 2: Intervention (January–June 2025). Identification and onboarding of participants; introduction to the Handbook; consensus building around realistic milestones and evaluation metrics; implementation of the intervention through the use of the Handbook to evaluate manuscripts submitted to participating journals over a three-month period; provision of ongoing support from the leadership team through biweekly check-in meetings; and administration of an exit questionnaire.

Stage 3: Evaluation (July–October 2025). Review and collation of exit questionnaire results from both intervention and positive control groups; collaborative preparation of this article to disseminate the findings and formulate recommendations.

Central to the TIER2 approach was the emphasis on co-creation activities and practical interventions with stakeholders. To maximise the success of the activities, the publishers' and journals' representatives self-organised into one or more of four roles (as detailed in **Table 1**):

I. **co-creation members**, who developed and refined the Handbook,
II. **intervention group**, who implemented the Handbook within their journals and completed a questionnaire regarding their interventions,
III. **positive controls group**, who provided valuable context and feedback during the intervention stage via a positive controls questionnaire on how their journals already implemented Handbook checks, and
IV. **advisory group**, who were involved in the intervention stage, helping to create questionnaires and/or supporting the members of those groups, but did not respond to the questionnaires.

13 out of 35 participants played more than one role. Leadership of this activity was jointly undertaken by representatives from the University of Oxford (through the FAIRsharing service) and Taylor & Francis, as TIER2-funded and associated partners, respectively.

Co-creation: defining the Handbook components

A total of 14 journals and nine publishers contributed to this stage (see **Table 1**) through a series of eight online workshops conducted in 2024. These workshops were designed to ensure that the components of the Handbook were both practical and adaptable to diverse editorial workflows, while remaining aligned with community standards and principles of good practice. Led by the project leadership team, the sessions facilitated iterative feedback, collaborative drafting, and consensus-building among participants. Offline contributions through shared documents and email exchanges complemented the workshops, enabling asynchronous input and internal review within participating organisations.

The co-creation stage, consisting of two parallel and interrelated workstreams, and the methodology employed are detailed in Taylor-Grant et al.[11]. The first workstream focused on developing the core checks and the accompanying guidance for their operationalisation. The second workstream concentrated on designing a generalised flowchart to situate the checks within an idealised manuscript submission workflow and associated staff roles.

Although journals employ a variety of internal checks, their type, scope, and rigour vary considerably, and there is little consistency across policies. To address this, the first workstream reviewed 25 existing resources and initiatives relevant to our scope in order to identify the most frequently recommended elements that were also broadly applicable across disciplines and editorial contexts. In addition to refining the checks, these discussions enabled us to distinguish between those checks that depend on author or journal expertise and those that would require additional support for effective operationalisation.

Ultimately, relevant sections from 13 of these resources were incorporated and aligned with the draft checklist. The remaining resources were either considered potentially useful for future iterations or excluded for being overly granular or domain-specific. A complete list of the resources reviewed, including details of their inclusion or reasons for exclusion, is available at https://publishers.fairassist.org/context-credits-and-references#existing-material-revised-to-identify-the-checks.

Through this iterative process of discussion and refinement, a core set of 13 elements was established. Guidance for each element was subsequently developed and structured as a series of webpages, providing definitions, implementation tips, and instructions on their use within the flowchart component.

Journals and publishers employ a variety of internal processes, and the successful implementation of any check depends not only on its content but also on who performs it and at what point in the manuscript submission workflow it occurs. Accordingly, the second workstream focused on understanding how internal processes operate in practice and on identifying the most appropriate roles and workflow stages for each checklist element. The workshop sessions were directed toward collecting information and experiences regarding when each check was likely to occur (or was already occurring, in the case of journals with existing practices), who would be responsible for carrying it out, and how it would be implemented. Through iterative discussion and refinement, this workstream culminated in the development of the flowchart component, which maps each checklist element to both a role that gained a broad consensus within the workstream members and a specific stage of the manuscript submission workflow.

Intervention: what we test and how we measure it

The intervention stage involved three groups of participants: (i) intervention, (ii) positive controls and (iii) advisors. The latter contributed to the identification of the participant in the intervention group, and to the definition of the milestones and evaluation metrics. The publishers' and journals' representatives self-organised in groups taking up one or more of these roles (as detailed in **Table 1**).

The intervention group comprised publishers and journals that applied the Handbook to evaluate manuscripts submitted during the intervention period, while those that had already implemented the Handbook's checks formed the positive control group. Six journals completed the intervention (see **Table 1**), with one journal also participating in the co-creation phase. Intervention participants were recruited from the journal portfolios of the co-creation participants. Initially, 24 journals expressed interest in joining the intervention. Seven did not complete the process for reasons beyond their control, five indicated that participation represented too great a commitment at the time, three cited internal structural challenges, two provided no explanation, and one transitioned to the positive control group. These 17 journals were therefore not included as intervention participants in **Table 1**. Such attrition was anticipated and was

attributed primarily to the often-complex internal authorisation and prioritisation procedures within publishing organisations, which are not always easily aligned with community-driven projects of this nature.

Biweekly check-in meetings were held, as needed, to provide expertise on the checklist and support for the intervention. A set of realistic milestones was proposed to help participants structure both internal and external tasks to be completed during the intervention, should such help be required. Evaluation metrics were also collaboratively developed and included the number of checklist elements integrated into submission workflows, the time required to conduct manuscript assessments, author responses, and the overall impact on the manuscript submission workflow.

The positive control group was drawn from co-creation participants who had already integrated the Handbook's concepts in full. Composed of three journals and three publishers (see **Table 1**), positive controls were invited to provide feedback on their experiences through the co-development and completion of a positive control questionnaire. Participants contributed detailed accounts of how they met—and in some cases exceeded—the requirements outlined in the checklist. Their insights were particularly valuable for assessing the Handbook's utility and for identifying potential barriers to its application and broader uptake.

Evaluation: feedback and lessons learned

During the evaluation stage, questionnaires for both the positive control and intervention groups were finalised, distributed, and completed by participants. The positive control questionnaire was co-designed with participants to capture their motivations, enablers, barriers, and workflow modifications. Metrics assessed included the proportion of portfolios implementing checks, manuscript compliance rates, use of domain-specific repositories and formats, time required to complete checks, and the impact on editorial workflows and author correspondence. Participants were also invited to provide qualitative feedback on each checklist item, addressing implementation challenges, lessons learned, and recommendations for future adopters. The questionnaire was released to participants in April 2025. An export of the questionnaire in PDF format is available[12].

Using a similar methodology, the intervention exit questionnaire was co-created with the intervention group; an export of the questionnaire is available[13]. The questionnaire was organised into five Handbook-related sections: (i) administrative (e.g., journal details, checks employed), (ii) overall evaluation (e.g., motivations, enablers and barriers, modifications made), (iii) process outcomes (e.g., number of manuscripts evaluated, impact on submission times), (iv) FAIR-enabling outcomes (e.g., extent of sharing research objects), and (v) individual checklist elements (e.g., ease of understanding, roles and workflow positions assigned).

RESULTS

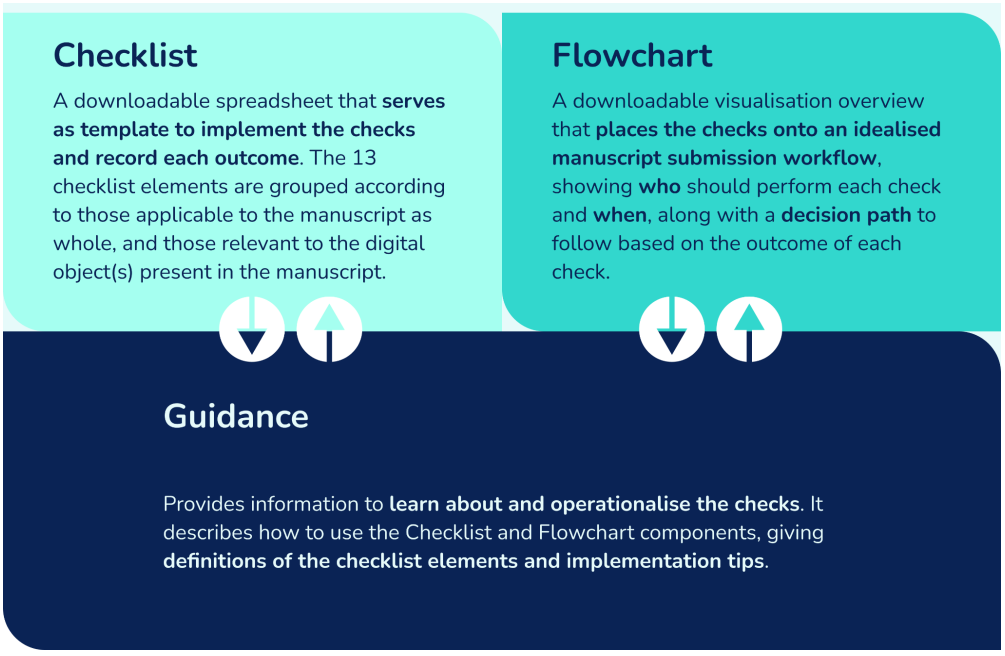
A practical guide to implementing checks: what, how and when

Co-created by 14 journals and eight publishers (see **Table 1**), the Handbook establishes a shared understanding of a fundamental set of checks that help enable FAIRness, underpin reproducibility, and apply to all digital objects (e.g., datasets, code, materials) associated with a publication. The Handbook also maps these checks onto an idealised internal manuscript submission workflow. In practice, whether each check is performed—and, if so, how, when, and by whom—varies across journals, with implications for the consistency and effectiveness of outcomes.

The aims of the Handbook are to: (i) operationalise the agreed-upon checks as part of an ideal internal manuscript submission workflow; (ii) support journals in integrating the Handbook's concepts into their policies and editorial processes; (iii) assist with the implementation of open research policies; and (iv) ultimately enhance the reusability and potential reproducibility of published research.

The Handbook is structured into three interlinked components (**Figure 1**), which may be used independently or in combination to assess individual manuscripts or, more broadly, to inform the updating of journal policies and submission workflows.

***Figure 1**: The three interlinked components of the Handbook and a brief description of each component.*



The guidance is provided as a website (https://publishers.fairassist.org/) and archived on OSF[14], serving as the primary entry point for learning about and implementing the Handbook. It contains detailed documentation to support the interpretation and application of each checklist element by offering

definitions, implementation advice, and procedural context. Each element within the checklist and flowchart includes direct links to its corresponding guidance. In addition, the website provides information on the development of the Handbook and acknowledges the contributions of its collaborators.

The checklist can be applied in two principal ways: first, to assess manuscript compliance with the specified checks, and second, to update or validate existing internal tools or processes by aligning journal policies with the checklist elements and making modifications as needed. The checklist is available in three downloadable formats, each hyperlinked to dedicated sections within the Guidance (https://publishers.fairassist.org/understanding-the-checklist).

Each check is mapped to a specific role and position in the flowchart and, when implemented, may return one of three outcomes: Pass, Fail, or Not Applicable (N/A). Although suggested positions within a consensus submission workflow are provided for each checklist element, these workflow positions are optional and intended to provide guidance. While some publishers begin implementing the checklist early in their submission workflows, others focus on checklist application post-review and/or pre-acceptance; later checks limit the strain that might otherwise be placed on journals with time-sensitive earlier workflow stages. Failed checks initiate corrective workflows in accordance with journal policies. In addition, checks are categorised by consideration level: *core* (applicable across all types of digital objects, irrespective of research domain) or *specialised* (relevant only to particular research areas or types of manuscripts, e.g., domain-specific repositories, which may not be pertinent to all journals or digital objects). A full list of the checklist elements is provided in **Table 2**.

***Table 2**: An overview of the 13 checklist elements, including their position and role within the flowchart and the type of consideration assigned. Checks 1–3 apply at the level of the entire manuscript, with check 3 designed to facilitate interaction with the checklist document itself rather than serving as an evaluative criterion. Checks 4–13 are applied individually to each digital object within the manuscript.*

Element Number	Position in flowchart	Role in flowchart	Element Name	Consideration Level
1	*Initial QC checks*	Administrator	**Are the availability statements for relevant digital objects present?**	Core
2	*Initial QC checks*	Administrator	**Are all digital objects and their contents clearly and correctly listed within the appropriate availability statement(s)?**	Core
3	*Initial QC checks*	Administrator	**How many digital objects are present across all availability statements?**	Core
4	*Initial QC checks*	Editorial Office	**Is the identifier provided for this digital object valid and recognised?**	Core
5	*Initial QC checks*	Editorial Office	**Is the licence for the digital object allowed by your journal?**	Core
6	*Initial QC checks*	Editorial Office	**Is the digital object openly available? If not, are there clearly-stated and valid ethical or data protection reasons for access to be controlled?**	Core
7	*Initial QC checks*	Editorial Office	**If access is controlled, is the digital object available to peer reviewers?**	Core
8	*Editor Assessment*	Editor (Internal or Academic)	**Has the digital object been deposited in an appropriate repository recognised by your journal?**	Core
9	*Editor Assessment*	Editor (Internal or Academic)	**Has the digital object been anonymised if necessary?**	Core
10	*Editor Assessment*	Editor (Internal or Academic)	**Where applicable, is there evidence that the research has been approved by a specific, recognised committee?**	Core
11	*Peer review and revisions*	Peer Reviewer	**Where applicable, has an appropriate domain-specific metadata format been used?**	Specialised
12	*Peer review and revisions*	Peer Reviewer	**Is the accompanying metadata complete according to format requirements or community best practices?**	Specialised
13	*Production and Typesetting*	Production Editor	**Does the digital object have a citation in the article's 'References' section?**	Core

The flowchart provides a high-level visual representation of the idealised editorial workflow, with each element linked to the corresponding section of the Guidance

(https://publishers.fairassist.org/understanding-the-flowchart). It illustrates the recommended position of each check within the submission process and the decision paths associated with different outcomes, including corrective actions. By mapping roles and responsibilities across the manuscript lifecycle, the flowchart supports training, process design, and communication within editorial teams, while also serving as a practical aid for implementing updates or additions to internal tools and journal processes.

Whereas the checklist specifies possible statuses for each element, the flowchart further outlines suggested next steps in cases of failure. A manuscript is considered compliant with the Handbook if all elements either pass or are deemed N/A. However, the specific actions taken in response to failed checks are determined by each journal's internal protocols. Examples of corrective actions include referring the failed check to appropriate internal channels, contacting authors after each instance of failure, or consolidating all failed checks and communicating them to authors in a single request for revision.

The Handbook in action: two practical examples

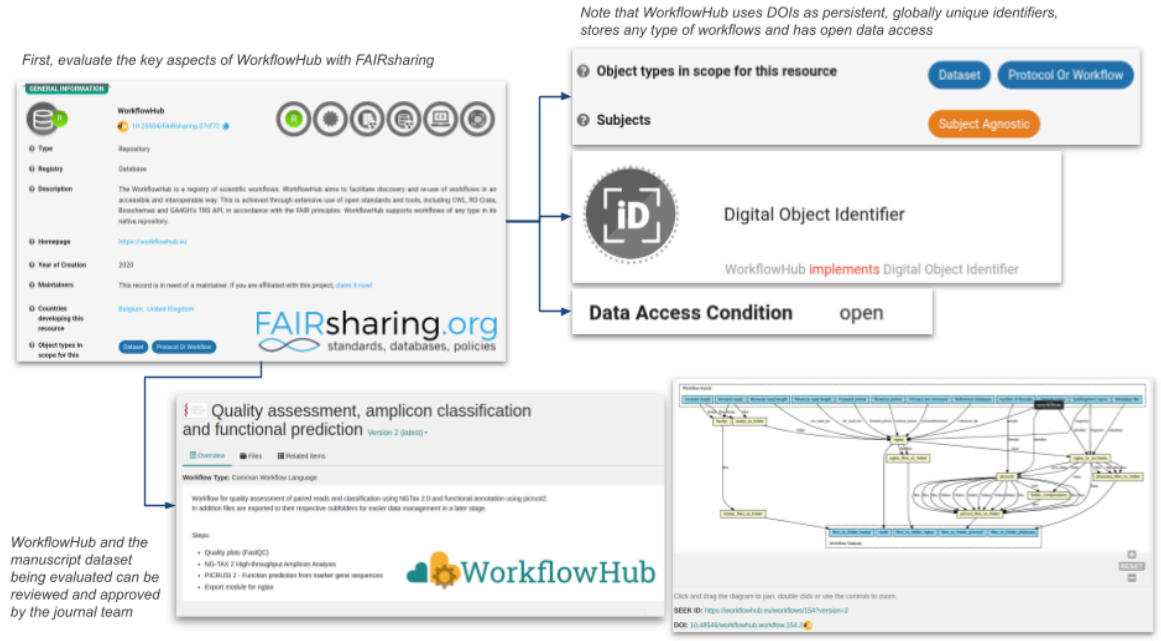
We selected two checklist elements to provide examples of how the Handbook can be used—core element 8 (deposition in an appropriate repository) and specialised element 11 (use of relevant metadata descriptions)—both of which represent fundamental pillars of FAIRness and good research practice. For both of these elements, adherence to community practices for specific digital object types and disciplines is supported through the Handbook's guidance, which promotes the use of discovery and educational services such as FAIRsharing.

To implement element 8, it is essential to have guidance on how to evaluate the appropriateness of a repository based on its scope and attributes. This check is considered successful if the digital object is deposited in an appropriate repository; conversely, it fails if an appropriate repository has not been used. The question of repository appropriateness, however, remains the focus of numerous ongoing projects and initiatives[1]. Given the lack of a consolidated community consensus, the Handbook defines appropriateness at a high level in terms of the type of digital object to be deposited and internal journal guidance. Different digital objects—such as datasets, software, workflows, protocols, and both qualitative and physical materials—require distinct types of repositories that best support their description, discoverability, and

[1]There is a variety of present and past community-driven efforts on repository appropriateness, including: the RDA Data Repository Attribute Working Group outputs[15], Repository Features to Help Researchers: An invitation to a dialogue[16], the RDA TRSP WG (https://www.rd-alliance.org/groups/community-based-catalogue-requirements-trustworthy-technical-repository-service-providers/activity/), the ELIXIR Core Data Resources selection criteria[17], Global Core Biodata Resources: Concept and Selection Process[18], the FIDELIS TTRAMatrix[19], and CoreTrustSeal[20]. Community-developed lists of appropriate repositories are also often categorised according to particular attributes, e.g. the APA's Open Science and Methodology repositories guide (https://apa-osm.github.io/open-guide/repositories.html) and the NIH-supported data sharing resources (https://www.nlm.nih.gov/NIHbmic/domain_specific_repositories.html, https://fairsharing.org/3493), and can be further explored using FAIRsharing's database attribute fields and advanced search (https://fairsharing.org/advancedsearch).

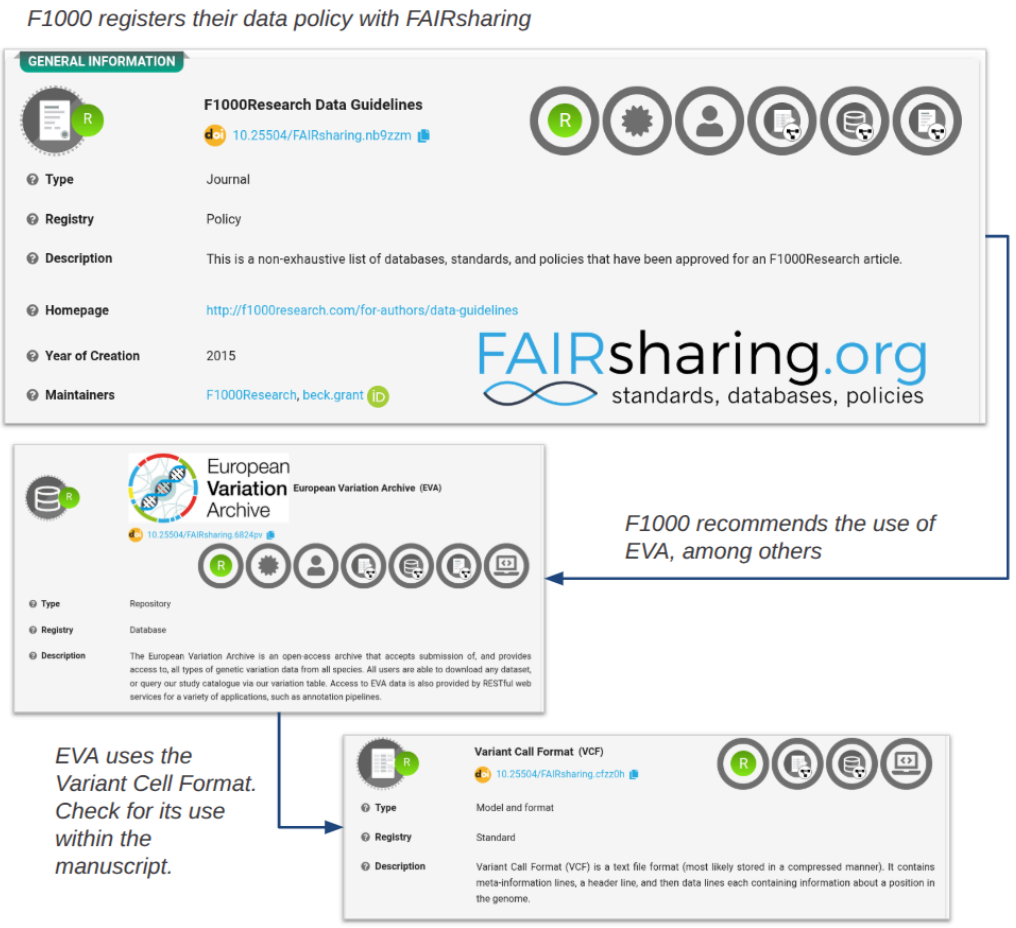
accessibility. The example in **Figure 2** illustrates how an editor can assess the attributes of a repository used by an author to share a workflow and make an informed decision regarding its suitability.

***Figure 2**: An example implementation of checklist element 8, to determine if the digital object has been deposited in an appropriate repository recognised by the journal. The author shared the workflow in WorkflowHub (https://doi.org/10.48546/workflowhub.workflow.154.2); the attributes of this repository can be seen in its record in FAIRsharing (https://doi.org/10.25504/FAIRsharing.07cf72), including the type of objects in scope for this repository, the use of unique and persistent identifiers, and open data access conditions. If these match the journal's requirements, the check passes.*



To implement element 11, guidance is required on how to evaluate whether a domain-specific metadata format has been used. This element is specialised and therefore not applicable to all journals. The check passes if a digital object employs an appropriate domain-specific metadata format; if no such format exists, the element is recorded as N/A. However, if a format is expected by a community or repository in which the digital object should be deposited but is not used, the check fails. The example in **Figure 3** illustrates how an editor can evaluate whether a genetic variation dataset has been shared using the appropriate metadata descriptors. It underscores the interdependence between checklist elements 8 and 11, as well as the value of registering journal policies in FAIRsharing. Such registration enables journals and publishers to (i) maintain a live list of recommended resources (e.g., repositories and the standards they implement) and/or (ii) dynamically identify resources based on specific attributes, such as the types of digital objects covered, data access conditions, and disciplinary scope.

***Figure 3**: An example implementation of checklist element 11, to determine if the digital object has used an appropriate domain-specific metadata format. The F1000 journal data policy is registered in FAIRsharing (https://doi.org/10.25504/FAIRsharing.nb9zzm), and is cross-linked to the recommended repository for genetic variation (EVA: https://doi.org/10.25504/FAIRsharing.6824pv), which in turn implements the Variant Call Format (https://doi.org/10.25504/FAIRsharing.cfzz0h). Using the information provided by their data policy and associated repository and format information, the assessor can evaluate the format of the dataset, and ensure that VCF is being correctly used to pass this check.*



Intervention outcomes: implementing the Handbook

In the intervention, all six participating journals implemented the Handbook to varying degrees, adapting it to their existing internal workflows. Completed at the end of the intervention period, their questionnaire responses[21,22] provided valuable insights into the use of the Handbook. Due to its scale, providing concrete numbers for many aspects of the intervention is challenging; the intervention was a small-scale pilot emphasising feasibility of the Handbook rather than quantification of responses. Participants began the intervention at a range of times, resulting in durations ranging from approximately two to six months. Journal submission volumes varied widely, from tens to thousands of manuscripts, with the number of

manuscripts assessed during the intervention broadly correlating with intervention length and ranging from 12 to 86 per journal, for a total of 190 manuscripts.

As anticipated, the number of intervention participants was lower than that of the co-creation phase. This reduction was primarily attributable to the complex internal authorisation and prioritisation processes within publishing organisations, which are not always easily adaptable to fast-moving, short-term community projects such as this one. Nevertheless, the intervention participants benefited from strong internal support from their leadership. Reporting separately to the questionnaire, one publisher noted that a strong commitment at the level of individual journal teams was a core enabler of intervention participation. Authorisation, prioritisation, and genuine commitment to, and belief in, the initiative emerged as the most common enabling internal factors.

Participants reported that the Handbook met their needs overall, noting that their journals had assumed a more active role in assessing the quality of digital objects and that policies had been strengthened as a result. Strengthening policies and assessment processes was frequently cited as a key motivator for implementing the Handbook. One participant specifically observed that improved data access and transparency reduced the risk of fraud. The checklist and guidance were the most frequently used components of the Handbook. Although internal workflows often diverged from the positions illustrated in the flowchart, participants nonetheless found the flowchart valuable as a reference point for shared practice.

The most frequently cited barriers to implementing the checks were the time required, competing editorial tasks, and variability in authors' beliefs, willingness, and skills. To implement the checklist, educational and training-related modifications to submission workflows were the most commonly applied actions. All participants indicated that they intended to continue using the Handbook following the intervention. Among those who measured the time required to complete their version of the checklist, estimates ranged from five to 60 minutes. Very few authors became unresponsive during the submission process (ranging from zero to 10%) or withdrew their manuscripts (ranging from zero to three percent), and no significant impacts on turnaround time (either zero or low impact) were reported, although two journals noted increased correspondence with authors and higher rates of return for revision.

A variety of digital object types were evaluated during the intervention. While datasets and software source code were assessed by all journals, some also assessed publications, images, questionnaires/surveys, and models. Among the four participants who monitored changes in the number of repository links attributable to the additional intervention checks, three reported an increase in links shared at the time of publication as a direct result of the checks. Determining the proportion of domain-specific repositories was more challenging; however, differences in journal scope clearly influenced the relative distribution of submissions to generalist versus domain-specific repositories. This tendency towards generalist options may also reflect

the influence of currently popularised open science practices, which often promote the use of well-established generalist repositories. Such norms can contribute to a degree of reluctance among authors or editors to deviate from familiar platforms, even when domain-specific alternatives might offer greater relevance or long-term value.

Participants reported that all checklist elements were relatively straightforward to implement, with the exception of element 2. This element requires verifying that all digital objects that should be included in availability statements are in fact listed. Because this necessitates an evaluation of the entire manuscript to identify potentially missing digital objects, rather than simply reviewing those already included in availability statements, participants found it more challenging to integrate into existing submission workflows. Implementation decisions on individual elements across all journals are summarised in **Table 3**.

***Table 3**: A summary of the checklist elements implemented by the six intervention participants both prior to and as a result of the intervention. It also includes information on elements that journals elected not to implement, despite their relevance, as well as those deemed not applicable. The final column provides the total number of journals who had implemented the checklist element at the end of the intervention. Green cells indicate decisions adopted by at least half of the participants, while yellow cells denote zero values.*

Element Number	Element Name	Implemented prior to the intervention	Implemented during the intervention	Chose not to implement	Not applicable to the journal	Total journals implementing the check post-intervention
1	**Are the availability statements for relevant digital objects present?**	6	0	0	0	6
2	**Are all digital objects and their contents clearly and correctly listed within the appropriate availability statement(s)?**	3	3	0	0	6
4	**Is the identifier provided for this digital object valid and recognised?**	2	4	0	0	6
5	**Is the licence for the digital object allowed by your journal?**	0	5	1	0	5
6	**Is the digital object openly available? If not, are there clearly-stated and valid ethical or data protection reasons for access to be controlled?**	5	1	0	0	6
7	**If access is controlled, is the digital object available to peer reviewers?**	1	4	0	1	5
8	**Has the digital object been deposited in an appropriate repository recognised by your journal?**	2	4	0	0	6
9	**Has the digital object been anonymised if necessary?**	2	4	0	0	6
10	**Where applicable, is there evidence that the research has been approved by a specific, recognised committee?**	4	0	2	0	4
11	**Where applicable, has an appropriate domain-specific metadata format been used?**	0	2	3	1	2
12	**Is the accompanying metadata complete according to format requirements or community best practices?**	0	1	4	1	1
13	**Does the digital object have a citation in the article's 'References' section?**	2	3	1	0	5
		27	***31***	***11***	***3***	

With 27 already-implemented checklist elements identified across all participating journals, the coverage of checklist elements prior to the intervention averages out at four out of 13. Participants added an average of five new elements to their workflows (31 new elements total) during the intervention. Elements 1 and 2 (presence of digital objects in the DAS), 6 (digital object availability) and 10 (approval by committees as required) were the most frequently implemented elements prior to the intervention. The most commonly added during the intervention were 2, 4, 5, 7 and 13 (identifier validity, licensing and correct citation) and 8 and 9 (deposition and anonymisation). The remaining elements (11 and 12, as element 3 is an administrative element only) were each implemented by at least one journal during the intervention, however these were less frequently chosen by our participants. 11 and 12 are specialised, domain-specific checks and therefore not applicable to all journals' scopes. No checklist elements were dropped during the intervention, although one journal repositioned element 13 within its workflow to better balance turnaround time. Prior to the intervention, only element 1 (verification of the presence of appropriate availability statements) had been implemented universally. As a result of the intervention, however, half of the elements—specifically elements 1, 2, 4, 6, 8, and 9—were implemented across all participating journals (discounting the administrative element 3).

Although the co-creation phase resulted in general agreement on staff roles for each element, intervention participants ultimately applied a wide variety of roles, underscoring the heterogeneity of submission workflows across journals. By contrast, while the co-creation phase recommended making checks at multiple stages of the submission workflow, the majority of checks during the intervention were conducted at the stages of initial quality control and editorial assessment.

Insights gained from existing good practices

Six organisations—three publishers and three journals—participated in the positive control group. Their questionnaire responses[23,24], summarised here, provide valuable insights into how existing internal workflows and checks align with the Handbook. The methods used to implement the checks varied considerably. Some publishers employ multiple levels of policy requirements, assigning each journal to a specific level, while others adopt either a single policy or a high-level policy with bespoke extensions for individual journals within the same organisation. The extent of checklist coverage across publisher portfolios also differed: some achieve complete compliance across their journals, whereas for others, the size and diversity of their portfolios makes full compliance impractical.

Several journals and publishers had integrated the checks to improve existing workflow procedures, while others had incorporated them from the outset. All positive controls reported that the majority of submitted manuscripts required additional work to achieve compliance. Rough estimates from positive control journals indicated that between 20% and 50% of manuscripts were compliant with the Handbook upon submission.

With respect to element 8, which addresses the storage of digital objects in compliant repositories, practices varied. Some publishers do not mandate specific repositories, others provide minimal requirements or required repositories for certain subject areas, and one described the use of extensive lists of suitable repositories covering the majority of submissions. All positive controls reported that generalist repositories were used more frequently than domain-specific repositories, though this pattern was strongly influenced by subject area.

Overall, all positive controls expressed motivation rooted in the conviction that such checks represent good publishing practices. Four noted that practices described in the Handbook were integral to their editorial identity and mission and were viewed as positive differentiators within the publishing landscape. One participant explicitly emphasised the clear relationship between these practices and the advancement of open science and high-quality open digital research objects.

Training, education, and persuasion of staff were identified as the most important modifications required to enable change within journals. Although time and funding constraints were recognised as barriers, internal willingness, expertise, and commitment to good practices for research objects were highlighted as key enablers for implementation. Moreover, despite the additional requirements placed on authors, all positive controls reported that authors' belief in these practices further served as an important enabling factor.

A range of information was collected regarding the practical impact of the checks. The majority of positive controls reported requiring all core checklist elements to pass. Half of the positive controls indicated that well-prepared manuscripts required up to 30 minutes to assess, whereas manuscripts needing revisions took longer. The remaining half reported that the checks typically required an hour or more, particularly when iterative communication with authors was necessary.

Changes are needed but achievable

Both the intervention and positive control group questionnaires included a series of questions addressing individual checklist elements. To assess their practicality, we generated a simple feasibility score from the twelve sets of responses, providing an indication of both the perceived importance of each check and the likelihood of its implementation by a given journal. The values determined by **Table 4** and shown in **Figure 4** provide a broad indication of which elements the participants were most positive about. The scores were derived by assigning weighted values to responses, as outlined in **Table 4**.

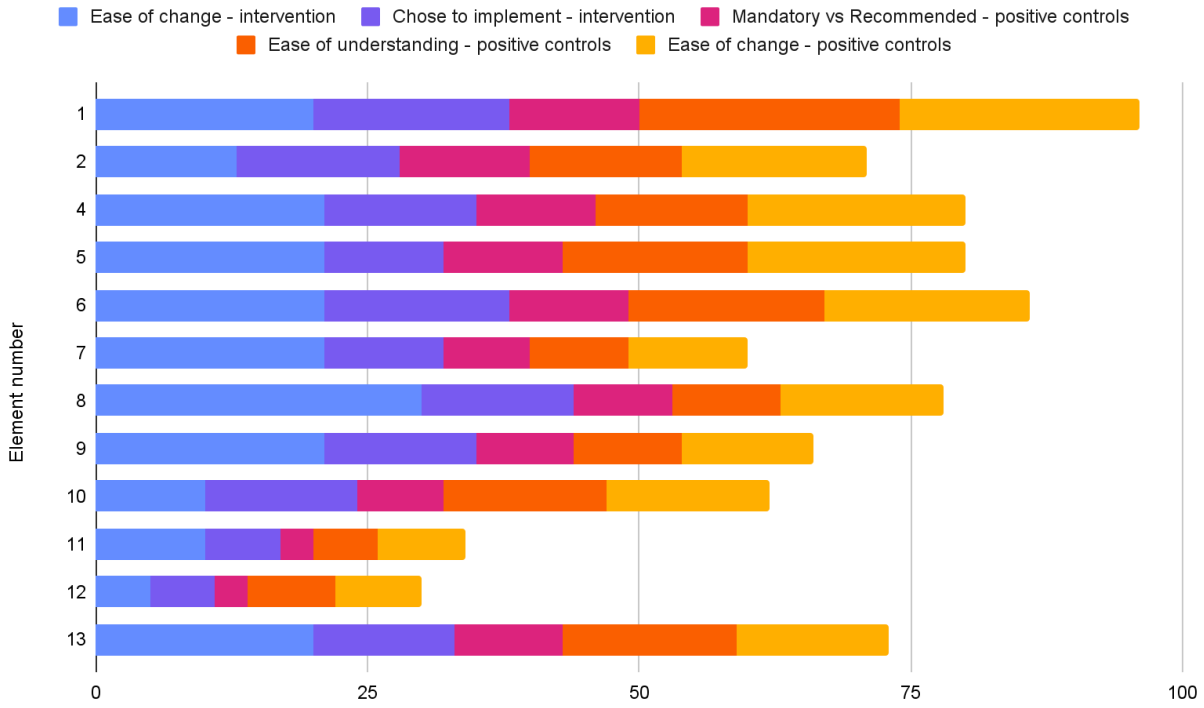
***Table 4**: A summary of each of the questions used to derive an indicative feasibility score for each checklist element, together with the weights assigned to each possible response. Different questions were asked of the positive control and intervention groups. The weights are intended to provide a rough indication of the likelihood or feasibility of implementing each element.*

Question	Answered by positive control (PC) group?	Answered by intervention group (IG)?	Available answers and associated weights
For each check: how easy was it to make the required changes within your submission workflow?	yes	yes	PC: Very easy: 5, Easy: 4, Neither easy nor difficult: 3, Difficult: 2, Very difficult: 1 IG: Easier: 5, Harder: 1, Not in our intervention: 0 (not added to graph)
For each check, is it: already implemented, added for the intervention, not applicable, or not implemented even though it is relevant to your journal?	no	yes	Already check: 3, Added the check: 2, Did not implement: 1, Not applicable: 0
Is each check mandatory for your manuscripts, or recommended?	yes	no	Mandatory: 2, Recommended: 1, Not applicable: 0
How complex is each check to understand?	yes	no	Very simple: 5, Simple: 4, Neither simple nor complex: 3, Complex: 2, Very complex: 1

Higher weights were assigned to responses indicating that a check was considered feasible or more likely to be implemented. For example, if a check was mandatory for a member of the positive control group, this was taken as evidence that the respondent regarded it as more important. Likewise, checks described as very simple to understand or easy to integrate into submission workflows were considered more likely to be adopted by journals. Finally, if participants in the intervention group had already implemented a check or elected to incorporate it into their workflows, this was interpreted as evidence of its higher feasibility.

No negative weights were applied, with each response contributed to a cumulative total. A higher feasibility score reflects a greater number of responses indicating simplicity or ease of implementation. For example, if a member of the positive control group rated checklist element 1 as *"very easy"* to incorporate into their submission workflow, five points were added to that check's score. Conversely, if a participant from the intervention group reported that Element 1 was *"harder"* to implement, a single point was added, yielding a cumulative score of six. **Figure 4** shows the feasibility scores across all checklist elements, and the underlying data used to create the chart is available[25].

***Figure 4**: A bar chart summarising the indicative feasibility scores for checklist elements. The intervention group evaluated each element across two categories (represented by the two sections furthest left in each bar) while positive controls evaluated each element across two to three categories (represented by the three sections furthest right in each bar). Higher scores show a greater proportion of responses suggesting that the element was both important and straightforward to implement. Element 3, an administrative item created solely to facilitate data entry within the checklist, has been excluded from this analysis.*



The positive control group reported the highest feasibility scores for checklist elements 1–6 and 13. The intervention group also reported similarly high scores for these checks, but their scores for checklist elements 7–9 were disproportionately higher than those of the positive controls (and roughly the same for element 10). Although this feasibility score is a qualitative measure, the results indicate that participants actively implementing the checks consistently judged all elements—aside from the specialised, domain-specific checklist elements 11 and 12—to be relatively straightforward to apply. The lower scores for checks 11 and 12 reflect both their greater complexity and their narrower applicability, as they are primarily suited to specialist rather than generalist journals. Overall, using **Figure 4**, the generally high feasibility scores (other than for elements 11 and 12) from intervention participants who directly engaged with the Handbook show that its elements are feasible to implement in real-world editorial contexts.

DISCUSSION

A small practical step with far-reaching potential

The Handbook integrates structured checks, narrative guidance, and visual workflows to bridge the gap between policy and editorial practice. It can assist journals and publishers in two primary ways: (i) for those

without internal guidance to enforce an open research policy, it provides a workflow for assessing and improving individual manuscripts; and (ii) for those with existing guidance, it offers principles that can be used to validate and enhance current methodologies. It provides a model for embedding good research practices and FAIR principles into the scientific publication process, while also exemplifying the broader cultural shift toward open and responsible practices within scholarly publishing. By offering a shared, operational resource grounded in a consensus set of small but practical checks aligned with journal roles and workflows, the Handbook addresses a critical gap and supports scalable adoption.

The processes of co-creation and intervention represent significant collaborative and practical steps toward the operationalisation of good open research practices. The Handbook has also demonstrated potential for informing improvements in internal editorial workflows and for harmonising journal policies. Although primarily aimed at in-house editorial staff managing manuscripts, the Handbook additionally benefits reviewers, authors, and service providers by making fundamental checks and requirements transparent and accessible.

All twelve participants (intervention and positive control groups; see **Table 1**) agreed that the Handbook, with its small but practical set of checks, is a valuable aid to good research practice that they intend to continue implementing. Differences in publisher methodologies and implementations—including variations in repository checks, policies, and staff roles—might initially appear to present a barrier to the Handbook's aim of aligning checks across journals and publishers. However, the experiences of both intervention participants and positive controls demonstrate that the Handbook is sufficiently rigorous to be educational and practical, while also retaining the flexibility necessary for adoption across diverse journal contexts, tailored to local readiness and priorities.

Qualities such as internal commitment and willingness to apply the checks underscore the motivation and engagement present within the publishing community, even amid acknowledged challenges of time and funding. Notably, intervention participants increased their alignment with the Handbook from an average of four checks per journal to nine. Through their engagement in and implementation of the Handbook, they have played a crucial role in sharing expertise and showing how policies can be extended, thereby amplifying the broader impact of the initiative.

Recommendations and next steps

Beyond its value as a practical resource, the creation of the Handbook was also a socio-technical initiative aimed at improving research culture, leading by example to influence and inform other publishers and journals. Its pilot use across a number of journals not only demonstrated its applicability but also highlighted areas requiring further development to ensure successful implementation. Participants in this activity were invited to share recommendations for journals and publishers seeking to adopt similar

practices. They emphasised the importance of investing in training for in-house editors on good research practices and suggested using the Handbook as a practical entry point for implementation. In addition, participants stressed that each journal should maintain a clear policy for digital research objects, with requirements and recommendations explicitly aligned with the checks being performed, thereby conveying a consistent and transparent message to authors and reviewers. Positive controls noted that the use of journal whitelists—mandating repositories and standards—was an effective means of strengthening policies and recommendations. Consequently, we have created a set of recommendations to aid implementation of the Handbook by future journals and publishers (see Box 3). Firstly, the Handbook should be implemented as fully and as transparently as possible, using the resources it provides to enhance existing checks. Secondly journal- and/or publisher-level policies should be registered with FAIRsharing to harmonise the description of policy attributes and make them discoverable by humans and machines. Thirdly, invest in the training, automation and policy upkeep required to ensure your guidelines evolve with community needs. Finally, champion good research culture and practices within your organisation and beyond, encouraging and recognising good data and research-sharing practices and collaborating with other organisations to harmonise policies and implement the practices outlined in the Handbook.

Box 3: Four recommendations for journals and publishers wishing to implement the Editorial Reference Handbook, embed FAIR principles, enhance editorial workflows, and build a culture of openness and integrity across journals and publishers.

1. Implement the Handbook and its checklist as fully as possible across your journals

- Align the checks you apply with the requirements and recommendations in your journal policies.
- Use the Handbook to refine, validate, or enhance any internal checks you already perform.
- Promote transparency by informing reviewers of these checks and clearly referencing them in author guidelines and data policies.

2. Register your journal or publisher-level policy for digital objects with FAIRsharing

- Use a common policy template to harmonise descriptions of attributes and requirements across publishers, making them clearer, more transparent, and easier to compare.
- Link your policy record to the specific standards and repositories you recommend via the FAIRsharing relationship graph—or signpost these resources to authors and reviewers according to your discipline and needs.
- Registering policies in FAIRsharing makes them citable via DOI and discoverable by both humans and machines.

3. Invest in your in-house capability and capacity

- Educate and upskill editorial staff to apply the checks effectively and to follow best practices for sharing and publishing digital research objects.
- Maintain a clear journal- or publisher-level policy for digital objects, keeping it updated and registered in FAIRsharing as a ‘live’ version that evolves with your and the community’s needs.

- Collaborate with internal or external service providers to operationalise the checks through automation, ensuring seamless integration into manuscript workflows via existing or emerging tools and AI-enabled systems.

4. Champion the research culture in your organisation and beyond

- Lead by example to drive cultural change—model openness, transparency, and FAIR practices that motivate and inspire others in the publishing community.
- Foster a supportive environment that recognises and rewards good data and research-sharing practices as core to research integrity and quality.
- Collaborate across publishers, communities, and service providers to harmonise policies and share lessons learned, strengthening a shared culture of reusable and reproducible research.

While the project has already engaged with a broad group of publishers and journals, there is potential to socialise the Handbook and support further adoption through relevant channels such as the STM Association and the Research Data Alliance Policy Interest Group. Looking ahead, the Handbook and its community have the potential to serve as a foundation for broader initiatives in good research practices and reproducibility, policy harmonisation, and cross-publisher collaboration. Further integration with services such as FAIRsharing could enable the development of automated dashboards, policy audits, and metadata validation tools. We therefore invite relevant groups and initiatives to engage with the Handbook leadership to explore opportunities for extending and sustaining the success of this endeavor.

LIST OF FIGURES AND TABLES

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CODE AVAILABILITY

No custom code has been used.

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AUTHOR CONTRIBUTIONS

CRediT tags from https://credit.niso.org/

Name	CRediT tags
Allyson L. Lister	Conceptualization, Visualization, Writing – original draft, Writing – review & editing, Project administration, Resources, Supervision, Methodology, Investigation
Rebecca Taylor-Grant	Conceptualization, Methodology, Writing – review & editing, Project administration
Matthew Cannon	Conceptualization, Methodology, Writing – original draft, Resources, Project administration, Writing – review & editing
Roshan Ahmed	Investigation, Writing – review & editing
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COMPETING INTERESTS

The author(s) declare no competing interests.

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These modifications were:

1. Both Copilot and chatGPTEdu (to Oxford): As a ‘drafting buddy’ by providing the tools only with our own material relating to this project (i.e. workshop notes, presentations, news items, TIER2 internal reporting on the work), to create an initial summary of the project. The resulting drafts had a number of failings including being too short, lacking comprehensiveness, and sometimes providing incorrect or incorrectly interpreted information. The first draft was therefore re-written by the named human authors, to expand as well as extend it to include additional material such as the results of the surveys.
2. chatGPTEdu (to Oxford): Solely for “AI assisted copy editing” as per the definition provided by Nature policies (https://www.nature.com/nature-portfolio/editorial-policies/ai).