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Guidelines on Recommending Data Repositories as Partners in Publishing Research Data

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Abstract

This document summarises guidelines produced by the UK Jisc-funded PREPARDE data publication project on the key issues of repository accreditation. It aims to lay out the principles and the requirements for data repositories intent on providing a dataset as part of the research record and as part of a research publication. The data publication requirements that repository accreditation may support are rapidly changing, hence this paper is intended as a provocation for further discussion and development in the future.

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Introduction

The Peer REview for Publication and Accreditation of Research data in the Earth sciences (PREPARDE) project¹ was led by the University of Leicester and funded by Jisc and NERC. It aimed to investigate the policies and procedures required for the formal publication of research data, in particular focussing on those required for the smooth operation of a data journal. Part of the project investigated the criteria needed for a repository to be considered trustworthy, hence the following guidelines were written and reviewed by the many members of the data-publication email list² set up by the project.

It is anticipated that these guidelines will continue to be updated and revised as data publication becomes common place, e.g. through the new Publishing Data and Certification of Digital Repositories Interest Groups of the Research Data Alliance, and as repository accreditation schemes gain members. It is hoped that many of the main principles identified remain the same over the long term.

Background

Peer REview for Publication and Accreditation of Research Data in the Earth sciences (PREPARDE) was a one year (2012-13) project supported by Jisc. It aimed to capture the processes and procedures required to publish a scientific dataset, ranging from ingestion into a data repository, through to formal publication in a data journal. One focus for these efforts was a new journal published by Wiley on behalf of the Royal Meteorological Society: the Geoscience Data Journal³.

Some pressing organisational and policy issues have motivated the PREPARDE project. These are of broad relevance to the data curation and scholarly communication communities and include:

- What journal and repository policies are required to achieve greater levels of data sharing, citation and linkages between publications and datasets?
- What partnerships between journals, data centres and research organisations are necessary to establish sustainable data publication solutions, and what business models are appropriate to sustain them in the long term?
- What peer review of data is appropriate, including acceptable levels of validation and error estimation?
- What characterises a suitable, trustworthy repository?

The project addressed these issues primarily through three stakeholder workshops, with participants from a variety of roles in data publication; researchers, funding bodies, publishers, learned societies, national libraries, national and international support organisations, research institutions and libraries, repositories and domain-based data centres.

¹ PREPARDE: <http://www2.le.ac.uk/projects/preparde>

² Project email list: <http://www.jiscmail.ac.uk/data-publication>

³ Geoscience Data Journal: <http://www.geosciencedata.com/>

Data publication stakeholders' needs and perspectives on trusted repository accreditation were the topic of a workshop organised by PREPARDE at the International Digital Curation Conference 2013 (IDCC13)⁴. IDCC13 workshop presentations and discussion informed draft recommendations on repository accreditation (the current paper) and peer review⁵, both of which were made available for comment from March to July 2013. We return later in the paper to the issues raised and how these are reflected in the guidelines.

Trust and Quality from a Data Publishing Perspective

Trust is an attribute of interpersonal relations that has been progressively applied to organisations, their agents and technical infrastructures (Rutter, 2001; Prieto, 2009). Trust is associated with vulnerability, specifically “the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another” (Yakel et al., 2013). In the digital repository context, work towards trust certification standardisation has long been associated with standards and practices for ensuring long-term integrity of digital objects, although as Prieto points out “it is ultimately their respective stakeholders – both those who deposit and use content – whose perceptions play a central role in ensuring a digital repository’s trustworthiness” (2009).

The development of standards for trusted digital repositories has a relatively long history spanning several decades, and has been well documented elsewhere (e.g. APARSEN, 2012). Our brief review here aims only to identify points that motivate our guidelines.

One motivation for the PREPARDE guidelines is the recent consolidation of trust accreditation standards, which provide self-assessment and audit-based approaches relevant to this need. The European Framework for Audit and Certification of Digital Repositories⁶ formalizes a three-level approach to suit repositories’ different requirements. This comprises the Data Seal of Approval⁷, Nestor Seal for Trustworthy Digital Archives or DIN 31644⁸, and ISO 16363⁹, each comprising a greater number of metrics, and with options for self-assessment or external review. The ICSU World Data System (WDS) also offers cross-disciplinary Criteria for Membership and Certification¹⁰, aiming to ensure the trustworthiness of WDS facilities, and stemming predominantly from those serving earth sciences. This accreditation scheme is informed by the above schemes, and by the Open Archival Information Systems (OAIS) reference model (CCSDS, 2012), which underpins each of the above certification approaches along with the Trustworthy Repositories Audit and Certification (TRAC) Criteria and Checklist (Center for Research Libraries, 2007) and NESTOR Catalogue of Criteria for Trusted Digital Repositories (Dobratz, 2007).

Through the development of trust standards, the preservation community has identified a proliferating range of digital repository attributes as characteristics of a ‘trustworthy digital repository’. For example, TRAC lists 84 criteria in three main

4 International Digital Curation Conference 2013: <http://www.dcc.ac.uk/events/idcc13/workshops>

5 PREPARDE peer-review draft guidelines available at: <http://bit.ly/DataPRforComment>

6 European Framework for Audit and Certification of Digital Repositories: <http://www.trusteddigitalrepository.eu>

7 Data Seal of Approval: <http://www.datasealofapproval.org>

8 DIN 31644: http://www.langzeitarchivierung.de/Subsites/nestor/EN/nestor-Siegel/siegel_node.html

9 ISO 16363: http://www.iso.org/iso/catalogue_detail.htm?csnumber=56510

10 ICSU World Data System Criteria for Membership and Certification: <http://www.icsu-wds.org/our-members/membership-application/criteria-membership-certification>

groups; ‘organisational’, ‘digital object management’, and ‘technologies, technical infrastructure, and security.’ The ISO 16363 standard overlaps with TRAC and extends it further to incorporate over 100 criteria aiming to be relevant to all kinds of repository, including those for commercial and cultural heritage, as well as scientific purposes.

Alongside these criteria, the community has established what kinds of evidence and auditing processes are sufficient to appraise particular repositories on the criteria. While this effort was somewhat slower (Ross and McHugh, 2006) it too is taking shape as ISO ISO/DIS 16919. Some dissent remains over whether a stable set of ‘trust’ dimensions is feasible, and risk management is a workable alternative (McHugh et al., 2008).

The PREPARDE project guidelines on repository accreditation sought to understand how journals could draw on repository accreditation schemes to help meet their needs as users of any repository storing the data underlying an article submitted for publication. These needs could include, for example, a journal editors’ requirement for a short period of data access to be limited to peer reviewers, allowing them to scrutinise the data as evidence for assertions made either in a conventional scholarly article or in a ‘data paper’. The needs of journals and the broader repository user community also extend to the long-term – to the persistence of the scholarly record and links between its components (Pampel et al., 2012).

The project addressed these needs in the context of data papers, which we have defined as follows:

‘A “data paper” describes a dataset, giving details of its collection, processing, calibration, software, file formats etc, without the requirement of novel analyses or ground breaking conclusions, allowing the data paper to be published rapidly after the completion of the dataset. This encourages other users either to cite the data directly (as publication requires the dataset to have a DOI or other permanent identifier), or to cite the data using the data paper as a proxy. Additionally, the data paper allows the reader to understand when, how and why the data were collected, and the research context in which the dataset was generated’ (Callaghan et al., 2013).

The data journal concept is one of several models seeking to address concerns over the accessibility, quality and usability of the ‘supplementary material’ that authors may submit with conventional articles (Vision, 2010). Data publication models (reviewed in Lawrence et. al., 2011) are broader than the data journal. For example, a repository (or its depositor) may be considered to be ‘publishing’ data through the act of deposition and dissemination of archived datasets. The Dryad data repository has popularized the ‘article-related-datasets’ model, whereby authors of journal articles are encouraged to deposit underlying datasets, which themselves become citable scholarly products (Vision, 2010). While there is ongoing debate regarding the adequacy of ‘data publication’ as a metaphor for making research data broadly available (Parsons and Fox, 2013), innovation in data publication models continues apace.

The main motivation for the PREPARDE guidelines is that, while data publication is of escalating interest to stakeholders in data sharing and data repositories are central to data publication models, only a minority of repositories are currently certified on TRAC or the European Framework. While this will no doubt change in years to come, meanwhile journals, publishers and other reusers need to make ‘good enough’ decisions on whether a repository is trustworthy.

As a guide to basic principles for data sharing, the OECD report Principles and Guidelines for Access to Research Data from Public Funding had a galvanising effect

on funding body policies in OECD member countries. Among the report's principles are 'professionalism' and 'quality'. Trust is among three factors identified under the heading of professionalism: "Mutual trust between researchers, and trust between researchers, their institutions and other organizations..." (OECD, 2007).

These principles are relevant here because they relate the formation of trust between stakeholders in data sharing to standards for data description, peer review and data citation. Under 'quality' the OECD principles state that "Data managers, and data collection organisations, should pay particular attention to ensuring compliance with explicit quality standards" and specifically that:

- Data access arrangements should describe good practices for methods, techniques and instruments employed in the collection, dissemination and accessible archiving of data to enable quality control by peer review and other means of safeguarding quality and authenticity.
- The origin of sources should be documented and specified in a verifiable way. Such documentation should be readily available to all who intend to use the data and incorporated into the metadata accompanying the data sets. Developing such metadata is important for enabling scientists to understand the exact implications of the data sets.
- Research institutions and professional associations should develop appropriate practices with respect to the citations of data and the recording of citations in indexes, as these are important indicators of data quality (OECD, 2007).

The OECD principles emphasise the need for coordinated action by research communities, institutions and other stakeholders, including learned societies and publishers, to develop norms and standards around trust. Such efforts have more recently come to the fore through the Research Data Alliance. Other recent cross-disciplinary efforts have addressed peer review (Pampel et al., 2012), data citation (e.g. Force11, CODATA, 2013) and metadata standards for research data discovery (e.g. DataCite¹¹ and OpenAIRE¹²).

However well-grounded the preservation community's view that certification 'engenders trust', until recently there has been little examination of how far repository users share this view, or vary in their perceptions. In Yakel et al.'s study, interviewees linked a range of factors to trust, including 'transparency' and 'guarantees of preservation and sustainability', and with the highest overall agreement on 'institutional reputation' (Yakel et al., 2013).

In conclusion, the PREPARDE guidelines highlight a minimal set of principles for establishing repository trustworthiness in the research data publication context. These are informed by the well-established need to provide effective access to data and metadata, facilitate peer review and citation, and maintain a persistent record of the data and its provenance. The guidelines also recognise that trustworthiness depends partly on repository user perceptions of reputation and service level.

¹¹ DataCite: <http://www.datacite.org>

¹² OpenAIRE: <http://www.openaire.eu>

Development of the Guidelines

The guidelines were developed by an iterative process of consultation with the user community via the data-publication email list. A “straw man” set of guidelines were drafted following the IDCC13 workshop and sent to the data-publication email list and the project team for comment and discussion. The draft reflected workshop themes, which included:

- Recognition of the variety of data publication models with common emphasis on quality assurance and persistence of the research record, transparent data management processes, accessibility, reproducibility and discoverability of the results, and due credit for those involved in data management.
- The need for third party infrastructure around persistent identification and ‘linking services’ to support efficient exchanges between data repositories and journals, catalogues and bibliometric services.
- The multi-faceted nature of ‘trust’, with workshop participants variously emphasising repository sustainability and continuity planning, clarity of collection policy, and evidence of take-up and usage.
- The need to distinguish between criteria for trust accreditation and those for quality review of datasets themselves.

The guidelines went through several iterations and around thirty changes were made in response to the comments received through email lists. The main points of contention were:

- Whether it is premature or desirable to require repositories to publish usage metrics, or even to specify what these should be.
- A need to more clearly distinguish criteria from accreditation processes and sources of guidance on whether the criteria are met.

The guidelines presented here are very general and high level, as they are designed for the use of journal editors who would like a quick and simple way of identifying which repositories are suitable hosts for published data. For that reason they are presented almost as a statement of principles, on the understanding that Trusted Digital Repository accreditation fulfils them; and that, where accreditation is absent, the required technical or organisational solutions may vary across the different domains where data is published.

The authors of this paper would very much like to thank all the members of the data-publication list for their generosity in giving their time to read and comment on the guidelines.

Guidelines on Recommending Data Repositories as Partners in Data Publication

These guidelines outline the requirements for data repositories intent on providing a dataset as part of the research record. This may be either as a cited dataset (linked from

and supporting a journal article or data paper), or as a published entity in its own right (published formally by the hosting repository).

This document is primarily intended as a resource for journal editors and publishers who wish to determine quickly and easily whether a repository is suitable to host data that is the basis of a research publication. It may also be of interest to researchers looking for a suitable institutional or discipline-specific repository for their data and those wishing to start a new data repository, as well as other parties with an interest in data publication and repository management.

These guidelines are intended to cover all the data associated with a research publication, from the small subsets that form the “data behind the graph” to the whole dataset underlying the research article.

Guidelines

For data publication, a repository must be actively managed in order to:

1. Enable access to the dataset
 - a. Ensure that data will be accessible (either as open data, or provide information on conditions of access and a clear point of contact);
 - b. Have a policy in place allowing appropriate access for peer reviewers, as required as part of support for the data peer-review process;
 - i. In the context of data, peer reviewers are individuals with appropriate scientific and/or technical expertise who produce or use data.
2. Ensure dataset persistence
 - a. Have a clear and public assertion of responsibility to preserve the data and provide access to the data over the long term;
 - b. Have an appropriate, formal succession plan, contingency plans, and/or escrow arrangements in place in case the repository ceases to operate or the governing or funding institution substantially changes its scope;
 - c. Develop and implement suitable quality control and security measures to ensure the metadata is correct and the data themselves are maintained and curated to avoid degradation;
 - i. User feedback can and should be used to strengthen and correct the metadata as needed;
 - d. Assign globally unique persistent IDs to the published datasets and maintain a repository-managed URI associated with each of those IDs. These URIs should also be associated with versions of the datasets;
 - e. Ensure permanent IDs for the dataset resolve to a publicly accessible landing page which must:
 - i. Be open and human readable (and it would be preferred that they should also be provided in a format which is machine readable);
 - ii. Describe the data object and include appropriate metadata and the permanent identifier (used to identify the page in the first place);

- iii. Be maintained, even if the data has been retracted.
3. Ensure dataset stability
 - a. Stability means that the exact same version of the dataset that was cited can be returned to when the citation is resolved;
 - b. If dataset versioning is supported, new versions should be permanently identified and linked from the original, published dataset landing page, without overwriting the original version linked from the article. The database should provide time stamped versions of archival data.
 4. Enable searching and retrieval of datasets
 - a. Allow users to easily determine whether a dataset has been peer reviewed or been subject to a robust quality assurance process;
 - b. Provide appropriate metadata about the dataset in human readable form on the landing page (see point 2.e), and when possible standardized machine readable formats e.g. DataCite metadata schema¹³;
 - c. Provide appropriate information about licensing and permissions, and manage access to restricted or embargoed material, as appropriate;
 - d. Provide access to allow metadata for the datasets to be searched and retrieved through interfaces designed for both humans and computers.
 5. Collect information about repository statistics
 - a. Publish statistics on the level of access to any deposited item that is publicly accessible to contribute to metrics of the item's publication impact;
 - b. Publish information to enable journals and depositors to assess its take-up in the community it aims to serve, e.g. about any operational agreement with a well-established journal, learned society or equivalent body.

Repository Accreditation Initiatives

The following provides a list of ways by which a repository can demonstrate that it meets the recommendations given above. It is split into generic schemes and subject-specific schemes.

Generic resources

The following resources may be of value when identifying which repositories are suitable for use. Note that only the first two headings are actual accreditation schemes, but the remaining listed resources may be of use when determining if a data repository is suitable for data publication.

¹³ DataCite Metadata Schema: <http://schema.datacite.org>

Trusted Digital Repository

Any of the three certification levels outlined by TrustedDigitalRepository:¹⁴

- Basic Certification is granted to repositories which obtain Data Seal of Approval¹⁵ certification;
- Extended Certification is granted to Basic Certification repositories which in addition perform a structured, externally reviewed and publicly available self-audit based on ISO 16363 or DIN 31644;
- Formal Certification is granted to repositories which in addition to Basic Certification obtain full external audit and certification based on ISO 16363 or equivalent DIN 31644.

For more information, see the Alliance for Permanent Access to the Records of Science Network (APARSEN) report on peer review of digital repositories¹⁶.

ICSU World Data System

Regular or network membership¹⁷ of the ICSU World Data System.¹⁸

DataCite

Contractual arrangement with a DataCite managing agent for the purposes of minting DOIs.

Data repository directories

Inclusion in a data repository directory that identifies repositories with standing in the scholarly community and publishes its selection criteria. Current examples include Re3data¹⁹ and Databib²⁰.

Data repository directories do not necessarily require any of the practices listed above in the guidelines in order for a repository to be registered. These repository directories might be able to help to raise standards by themselves either a) requiring some of the recommendations listed in this paper (the ideal situation), or b) indicating in their listings the extent to which the accreditation recommendations are being met by each repository (recommended).

Subject-specific resources

The following list of subject-specific resources may be of use, but are not intended to be an exhaustive list of the resources or subject areas with an interest in data publication.

It is hoped that different subject areas will update these guidelines with information about resources in their fields.

¹⁴ Trusted Digital Repository: <http://www.trusteddigitalrepository.eu/Site/Trusted%20Digital%20Repository.html>

¹⁵ Data Seal of Approval: <http://www.datasealofapproval.org/>

¹⁶ Alliance for Permanent Access to the Records of Science Network (APARSEN) report on peer review of digital repositories: http://www.alliancepermanentaccess.org/wp-content/uploads/downloads/2012/04/APARSEN-REP-D33_1B-01-1_0.pdf

¹⁷ Details of the evaluation criteria for membership can be found at: <https://www.icsu-wds.org/files/wds-certification-summary-11-june-2012.pdf>

¹⁸ ICSU World Data System: <http://www.icsu-wds.org/>

¹⁹ Re3data: <http://www.re3data.org/>

²⁰ Databib: <http://databib.org>

Geosciences

- MEDIN²¹
 - Details of the accreditation process available at:
http://www.oceannet.org/data_submission/documents/medin_dac_accred_proc_v1.1_sept10.doc
 - A list of accredited repositories is at:
http://www.oceannet.org/data_submission/index.html
- IODE International Oceanographic Data and Information Exchange²²

Life Sciences

- BioSharing²³
 - Registry of data and metadata reporting standards for different types of life science data.²⁴
 - Catalogue of databases in the life sciences described according to the community-defined, uniform, generic description of the core attributes.²⁵

Adoption and Promulgation of these Guidelines

As mentioned in the introduction, it is anticipated that these guidelines will continue to be updated and revised as data publication becomes common practice. The PREPARDE project was, to our knowledge, the first project to look at the requirements for digital repositories from the point of view of data publishing, and we do not in any way claim to have the last words on the subject! In fact, it is our sincere hope that these guidelines will provoke further discussion and refinement in the digital repositories and data publication communities, though we also hope that many of the main principles identified remain the same over the long term.

Members of the project are engaged with the Publishing Data and Certification of Digital Repositories Interest Groups of the Research Data Alliance (RDA), and will use these groups as venues for further refinement of the guidelines. Similarly, engagement with other repository certification schemes (including, but not limited to: Trusted Digital Repository, Data Seal of Approval, ICSU World Data System and DataCite) will allow the standardisation and promulgation of the guidelines as repository accreditation schemes gain members.

These guidelines have already influenced the development of policies for data journals such as *Geoscience Data Journal*, *F1000Research*²⁶ and *Scientific Data*²⁷, and

²¹ Marine Environmental Data and Information Network: <http://www.oceannet.org/>

²² IODE International Oceanographic Data and Information Exchange: <http://www.iode.org/>

²³ BioSharing: <http://www.biosharing.org>

²⁴ See: <http://biosharing.org/standards>

²⁵ BioDBcore: <http://biosharing.org/biodbcore>

²⁶ F1000Research: <http://f1000research.com/faqs>

²⁷ Scientific Data: <http://www.nature.com/scientificdata/for-authors/data-deposition-policies/> and <http://www.nature.com/scientificdata/about/scientific-data-faq/#q19>

will provide guidance to editors and journal publishers wishing to set up new data journals.

As the PREPARDE project is now completed, the next steps for these guidelines will be to publish them formally (in this paper) and inform researchers of their existence at conferences, such as the International Digital Curation Conference and the European Geophysical Union General Assembly, and meetings of organisations such as the Research Data Alliance. Further development of the guidelines could take place as part of the RDA's Publishing Data Interest Group, or in a future project or COST Action²⁸.

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²⁸ A COST Action proposal on Publishing Academic and Research Data (PARD) was submitted in September 2013 and we are awaiting the results of the call, expected in May 2014.

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