Project Title	Fostering FAIR Data Practices in Europe
Project Acronym	FAIRsFAIR
Grant Agreement No	831558
Instrument	H2020-INFRAEOSC-2018-4
Topic	INFRAEOSC-05-2018-2019 Support to the EOSC Governance
Start Date of Project	1st March 2019
Duration of Project	36 months
Project Website	www.fairsfair.eu

D4.3 REPORT ON THE CERTIFICATION SUPPORT AND GUIDANCE FOR REPOSITORIES AND REVIEWERS

Work Package	WP4 - FAIR Certification
Lead Author (Org)	Maaike Verburg, Ilona von Stein (DANS)
Contributing Author(s) (Org)	Linas Cepinskas (DANS), Hervé L'Hours (UKDA), Patricia Herterich, Joy Davidson, Kevin Ashley (DCC), Olivier Rouchon (CINES), Andrea Greco, Serenella Muradore Gallas, Sara Pittonet (TRUST-IT)
Due Date	31.08.2021
Date	19.07.2021
Version	1.0
DOI	https://doi.org/10.5281/zenodo.5113522

Abstract

Supporting repositories towards becoming more trustworthy and FAIR-enabling is at the heart of the FAIRsFAIR project. This paper introduces the in-depth support programme created by FAIRsFAIR and shares the successes, common challenges and lessons learned. It details the support and guidance provided for repository managers as well as for CoreTrustSeal Reviewers. This work also provides recommendations for developing a support programme towards repository certification.

Versioning and contribution history

Version	Date	Authors	Notes
0.1	22.03.2021	Maaike Verburg (DANS)	Draft outline structure
0.2	22.04.2021	Maaike Verburg, Ilona von Stein, Linas Cepinskas (DANS), Olivier Rouchon (CINES), Joy Davidson, Patricia Herterich, Kevin Ashley (DCC), Hervé L'Hours (UKDA), Andrea Greco, Serenella Muradore Gallas, Sara Pittonet (TRUST-IT)	Incorporated WP4 structure feedback. Content added, WP4 internal feedback incorporated.
0.3	25.06.2021	Ilona von Stein, Maaike Verburg (DANS)	Ready for internal review
0.4	09.07.2021	Maaike Verburg, Ilona von Stein (DANS)	Incorporate internal feedback, final details
1.0	19.07.2021	Maaike Verburg, Ilona von Stein (DANS)	Ready for general review

Disclaimer

Abbreviations and Acronyms

FAIR	Findable, Accessible, Interoperable, Reusable
EOSC	European Open Science Cloud
TDR	Trustworthy Digital Repository
TFiR	*Turning FAIR into Reality*, the 2018 report by the European Commission expert group on FAIR data
RoP	Rules of Participation
AMT	Application Management Tool
RIO	Research Infrastructure Organisations
RDA	Research Data Alliance
WDS	World Data System

Executive Summary

This report is deliverable D4.3 of FAIRsFAIR's Work Package 4 (FAIR Certification), task 4.3 (Support for FAIR certification). In this deliverable, the FAIRsFAIR repository support programme and its contents are described and evaluated. Ten European repositories were supported on their journey towards becoming more FAIR-enabling and trustworthy. The programme consisted of several forms of support, including collaborative workshops and peer community support, as well as one-on-one support calls and practical tools, all of which to help prepare the selected repositories for CoreTrustSeal certification. In an iterative process, repositories drafted self-assessments and received feedback from experts from the FAIRsFAIR support team, in preparation of the formal CoreTrustSeal submission.

Several sections detail the support and guidance provided for a) the repository managers, to improve their knowledge of activities related to the preparations for CoreTrustSeal self-assessments (section 2.2) and b) the CoreTrustSeal Assembly of Reviewers, to help them conduct consistent peer reviews (section 2.3). Both these stakeholder groups in return shared their invaluable knowledge on how trustworthy repository practices best enable FAIR data and how self-assessments can best be evaluated and reviewed. Reflections on the challenges, successes, and lessons learned provide some initial insights into the evaluation of the support programme.

This evaluation is extended in section 2.4, in which recommendations are made for other initiatives looking to develop a repository support programme:

- Broad engagement within applicant organisations can minimise the effort of preparing self-assessments while maximising internal communication and knowledge exchange.

- In setting up a support team, include members with a variety of backgrounds and disciplinary experience to provide high-quality support.

- After the introductory information stage, consider dividing support work across the supported repositories based on their experience of CoreTrustSeal, their maturity as an organisation and the outcomes they have identified as key goals of the process.

- Design the support programme with different support routes and engagement types. Identify and divide content into specific areas of focus. This enables targeted learning and the revision and re-use of support content so that it is optimised for different approaches.

It is important to clarify this initial focus on CoreTrustSeal and on the concept of repositories 'enabling' FAIRness in contrast to objects being assessed as FAIR. As FAIR object assessment gains community recognition and support and as approaches to elaborating FAIR around the 'Core' of CoreTrustSeal are further developed, support programmes will need to be expanded and adjusted.

Lastly, the part of the programme still to come is detailed and suggestions for further steps are made. This includes exit interviews with the repositories and reflection by the support team to further mature the lessons learned and guidance available for other initiatives.

Table of contents

1. Introduction

One of the goals of FAIRsFAIR- Fostering FAIR Data Practices in Europe- is to develop global standards for the FAIR certification of repositories. This is expressed in Work Package 4 (FAIR Certification). This work contributes to the implementation of the European Open Science Cloud (EOSC) programme into a functioning infrastructure. The EOSC Rules of Participation (RoP) as proposed by the RoP Working Group of the EOSC Executive Board[1] require EOSC resources to align with the FAIR principles. This pertains to individual research objects as well as repositories that are findable via the EOSC. FAIR data and data sharing require good data management throughout the research data life cycle, including long-term data preservation and access. Transparency and trust are essential in this process. Researchers need to be able to choose a repository to deposit their data in based on accessible evidence provided by the repository regarding their quality of service. FAIRsFAIR's Work Package 4 has aligned its work with the EOSC RoP and the core concepts of *trust* and *assessability*. The focus of this work therefore lies on Trusted Digital Repositories (TDRs). The Science Europe Data Glossary defines a TDR as a repository whose mission is to provide reliable, long-term access to managed digital resources to its designated community, now and in the future[2]. A TDR must therefore seek to adhere to recognised criteria in their domain and clearly communicate the level of quality they are currently upholding[3]. Though the EOSC RoP do not stipulate a particular threshold for FAIRness, mechanisms through which this should be achieved, or the period for which data should be kept FAIR, it does call for the facilitation of FAIR assessment by potential data reusers[1]. The focus of FAIRsFAIR's Work Package 4 is on the ability of data repositories to support and enable FAIR data, and demonstrate (ways towards) repository trustworthiness.

A repository can use different mechanisms to assess their trustworthiness. Formal audit and certification can be carried out by an external service provider, or repositories can perform a self-assessment based on community-recognised criteria. Following the recommendations from the European Commission expert group on FAIR data in their report *Turning FAIR into Reality (TFiR)*[4], the work of Work Package 4 focuses on encouraging repositories to pursue certification. Within Work Package 4, task 4.3 aims to help progress repositories towards becoming more FAIR-enabling and trustworthy. Specifically, a repository support programme was developed to pursue CoreTrustSeal[5] certification, again aligned with the *TFiR* recommendations that propose CoreTrustSeal as a starting point for the professionalisation of data repositories[3] while a FAIR focused certification has not yet been developed. As a replacement of the Data Seal of Approval and the World Data System Regular Members certification[6], CoreTrustSeal is an "international, community based, non-governmental, and non-profit organization promoting sustainable and trustworthy data infrastructures"[5]. Categorizing according to the three levels of TDR certification proposed by the European Framework for Audit and Certification[7] (Core, Extended, and Formal), CoreTrustSeal provides certification at the

---

[1] https://op.europa.eu/s/pa4Z EOSC Rules of Participation (2021)

[2] http://sedataglossary.shoutwiki.com/wiki/Trusted_digital_repository TDR as defined by the Science Europe Data Glossary

[3] Lin, D., Crabtree, J., Dillo, I., Downs, R. R., Edmunds, R., Giaretta, D., ... & Westbrook, J. (2020). The TRUST Principles for digital repositories. Scientific data, 7(1), 1-5. https://doi.org/10.1038/s41597-020-0486-7

[4] https://op.europa.eu/s/pa5m Turning FAIR Into Reality (2018)

[5] https://www.coretrustseal.org/

[6] https://dans.knaw.nl/en/current/coretrustseal-certification-launched

[7] http://www.trusteddigitalrepository.eu/Trusted%20Digital%20Repository.html Levels of certification as defined by the European Framework for Audit and Certification

Core level, making it an accessible first step for repositories. Other certification organisations exist that provide Extended (nestor-Seal DIN31664[8]) and Formal (ISO16363[9]) certification.[10]

This report, deliverable 4.3, describes the FAIRsFAIR repository support programme and its contents. It also evaluates the programme and provides guidance for other repository support initiatives. For repositories that do not yet feel ready to pursue formal certification, FAIRsFAIR has also provided several recommended actions for repository managers to start their journey towards becoming more FAIR-enabling and more prepared for a certification process in deliverable D3.5[11]. The CoreTrustSeal Board has expressed their support and engagement towards the work of FAIRsFAIR and other FAIR initiatives, including the repository certification support programme described in this deliverable (See Appendix A).

Between July and August 2020, an open call ran for repositories to apply to the certification support programme. The support programme started in February 2020 and will continue to run until January 2022. In the span of the programme, the selected repositories receive support in the form of several workshops, support calls, and evaluations of their CoreTrustSeal self-assessments. The next sections of this deliverable will delve deeper into the content of the programme (section 2.1), the support provided for the repository managers (section 2.2.), the support provided for the CoreTrustSeal reviewers (section 2.3), and the guidance FAIRsFAIR can offer others who want to set up their own repository support programme (section 2.4).

It is important to note that certification, CoreTrustSeal or otherwise, can also be achieved without participation in a support programme such as the one detailed here. The certification organisations generally provide adequate guidance to achieve certification, and will also provide feedback during the evaluation procedure. Repositories looking to apply for certification themselves can also make use of the documentation and resources mentioned in this deliverable for additional guidance.

2. FAIRsFAIR's repository support programme towards trust and FAIR

2.1. Making your repository more trustworthy and FAIR-enabling: a support programme

The 10 supported repositories were identified via an Open Call for Support.[12] Repository managers and representatives were invited to apply to receive a financial incentive (€1.000,00) as well as dedicated support for pre-submission to the CoreTrustSeal certification process. From 73 applications, 10 repositories were selected by an independent expert committee that assessed the incoming applications based on the repository's focus on long-term preservation and on the feasibility of their repository obtaining CoreTrustSeal certification within the given timeframe. Given this feasibility criterion, the repository sample might be biased to consist of more mature

---

candidates. The experiences, challenges, and lessons learned described in this deliverable may therefore not be fully representative of all repositories, as it may be that less mature applicants experience other challenges and need other support. The expert committee also aimed to achieve a diverse geographical and disciplinary spread among selected repositories to participate in the support programme. Table 1 displays the eventual spread in the repository sample. For an overview of the open call text and more extensive descriptions of the supported repositories, see Appendix B.

Table 1. An overview of the selected repositories for the support programme. The categorization of domains is based on the re3data classification of the repository.

Repository	Domain	Country
Apollo	Social Sciences and Humanities, Life Sciences, Natural Sciences, Engineering Sciences	United Kingdom
DaSCH	Social Sciences and Humanities	Switzerland
DASS-BiH	Social Sciences and Humanities	Bosnia & Herzegovina
DASSH	Life Sciences	United Kingdom
ESRF	LIfe Sciences, Natural Sciences	France
IAGOS	Natural Sciences	France
ICOS	Natural Sciences	Sweden
Movebank	Life Sciences	Germany
ICTS SOCIB	Natural Sciences	Spain
Tárki	Social Sciences and Humanities	Hungary

This section provides a visual overview of the FAIRsFAIR repository support programme where we help to progress selected repositories towards CoreTrustSeal certification. Among other things it displays the support activities, structure and timeline of the programme. This two-pager can also be found on Zenodo[13].

Not included in the visual but relevant to mention here is that at the time of writing (July 2021), 8 out of 10 repositories have formally submitted their application to CoreTrustSeal. Throughout the course of the FAIRsFAIR project, the FAIRsFAIR support team will keep supporting and monitoring the progress of repositories.

---

[13] Ilona von Stein, Olivier Rouchon, Maaike Verburg, Serenella Muradore Gallas, Sara Pittonet Gaiarin, & Andrea Greco. (2021). Making your repository more trustworthy and FAIR-enabling a support programme. Zenodo. http://doi.org/10.5281/zenodo.5106165

FAIRSFAIR
Fostering Fair Data Practices in Europe

Making your repository more trustworthy and FAIR-enabling: a support programme

FAIRsFAIR is supporting 10 European repositories on their journey towards becoming more FAIR-enabling and trustworthy. This includes helping them make and keep their data FAIR and preparing them for the CoreTrustSeal certification as trustworthy repositories.

In return, the repositories share their invaluable knowledge on how trustworthy repository practices best enable FAIR data. Their observations and common issues in the certification process help create better guidance and support material for the wider repository community, developing recommendations for integrating FAIR into the CoreTrustSeal requirements.

The programme in detail

- collaborative workshops
- test peer-review of CoreTrustSeal applications by experts as preparation for formal submission to the CoreTrustSeal process
- 1-on-1 support and advice
- a variety of practical tools to support services and individuals in their FAIR data practices
- a dedicated helpdesk
- peer community support

Introductory workshop (February 2020)

"For our repository trust, reproducibility and actual reuse were main drivers for certification. FAIRsFAIR support was extremely useful for us"

Rudolf DImper (ESRF)

Other FAIRsFAIR tools for researcher, data stewards and repositories increase their FAIR share

F-UJI | Automated FAIR Data Assessment Tool

FAIR Aware

We continue to share our lessons learned and challenges with a wider repository audience

FAIRSFAIR
Fostering Fair Data Practices in Europe

Support team

CINES DANS DCC PANGAEA. UK·DATA ARCHIVE

Supported repositories

Apollo CREDI ... DANSEL ESRF IAGOS ICOS MOVEBANK SOCIB TÁRKI

Phase 1 — Early 2020

The Journey to CoreTrustSeal Certification Begins
Introductory workshop with working sessions, tools and support materials to improve the knowledge of activities related to the **preparations for CoreTrustSeal application**. Repositories were invited to comment on the CoreTrustSeal+FAIR overview to further improve the mapping between FAIR data principles and CoreTrustSeal repository requirements.

- **February 2020**
  Introductory workshop. DANS, The Hague

Phase 2 — Mid 2020

The Self-assessment phase
Repositories worked on completing a draft self assessment where they answered the CoreTrustSeal requirement questions using a pre-prepared template.

Phase 3 — Late 2020

The test-peer review period
The self assessments were reviewed by five teams of two reviewers each and peer reviews of the submitted work were performed, followed by individual support calls.

- **November 2020. Certification support workshop.**
  Discussing common issues raised during the certification process via a survey
- **February 2021. CoreTrustSeal Certification Support Workshop: Preservation Planning**
  A preservation planning worksheet identified challenges in long-term preservation policy development and discussed possibilities to meet these challenges.

Phase 4 — 2021

The CoreTrustSeal application
The repositories submitted their final self-assessments to the CoreTrustSeal Board and entered the standard CoreTrustSeal certification process of application, review, revision and approval.

Next steps
Certification Support Process

October 2021
a short survey will provide an overview of financial expenditure and lessons learnt

November 2021
a workshop will be organized to reflect on key challenges for repositories & lessons learnt while celebrating the achievement

December 2021
final interviews will be conducted to discuss the process, outcomes and lessons learnt with each repository as a closing of the support programme

2.2. Support for repository managers

As the visual in the previous section laid out, the repository support programme provided a range of material and workshops to support managers of supported repositories. This section will explore some of the support offered in more detail.

The Kick-off workshop in February 2020[14] allowed repository staff to get to know each other and get introduced to the support team. It provided an overview of CoreTrustSeal and the application process and asked attendees for their preferred routes for delivering support. This resulted in the following preferences (see Figure 1):
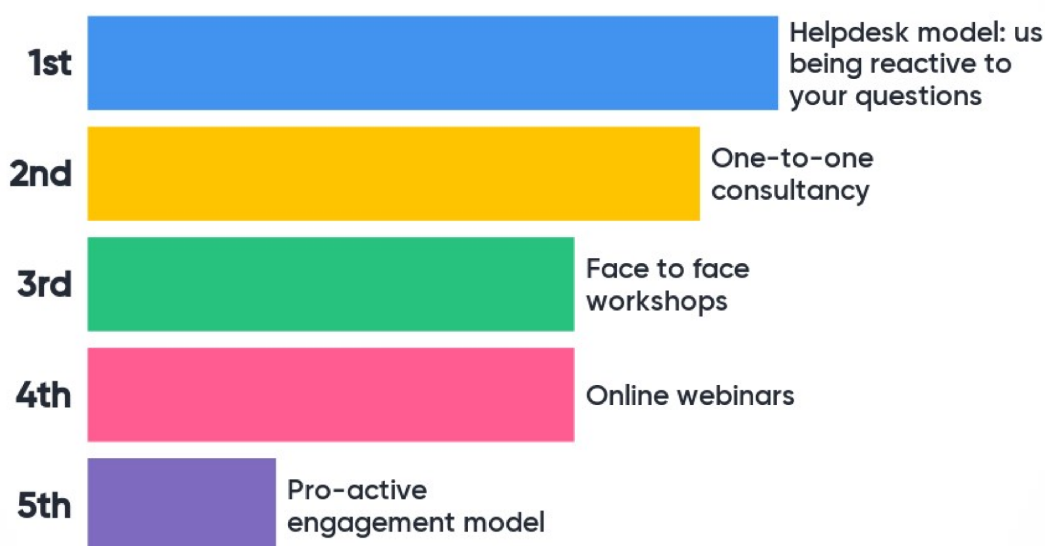
Figure 1. Preferred forms of support as indicated by the supported repositories (Mentimeter results).

The certification support email-inbox was well used throughout as it provided a first point of contact for all kinds of questions for the supported repositories. Due to the COVID-19 pandemic, additional face to face workshops have not been possible, but FAIRsFAIR offered various online options for further engagement.

In June 2020, the initial workshop was followed up by a general support call that allowed repositories to ask any questions that were raised while putting their first assessment together.[15] Based on the frequently asked questions to the support inbox, the support team decided to set some time aside to discuss guidance around evidence and documentation in more detail.

Once the first drafts of the self-assessments were submitted to FAIRsFAIR, they were reviewed by the FAIRsFAIR team. Each repository was assigned two mentors from the FAIRsFAIR support team, ensuring that one of the two mentors was a member of the CoreTrustSeal Assembly of Reviewers.

---

[14] https://www.fairsfair.eu/news/journey-coretrustseal-certification-begins-ten-repositories. Workshop slides: Ilona von Stein, Frans Huigen, Mustapha Mokrane, Hervé L'Hours, Patricia Herterich, Anusuriya Devaraju, & Olivier Rouchon. (2020, April). Certification + FAIR Support Workshop for Data Repositories. Zenodo. http://doi.org/10.5281/zenodo.3754292

[15] Workshop slides: Ilona von Stein, & Frans Huigen. (2020, August). General Support Call for Repositories. Zenodo. http://doi.org/10.5281/zenodo.3979359

The FAIRsFAIR teams provided feedback using a form that followed the structure of the CoreTrustSeal Application Management Tool (AMT)[16]. In addition, each repository was invited to at least one video call with their mentors to go through the feedback that was provided and to share additional insights. If requested by the repositories, additional reviews of rewritten sections of the applications were provided and additional one-on-one support calls were arranged.

2.2.1. Common challenges for repositories

An analysis of the draft reviews was undertaken to enable the identification of common challenges. This helped with highlighting those CoreTrustSeal requirements where repositories struggled to determine what they should provide as part of their answer and what supporting evidence to provide. The common challenges identified in this analysis are listed in Table 2.

Table 2. An overview of the common challenges experienced by the supported repositories when making their first CoreTrustSeal application draft.

CoreTrustSeal requirement	Challenge identified
R0 Context	Entity applying for CoreTrustSeal certification. How to define the Designated Community? What drives choice between levels of curation? A clear description of relationships between partners that the repository works with (e.g. Insource/Outsource Partners) .
R1 Mission/Scope	Preservation is not explicitly mentioned.
R2 Licenses	Compliance monitoring of applicants' self-assessed progress. Details on Data usage licences as part of data policy and terms of use.
R3 Continuity of access	Details on preservation plans & procedures.
R4 Confidentiality/Ethics	Details on processes and procedures. Details on types of personal information.
R5 Organizational infrastructure	Details on number of staff, funding scheme, organisational structure and governance.
R6 Expert Guidance	Details on interaction with experts and how their feedback is addressed. Evidence on long-term partnerships and examples of user groups involved.
R7 Data integrity & authenticy	Evidence on how data integrity and authenticity are maintained.
R8 Appraisal	Evidence demonstrating that data remain relevant and understandable

---

[16] https://amt.coretrustseal.org/

	to your Designated Community. Details on usage of PIDs. Details on data collection policy.
R9 Documented storage procedures	Evidence on processes in place.
R10 Preservation Plan	Documented approach to preservation planning (preservation plan).
R11 Data Quality	Documentation on procedures for data quality control.
R12 Workflows	Description (illustration) of archiving workflows and their management.
R13 Data discovery and identification	Description of search interfaces and discovery options.
R14 Data Reuse	Creation, curation and preservation of data and metadata in response to changes in technology and the needs of the community.
R15 Technical infrastructure	Procedures and workflows confirming that the chosen hardware and software are appropriate. Technical aspects of business continuity, disaster planning and succession planning.
R16 Security	Risk analysis practices and controls to minimize threats, including information security management.

In a next step, repositories were asked to rank the 29 common challenges identified in the evaluations of the self-assessments. This ranking provided the support team with a better understanding of where the repositories require clarification and additional explanation to be able to provide a response. Some of the challenges might have been addressed in the 1-1 support calls with their FAIRsFAIR reviewers, this survey helped to highlight issues that were worth exploring with the wider group of repositories. The ten most difficult common challenges are presented in Figure 2.

Top 10 most difficult CoreTrustSeal requirements
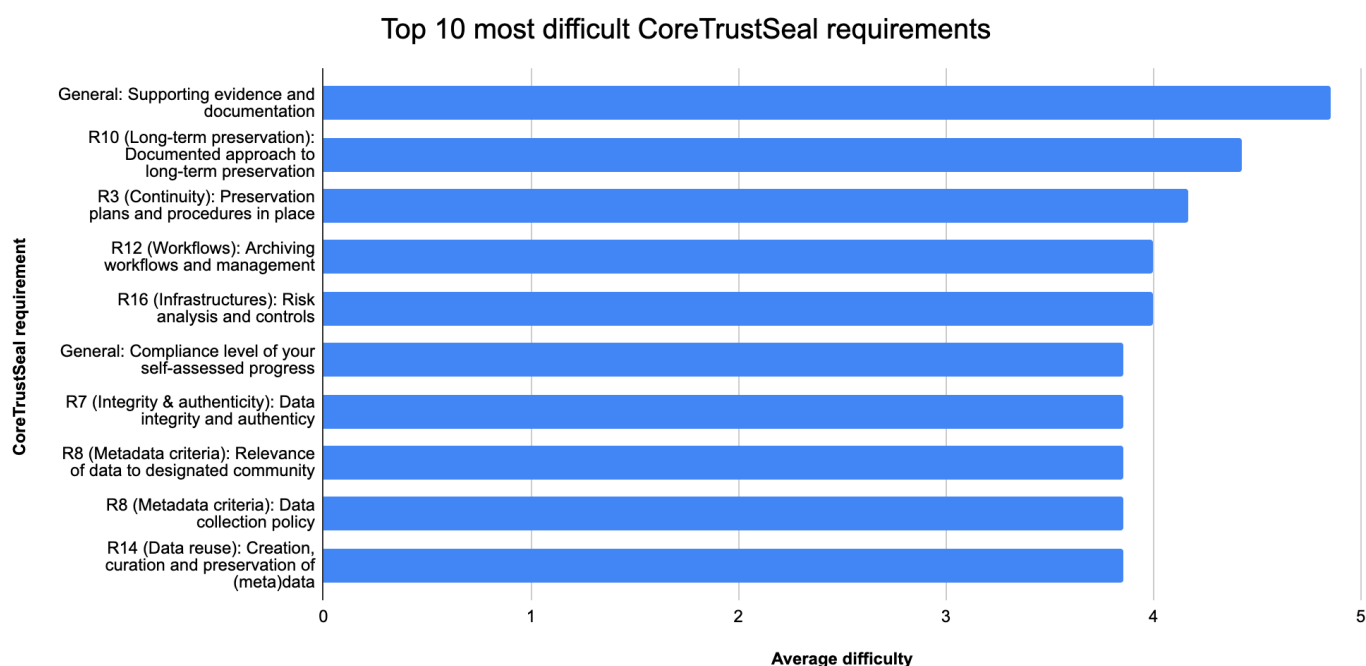
Figure 2. Common challenges identified in the review of the first CoreTrustSeal application drafts. A top 10 ranked by average experienced difficulty.

The November 2020 workshop thus followed on a deep dive into the requirements R3 *Continuity of Access*, R10 *Preservation Plan*, and R12 *Workflows*, with the general challenge of supporting evidence and documentation having been covered in some detail in an earlier support session with the repositories.[17]

Preservation planning was picked up in an additional workshop in February 2021 as many of the supported repositories were unclear about the evidence they needed to produce to address this requirement. In preparation for the workshop, the supported repositories were asked to go through a Preservation Policy Planning Worksheet (adapted from the Digital Preservation Coalition) to help them identify areas where they can improve in future. The workshop provided insights into the approaches from some of the FAIRsFAIR partners and provided another opportunity for peer discussion.[18]

2.2.2. Successes and lessons learned

As of July 2021, the support programme resulted in 8 out of 10 repositories submitting their CoreTrustSeal applications for review. The support provided by FAIRsFAIR throughout the iterations

---

of their drafts ensured that the repositories felt ready and confident in their assessment before submitting to CoreTrustSeal. Two repositories were invited to share their experiences with the program at the Open Repositories 2021 conference. Peter Sutton-Long explained the incentives Apollo repository had to apply for the support programme: *"For our repository trust, reproducibility and actual reuse were main drivers for certification. FAIRsFAIR support was extremely useful for us"*. Rudolf Dimper depicted how the support programme led the ESRF repository to be in a better position for CoreTrustSeal certification: *"For us, it was very important to have the support from FAIRsFAIR, and we are extremely grateful for this. The interaction during the process allowed us to make everything understandable and fill in the gaps before entering the actual certification process. Apart from learning a lot, we now understand where we are weak. Overall, I think we are in a good position for the certification process"*.

The initial general lessons learned from the FAIRsFAIR support team are two-fold. Firstly, extensive planning is required to make and adhere to a feasible timeline for the programme. To allow for multiple iterations of draft assessments, repositories must have people available to create and update the drafts, and reviewers must be available to evaluate them. With the goal to have all repositories ready for submission to the CoreTrustSeal Board six months before the end of the FAIRsFAIR project, timing really was of the essence. Second, uniquely tailored support is necessary to adequately support each repository to the point of application. As each repository had their own starting point in terms of CoreTrustSeal-readiness, the support and guidance given needed to have different starting points as well. The one-on-one support calls held were an example of an effort to tailor the support. With the programme still ongoing, the FAIRsFAIR support team will further reflect on successes and lessons learned throughout the year (see section 2.5 for some of these intentions).

One additional specific lesson learned with regards to the practical aspects of the programme is that while most of the support options were picked up by the supported repositories, the community forum that was created for the repositories to communicate with each other and ask questions to the wider group and not just the certification support inbox, was not used for peer exchange. Reasons for that will need to be explored as part of the exit interviews with the repositories (See section 2.5).

The successes and lessons learned within the FAIRsFAIR support programme, were shared with a wider (repository) audience via workshops and sessions at various international conferences and symposia, most notably the 15th the International Digital Curation Conference 2020 (IDCC),[19] Open Repositories 2020[20] and 2021[21], American Geophysical Union Fall Meeting 2020[22] and the Repository Support Public Meeting of the FAIRsFAIR2021-event.[23]

---

[19] Ten things you can do to support the FAIR data culture: https://www.fairsfair.eu/articles-publications/ten-things-you-can-do-support-fair-data-culture-fairsfair-worshop-idcc2020

[20] Herterich, Patricia, & Davidson, Joy. (2020, June). How repositories can contribute their FAIR share. Zenodo. http://doi.org/10.5281/zenodo.3871523

[21] https://www.fairsfair.eu/events/fairsfair-open-repositories-2021

[22] Supporting the Transition to FAIR-enabling through Trustworthy Digital Repositories and FAIR-aligned Policies:https://agu.confex.com/agu/fm20/meetingapp.cgi/Paper/672110

[23] https://www.fairsfair.eu/events/fairsfair-repository-support

2.3. Support for CoreTrustSeal reviewers

The FAIRsFAIR repository support programme provided support and capacity building for CoreTrustSeal Assembly of Reviewers as well, to help them conduct consistent peer reviews. It contributes to the improvement of repository landscape and coherence in reviewer practices.

A key aim of FAIRsFAIR is to help foster the emergence of a network of TDRs that can be extended and sustained beyond the life of FAIRsFAIR, so we placed an emphasis on building relationships during these workshops. CoreTrustSeal reviewers consist of people that work for certified repositories, so they represent a trustworthy repository already.

2.3.1. CoreTrustSeal Assembly of Reviewers Workshop series

A series of virtual workshops was held in May as part of the 2021 CoreTrustSeal Assembly of Reviewers, co-organized by FAIRsFAIR and CoreTrustSeal[24]. It consisted of four sessions during which reviewers could meet their peers and discuss the following topics:

- Overview of the wider certification environment and how CoreTrustSeal and its application process sit within;
- Insights, tips, good practices and experiences for assessments evaluation;
- Explanation of the CoreTrustSeal Requirements in regard to applicant response statements and clarification of potential questions through real use cases;
- Ways to improve coherence and consistency in CoreTrustSeal reviews;
- Roadmap to FAIR principles inclusion into the CoreTrustSeal criteria.

More than forty CoreTrustSeal reviewers registered and attended the event.

Figure 3. CoreTrustSeal Assembly of Reviewer Workshop series jointly organized by FAIRsFAIR and CoreTrustSeal

---

[24] Workshop series: https://www.fairsfair.eu/events/coretrustseal-assembly-reviewer-workshop-series

During the first session, participants learned about the wider certification environment and how the CoreTrustSeal foundation and the application process interact with each other. They also had the opportunity to get to know each other better by introducing themselves in smaller groups.

To help submitting repositories optimise their efforts to develop the first draft of their assessment, participants discussed the CoreTrustSeal requirements from the applicants' point of view in the second session. Working in small groups, they analysed mock samples of applicant statements and clarified existing questions.

During the third session, reviewers discussed and identified various ways to improve coherence across CoreTrustSeal reviews. By discussing mock samples of applicant statements, they practised their reviewing skills and shared their best practices.

At the closing session, participants were invited to think ahead and focus on quality, coherence and confidence in the review process. They were also invited to reflect on short pitches of the CoreTrustSeal Board members, focusing on improving the AMT, the elaboration approach of CoreTrustSeal as a core repository certification and Preservation for a Designated Community[25].

Besides these more formal sessions, the open coffee hour was an excellent opportunity to network and ask any additional questions and exchange thoughts. A post-event blog around the workshop can be found on the FAIRsFAIR website[26].

2.3.2. Successes and lessons learned

The attendance of over 40 CoreTrustSeal reviewers out of the total 57 members of the Assembly of Reviewers is a great demonstration of the CoreTrustSeal community and the reviewers' motivation to provide high quality application evaluations. This was seen as the first success of the workshops. An evaluation survey was sent out to participants to look back on the workshop series. The overall feeling shared by the participants was that the workshop met their expectations or exceeded them (93.3%). According to the participants, there was a good balance of initial information, but an important focus on discussion and engagement.

The workshop series provided the CoreTrustSeal reviewers with a range of views and ample networking opportunities. The series encouraged them to compare their ways of working and formulating responses in an interactive setting. Importantly, the reviewers emphasised the importance of learning from each other, especially while doing practice reviews. When asked about their level of confidence in doing reviews, 73.3% of the reviewers were of the opinion that their level of confidence in doing reviews had increased after attending the workshop sessions. This finding clearly demonstrates the need and relevance of such workshops to the participants.

In future events, the participants would prefer a similar workshop series once or twice a year keeping the current format. However, they would like to have facilitated breakout groups to better

---

[25] L'Hours, Hervé, Kleemola, Mari, von Stein, Ilona, van Horik, René, Herterich, Patricia, Davidson, Joy, … Huber, Robert. (2021, May 24). FAIR + Time: Preservation for a Designated Community (Version 01.00) Zenodo. https://doi.org/10.5281/zenodo.4783116
[26]
https://www.fairsfair.eu/articles-publications/towards-building-community-confident-reviewers-and-satisfied-applicants

guide conversations. Some other suggestions included sharing materials by email, via an online forum or email lists. In addition, (online) onboarding events for new CoreTrustSeal reviewers were seen to be helpful to increase coherence across reviews.

In line with the above, the reviewers appreciated the workshop series, and they would like to have more such events in the future. The fact that the workshops had increased their level of confidence of performing reviews and offered new perspectives of comparing ways of working and formulating responses, demonstrates a tangible added value of such events. As Ilona von Stein, a CoreTrustSeal reviewer and FAIRsFAIR colleague explained, her *"key take-away from the workshop is that there is a future potential to benefit from and leverage on existing practices of sharing knowledge and sharing experiences"*.

Our ten repositories supported by FAIRsFAIR prefigure a nucleus of a proposed European network of FAIR-enabling Trustworthy Data Repositories. Such a network should be coordinated, connected and nurtured as part of the EOSC FAIR-enabling ecosystem to ensure long term digital preservation of data made available in EOSC. At this point, such a network does not exist at a cross-disciplinary European level. The benefits and possible set up of such a network should be explored with stakeholders such as Trustworthy digital repositories, EOSC Partnership, CoreTrustSeal Board and other projects in the EOSC and FAIR space.

2.4. Recommendations for developing a support programme towards repository certification

While reflecting on our experiences and lessons learned so far, we have formulated some initial recommendations for other initiatives looking to organize a similar support programme. All quoted text and the overall structure of this section follows and expands upon the *CESSDA Trust Group: Overview of Support Approaches* that is referenced in *Efforts and initiatives from others* below*.*

The primary focus of the support programme developed by FAIRsFAIR[27] was the achievement of CoreTrustSeal by the selected repositories. In parallel the issue of how repositories could become more FAIR enabling was also considered. Early engagement with the repositories included feedback on the alignment of CoreTrustSeal and FAIR. Later engagement will include repository feedback on CoreTrustSeal+FAIR proposals revised in light of developments in the FAIR data indicators[28] and FAIR assessing tools and tests[29]. It is important to clarify this initial focus on CoreTrustSeal and on the concept of repositories 'enabling' FAIRness in contrast to objects being assessed as FAIR. As FAIR object assessment gains community recognition and support and as approaches to elaborating FAIR around the 'Core' of CoreTrustSeal are further developed[30], support programmes will need to be expanded and adjusted.

---

[27] Evaluation of Procedures and Processes of Certification Mechanisms Provided https://doi.org/10.5281/zenodo.3738965

[28] FAIR Data Maturity Model. Specification and Guidelines http://doi.org/10.15497/rda00050

[29] M4.9 Report on Fair Data Assessment Mechanisms to Develop Pragmatic Concepts for Fairness Evaluation at the Dataset Level https://doi.org/10.5281/zenodo.4118405

[30] M4.2 Draft Maturity Model Based on Extensions and-or Additions to CoreTrustSeal Requirements https://doi.org/10.5281/zenodo.4003598

For this work the subset of stakeholders addressed was organisations that identified with the roles and missions of trustworthy digital repositories, including the provision of active preservation of (meta)data for a designated community (see section 2.2). We would also expect future work to clarify requirements for and assessment of data services (as a superset of *repository* data services) will provide opportunities for expanding these support approaches to a wider range of research infrastructure organisations (RIO).

2.4.1. Repository Actor Types

The breadth of coverage of the CoreTrustSeal Requirements might indicate that a manager, a curation practitioner, and a technologist would be the three types of actor needed to complete a self-assessment. For the FAIRsFAIR support programme, a key contact was designated by each repository which required some effort on their part to coordinate responses from across the organisation. An alternate approach would have been to include representatives of each type of actor directly in the project interactions.

FAIRsFAIR Recommendation

Broad engagement within applicant organisations can minimise the effort of preparing self-assessments while maximising internal communication and knowledge exchange.

2.4.2. Experience of Support Providers

The FAIRsFAIR support team members had a wide breadth of experience in research data management and infrastructure, e.g. a wide disciplinary coverage and various repository roles. In pairing support staff with the repositories consideration was also given to an appropriate spread of direct experience with the CoreTrustSeal Requirements and the review process. No support process can guarantee a successful application for certification, but feedback iterations from CoreTrustSeal reviewers can be minimised by ensuring appropriately experienced support staff.

FAIRsFAIR Recommendation

In setting up a support team, include members with a variety of backgrounds and disciplinary experience to provide high-quality support.

2.4.3. Audience Segmentation by Experience, Maturity and Goals

The FAIRsFAIR open call for support sought self-identified repositories that saw themselves as candidates for Trustworthy Digital Repository status. The financial incentive provided further assurance that other barriers to seeking certification could be removed. The structure of the

FAIRsFAIR description of action indicated a direct and common structure to the support process, with bespoke and detailed support delivered through the one-on-one aspects of the process.

For future support programmes, including those outside a project context or aimed at a wider range of data service types, there are three recommended areas for audience segmentation: experience, maturity and goals.

Experience in the standard requirements among the staff receiving support will help guide the initial level of targeted support.

- "**Introductory**: basic overviews of trust standards, their goals and benefits
- **Intermediate**: mapping trust standards to local practice
- **Advanced**: managing and improving evidence and efficiency over time."

Maturity of practice in the organisation receiving support will help identify their capabilities at the start of support (as is) and to design steps towards reaching their target state (to be). The emerging CoreTrustSeal Capability-Maturity approaches[31] may be helpful to the design of future support approaches.

Organisations may have different goals overall, or within the timeframe of the support process. These may depend in part on the experience of those involved and the initial capability-maturity level of the organisation. The CoreTrustSeal also provides a basis for internal knowledge exchange with numerous requirements applicable to non-TDR data services so certification itself may not always be the final goal. Examples goals include:

- "**Baseline**: familiarise the organisation with good repository operational practice based on standards
- **Integrated**: aligning the repository processes and data types with those standards
- **Assessment**: using internal assessment or peer review to evaluate the level of alignment between standard practice and local practice
- **Certification**: undertaking some formal review and recognition process by an independent third party
- **Renewal**: managing operational documentation to minimise the resource expenditure on maintaining certification. Change managing internal materials over time so they remain operationally useful and valid as evidence for certification. Adapting local materials in a managed way to address changes in standards."

FAIRsFAIR Recommendation

After the introductory information stage, consider dividing support work across the supported repositories based on their experience of CoreTrustSeal, their maturity as an organisation and the outcomes they have identified as key goals of the process.

---

[31] https://doi.org/10.5281/zenodo.4003598

2.4.4. Support Modalities: Routes, Approaches and Focus

Throughout the support programme, the supported repositories were consulted on their preferred support routes and approaches. FAIRsFAIR support process has employed virtually all of the modalities covered below. At the initial stage, the "Helpdesk model: us being response to your questions" was most appreciated (see figure 1) while later in the support process, there appeared to be a higher need for one-to-one consultancy. The regular online webinars and workshops proved to be very helpful (to the support team as well as the repository representatives) to help monitor progress and continue to benefit from peer-community support.

Support Routes:

- Online Webinars
- Face to Face workshops
- Consultancy 'surgeries' for one-to-one support
- Helpdesk model: reactive to questions from multiple sources
- Direct engagement model: pro-active engagement with an applicant or group of potential applicants

Support Approaches

- Information delivery (broadcast)
- Roundtable (participant engagement)
- Q&A

Support Focus

- Trust overview
- Introduction to the CoreTrustSeal
- Changes to the CoreTrustSeal
- Addressing specific requirements
- Developing evidence statements
- Ideal evidence
- Evidence management
- Evidence alignment"

FAIRsFAIR Recommendation

Design the support programme with different support routes and engagement types. Identify and divide content into specific areas of focus. This enables targeted learning and the revision and re-use of support content so that it is optimised for different approaches.

As mentioned above, the CoreTrustSeal support process is ongoing, but overall feedback is positive and there has been success in initial applications for certifications. The early identification of common challenges across the supported repositories and consultation on ranking these perceived issues has been a positive process that could be integrated into future support approaches. Some

issues in terms of contacting a broad range of repository staff, timing and variability among candidates are a result of the project model and could be mitigated by more broadly focussed longer-term funding of support programmes. CoreTrustSeal itself has some limitations in its three yearly review process. This periodic snapshot is not designed for assessment of current status or to support progress towards future goals, but this could be mitigated with the type of capability-maturity approaches being proposed by FAIRsFAIR.

The CoreTrustSeal Requirements and the evidence sought focus on repository policy, procedures and workflows. There is a lack of 'evidence of outcomes', partially because a repository data collection can be very heterogeneous (formats, disciplines, etc.) with different levels of curation for different objects. There is no community-agreed method to analyse outcomes at 'collection' level whether as a general description or based on aggregated metadata from objects in the repository. We expect this to change as FAIR and other object assessments progress. This will also help progress the move from human-mediated to more machine actionable repository evaluation. This is desirable for scalability and consistency but depends on community agreed minima as well as generally actionable tests. These changes will necessitate periodic re-evaluations of and updates to support programmes around CoreTrustSeal and related standards.

2.4.5. Efforts and initiatives from others

The CoreTrustSeal has seen wide adoption across domains and regions[32] since it emerged from the Research Data Alliance (RDA) working group[33] process. The FAIRsFAIR Project, undertook programme development with an initial reference point of the CESSDA Trust[34] Overview of support approaches. The requirements for membership of the Consortium of Social Science Data Archives (CESSDA) include progress towards a TDR standard (CoreTrustSeal) and some types of CLARIN membership[35] require CoreTrustSeal.

The World Data System (WDS) have incorporated FAIR into the acceptance process for their regular members[36]. These approaches may be formalised and expanded in future in view of the models FAIRsFAIR is proposing for elaborating additional requirements around CoreTrustSeal[37]. These initially focus on FAIR, but could also be extended to open data or additional criteria set by ERICs or disciplinary organisations.

The CESSDA support overview was also taken into consideration in the development of CoreTrustSeal support[38] for the SSHOC[39] project and the EOSC Nordic project[40]. Expressions of interest[41] for CoreTrustSeal support were being sought by the Australian Research Data Commons (ARDC) in 2019. Additional help for institutions with a digital archive that want to get started with

---

[32] https://www.rd-alliance.org/rda-coretrustseal-adoption-story-across-domains-and-regions
[33] https://www.rd-alliance.org/groups/rdawds-certification-digital-repositories-ig.html
[34] https://www.cessda.eu/About/Working-Groups/Trust
[35] https://www.clarin.eu/content/certified-centres
[36] https://www.worlddatasystem.org/community/membership/regular-members
[37] Hervé L'Hours, Ilona von Stein, Frans Huigen, Anusuriya Devaraju, Mustapha Mokrane, Joy Davidson, … Robert Huber. (2020). M4.2 Draft Maturity Model Based on Extensions and-or Additions to CoreTrustSeal Requirements (Version 01.00). Zenodo. https://doi.org/10.5281/zenodo.4003598
[38] https://doi.org/10.5281/zenodo.4558303
[39] https://sshopencloud.eu/
[40] https://www.eosc-nordic.eu/certification-support-seminar-on-fair-data/
[41] https://ardc.edu.au/news/call-for-expressions-of-interest-trusted-data-repositories-community-of-practice/

certification in the field of digital preservation is being provided in the Netherlands through the signpost for certification in the cultural heritages[42]. In France, certification of data repositories has been identified among the actions of the two successive National Plans for Open Science, published in 2018[43] and 2021[44] respectively. There has been active national support to CoreTrustSeal certification through RDA France[45] since its creation in 2018 and a common Working Group with the national Open Science Committee was set up in 2020 to support data repository certification[46]. In Canada the NDRIO-Portage CoreTrustSeal Certification Support Cohort & Funding has announced their selected repositories[47]. In the United States the National Institutes of Health (NIH)[48] has recently released a call to "strengthen NIH-funded biomedical data repositories to better enable data discoverability, interoperability, and reuse by aligning with the FAIR and TRUST principles and using metrics to measure their effectiveness. This provides an opportunity for existing repositories to increase "FAIR"-ness and "TRUST"-worthiness to improve their usage, utility, and impact throughout the data resource lifecycle"[49].

FAIRsFAIR engaged with many of the initiatives described above. With some our contacts and activities were closely intertwined (e.g. a virtual workshop around repository support with the EOSC Nordic project). With others our recommendations and lessons learned on setting up an open call and support programme were directly taken on board in a new support initiative (NDRIO-Portage).

2.5. Future steps

As noted above, the majority of the participating repositories (8 out of 10) have now submitted their assessments for review by CoreTrustSeal. Until the FAIRsFAIR project ends (early March 2022), we will continue to support these repositories in their review-feedback-revision cycle. In addition, we will continue to support those few repositories still working toward their CoreTrustSeal submission over the remainder of the FAIRsFAIR project with an aim to ensure they can submit in 2021. As much of the support has been delivered, the emphasis now shifts to packaging up the lessons learned to ensure that this knowledge and experience can be shared with the wider repository community. We will carry out some final reflection exercises, both for the FAIRsFAIR support team as well as for the supported repositories. The final reflection exercise for the repositories will include a survey to the repositories to better understand how the financial support was allocated to enable the repository to prepare their assessment and exit interviews with the repositories to allow them to feed back and reflect. We will also run a final workshop with the cohort to allow for the sharing of experiences in the wider group. Initial planning of the support work for the remainder of the project can be found in Figure 4.

---

[42] https://wegwijzercertificering.nl/en

[43] http://cache.media.enseignementsup-recherche.gouv.fr/file/Recherche/50/1/SO_A4_2018_EN_01_leger_982501.pdf (in English)

[44] https://www.enseignementsup-recherche.gouv.fr/cid159131/plan-national-pour-la-science-ouverte-2021-2024-vers-une-generalisation-des-pratiques-de-science-ouverte-en-france.html (in French)

[45] https://www.rd-alliance.org/la-certification-des-entrepots-de-donnees

[46] https://www.ouvrirlascience.fr/certification-des-entrepots-et-services-de-donnees/ (in French)

[47] https://portagenetwork.ca/news/repositories-selected-for-ndrio-portage-coretrustseal-support-funding/

[48] https://www.nih.gov/

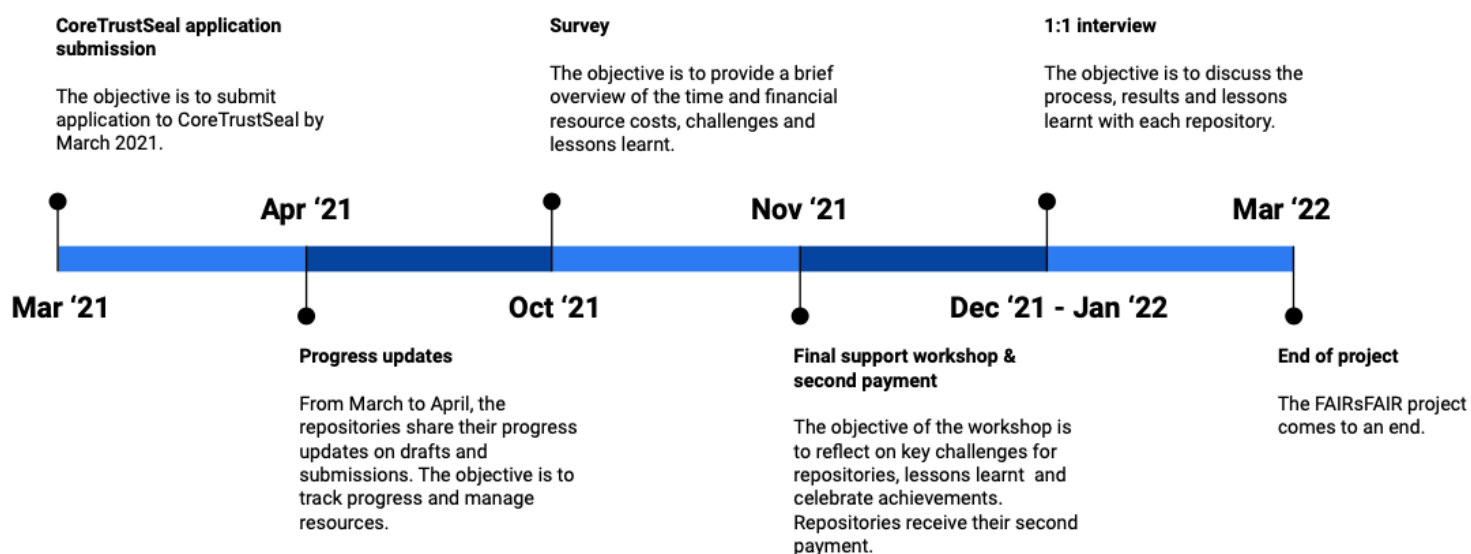[49] https://grants.nih.gov/grants/guide/notice-files/not-od-21-089.html

Figure 4. Proposed FAIRsFAIR repository support timeline for the remainder of the project

We will share the templates and materials developed for the support programme through the FAIRsFAIR Competence Centre[50] to enable a wider range of repositories to make use of these to support self assessment of their FAIR-enabling practices and, where relevant, to help make the process of applying for CoreTrustSeal status more efficient and straightforward. Preservation planning is an issue that is relevant to all repositories whether they seek CoreTrustSeal status or not. As long-term preservation planning has been highlighted as a key challenge among the supported repositories, FAIRsFAIR will provide a forthcoming Repository Support Webinar[51] that will be open to all repositories to help the wider community better understand how to engage with this process.

Two other important areas for future work have emerged during the FAIRsFAIR support programme. The first is the identification of variability in approaches to managing repository documentation for service delivery and evidence. Some FAIRsFAIR work on development of policy and evidence frameworks is ongoing, but this will remain vital post-project. The second is that research data infrastructure in general and trustworthy repositories in particular are seeing a wider range of actors and partners involved across the lifecycle. One result of this is that some parties have less understanding of key concepts such as designated communities and active preservation. With this in mind FAIRsFAIR has collaborated with the SSHOC and EOSC projects to develop a working paper to help fill this knowledge gap[52].

Furthermore, we will continue to engage with the CoreTrustSeal board to progress the alignment of CoreTrustSeal with the FAIR principles via CTS+FAIR[53]. The lessons learned through the FAIRsFAIR support programme will be fed back to CoreTrustSeal as suggestions to help them prioritise updates to their guidance materials and to consider possible amendments to the requirements as part of the next CoreTrustSeal review cycle. If possible, we hope to get a sense from CoreTrustSeal

---

[50] https://fairdataforum.org

[51] https://fairsfair.eu/repository-support-webinars

[52] FAIR + Time: Preservation for a Designated Community https://doi.org/10.5281/zenodo.4783116

[53] https://doi.org/10.5281/zenodo.4003630

whether our support helped. For example, was there any indication that our cohort's applications were more ready than others or did our support make the difference we hoped for?

Finally, we will start thinking about seeking mechanisms to leverage the experience of this cohort of supported repositories as part of a sustained network of TDRs that can provide similar guidance to others in their efforts to achieve CoreTrustSeal status, of which initial thoughts will be presented in future FAIRsFAIR deliverables D4.4 [Coordination Plan for FAIR-enabling TDRs] D1.6 [Sustainability Plan].

4. Appendices

A. CoreTrustSeal+FAIR: Statement of Cooperation & Support

FAIR data and other ongoing research data development have raised several key issues of relevance to CoreTrustSeal. We are actively engaging with FAIRsFAIR and a range of other FAIR-related projects and working groups. CoreTrustSeal-certified Trustworthy Data Repositories are vital components in enabling the realization of the Findable, Accessible, Interoperable, and Reusable (FAIR) Data Principles, both ensuring and enhancing the 'FAIRness' of data over the long term.
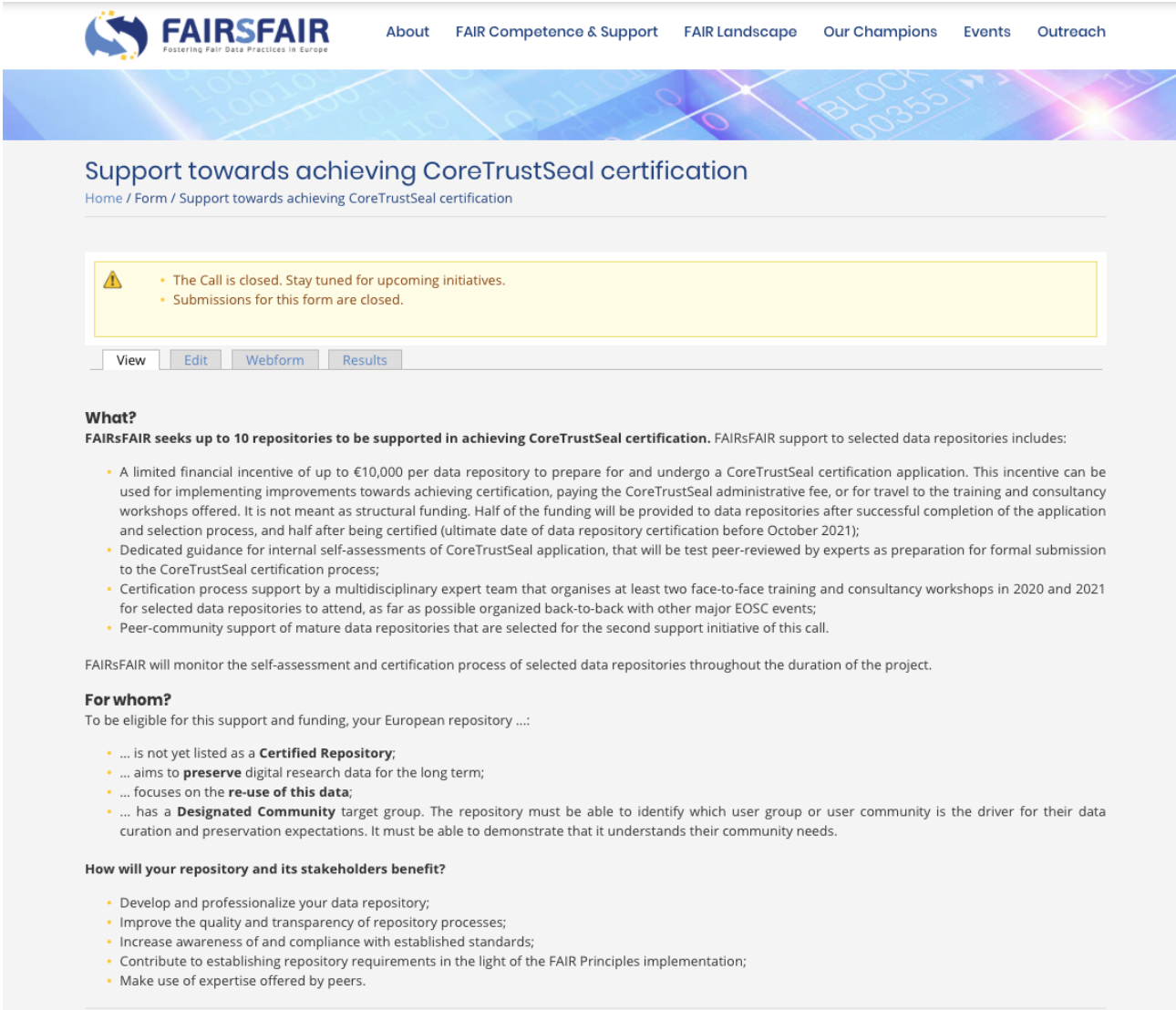
The mission for CoreTrustSeal endorsed by the Research Data Alliance and the wider community is to provide a single sustainable 'core' route for repository data service requirements and certification. The Board exists to manage and maintain that core route over time, and in response to community needs. As the FAIR Principles are clarified through indicators and evaluated through (ideally automated) tests against digital objects, CoreTrustSeal will continue to integrate 'core' best practices into the Requirements. We also recognise there may be more explicit FAIR requirements that may be elaborated around the foundation of the CoreTrustSeal. The CoreTrustSeal+FAIR work may be a case where we can integrate a FAIR-enabling assessment into the CoreTrustSeal process.

The CoreTrustSeal Board will continue to follow and engage in the work carried out by FAIRsFAIR and other FAIR-related initiatives around the world to ensure that CoreTrustSeal certification continues to address community needs for core-level certification.

CoreTrustSeal Standards and Certification Board (27 October 2020)[54]

---

[54] https://www.coretrustseal.org/why-certification/coretrustsealfair-statement-of-cooperation-support/

B. Open Call for repository support text and Supported Repositories

Apollo

Apollo[55] is the University of Cambridge institutional repository. The repository was established in 2003 as a service for sharing the outputs of Cambridge research activity. Apollo underpins the commitment of the University of Cambridge to preserve for the long-term and provide access to its research as widely as possible in order to contribute to society as well as to academic advancement. Though the repository offers different levels of access, its primary focus is on providing open access to the University's research publications. Apollo is one of the most widely used institutional repositories in the United Kingdom.

Data and Service Center for the Humanities (DaSCH)

---

[55] https://www.repository.cam.ac.uk/

The DaSCH repository[56] is designed for complex, qualitative data systems including bitstream objects (like digital images, sound or movie data formats), within the national Swiss humanity research community. The main goals of the DaSCH is to operate a platform for humanities research data that ensures long-term access to this data. Furthermore, the linking of data with other databases is promoted (linked open data), in order to create added value for further research and the interested public. The repository mainly services Swiss researchers in the field of humanities with complex, qualitative data connected to bitstream objects. Since 2021 DaSCH is a national data infrastructure primarily funded by the Swiss National Science Foundation (SNSF).

Data Archive for Social Sciences & Humanities in Bosnia & Herzegovina (DASS-BiH)

DASS-BiH[57] is the national service of Bosnia and Herzegovina with a role of ensuring long-term preservation and dissemination of social science research data. The purpose of the data archive is to provide a vital research data resource for researchers, teachers, students, and all other interested users. Data included in the archive are survey data from social science research in various disciplines, including economics, political science, psychology, sociology, society and culture, social welfare policy and systems. As a national service for Bosnia and Herzegovina, it is included in the list of CESSDA ERIC data archives[58]. Currently, it operates as an organisational unit of the Centre for Development Evaluation and Social Science Research (CREDI), which is a non-profit and non-partisan think tank organisation working on the research of migration, labour market, social policy and education. They have a mission of strengthening the culture of evidence-based policy-making in Bosnia and Herzegovina.

The Archive for Marine Species and Habitats Data (DASSH)

DASSH[59] is the UK archive for marine species and habitats data. They provide tools and services for the long-term curation, management and publication of marine species and habitats data, within the UK and internationally. Marine data is expensive to collect, therefore the repository promotes the 'collect once, use many times' paradigm. DASSH is part of a network of thematic marine UK data archive centres, operating under the Marine Environmental Data and Information Network (MEDIN) framework. DASSH is also a partner in the biological component of the European Marine Data and Information Network (EMODnet) and the UK node for the Ocean Biogeographic Information System (OBIS).

European Synchrotron Radiation Facility Data Repository (ESRF)

The ESRF data repository[60] is an institutional repository, intended to store and archive data from photon science experiments done at the European Synchrotron Radiation Facility (ESRF) in France. They also store digital material, such as documents and scientific results, which need a DOI and long term preservation. Data is made public after an embargo period of maximally 3 years.

---

[56] https://dasch.swiss/
[57] http://credi.ba/en/dass-bih/
[58] https://www.cessda.eu/About/Consortium/CESSDA-Countries/Partners/Bosnia-and-Herzegovina
[59] https://www.dassh.ac.uk/
[60] https://data.esrf.fr/

In-service Aircraft for a Global Observing System (IAGOS) Data Center

The IAGOS Data Centre[61] manages and gives access to all the data produced within the In-service Aircraft for a Global Observing System (IAGOS) project in France. IAGOS aims to provide long-term, regular and spatially resolved in situ observations of the atmospheric composition. The observation systems are deployed on a fleet of 10 to 15 commercial aircraft measuring atmospheric chemistry concentrations and meteorological fields. IAGOS is part of the H2020 project ENVRI FAIR, aiming to make all data from European environmental research interoperable. The IAGOS Data Center services more than 600 individual users from different communities. For example, some users work in the satellite community or the model community and use the IAGOS data for data validation purposes. Scientists working on process studies, trends, and climatologies also use the IAGOS data. In addition to these academics, IAGOS also provides Near Real Time data to the Copernicus Atmosphere Monitoring Service (CAMS) for model validation and data assimilation.

Integrated Carbon Observation System (ICOS) Carbon Portal

The ICOS Carbon Portal[62] is the data portal of the Integrated Carbon Observation System. It provides observational data from the state of the carbon cycle in Europe and the world. The Carbon Portal is the data center of the ICOS infrastructure, located in Sweden. ICOS will collect greenhouse gas concentration and fluxes observations from three separate networks. All these observations are carried out to support research to help us understand how the Earth's greenhouse gas balance works, because there are still many and large uncertainties. Data sets can be visualised and downloaded fully and/or partially. The ICOS Carbon Portal also offers some visualization services for the data. This data is interesting for a wide variety of scientists, including modellers of Earth 's climate system or dynamic vegetation, forestry and crop scientists, atmospheric inversion modellers and Earth Observation data providers.

The Movebank Data Repository

The Movebank Data Repository[63] is a repository in Germany that publishes datasets of animal-borne sensor data. All published datasets are standardized by first importing them to Movebank, a free, global research platform and e-infrastructure hosted by the Max Planck Institute of Animal Behaviour that helps researchers manage, share, analyse and archive animal movement and bio-logging data. The data in the Movebank Data Repository are unique observations of animal movements that can never be reproduced, and should be available to answer new questions decades from now. Movebank offers flexible tools for sharing, managing and analyzing animal movement data throughout all stages of research. The Movebank Data Repository complements this by providing a way to formally publish completed research datasets.

Balearic Islands Coastal Ocean Observing and Forecasting System Data Repository (ICTS SOCIB)

The Balearic Islands Coastal Observing and Forecasting System (ICTS SOCIB) Data Repository[64] is a multi-platform distributed and integrated system that provides streams of oceanographic data products and modelling services. It supports operational oceanography in a Spanish, European, and international framework and contributes to the needs of marine and coastal research in a global

---

[61] http://iagos-data.fr/
[62] https://www.icos-cp.eu/
[63] https://www.datarepository.movebank.org/
[64] https://www.socib.es/data/

change context. ICTS SOCIB coordinates the deployment and data management of a wide range of equipment and models from eight facilities. It also manages data from external international institutions and collaborates with international aggregators for the dissemination of ocean data. They provide streams of data, added value products, and forecasting services from the coast to the open ocean.

Tárki Data Archive

The Tárki Data Archive[65] is the national social science archive of Hungary, operated by Tárki Joint Research Center (Tárki JRC). Tárki JRC is a private, not-for-profit association of academic and educational institutions. The Tárki Data Archive specialises in policy research in the fields of social policy and the social consequences of economic policies. The data collection contains several studies in the research areas of the labor market and employment; income, property and savings; social behavior and attitudes; gender and gender roles; social stratification and groupings as well as mass political behavior. This includes related data-collection, archiving and statistical activities. One section of the databases archived is made up of TÁRKI's own surveys, and the other section comprises surveys from other Hungarian research institutes. Over the past two decades, the Tárki Data Archive has collected and archived more than 650 empirical social research data collections that are suitable for secondary analysis. As a national archive, the Tárki Data Archive is included in the list of CESSDA ERIC data archives[66].

---

[65] http://www.tarki.hu/eng/adatbank
[66] https://www.cessda.eu/About/Consortium/CESSDA-Countries/CESSDA-Members/Hungary