

Towards a European network of FAIR-enabling Trustworthy Digital Repositories (TDRs)

A Working Paper

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Table of contents

Version history	3
Table of Abbreviations	4
Executive Summary	5
Introduction	6
Challenges and Network functions	7
Networking and Knowledge Exchange	7
Stakeholder Advocacy and Engagement	7
Coordination and Development	8
Next steps: a framework for the Network	11
Membership	11
Business model	11
Governance model	12
Annex I - Background on current state of affairs	13
Open Science, FAIR, and TRUST principles in Horizon Europe and the EOSC	13
Existing certified repositories	14
The Network and related networks and associations	14
Existing networks on smaller scale	15
Collaboration in EU funded projects	15
FAIRsFAIR	15
SSHOC	16
EOSC-Nordic	17
FAIR-IMPACT	17
Annex II - Technical basis	18
References	19

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Table of Abbreviations

API	Application Programming Interface
CARE	Collective benefit, Authority to control, Responsibility, Ethics
DMP	Data Management Plan
DOI	Digital Object Identifier
EOSC	European Open Science Cloud
FAIR	Findable, Accessible, Interoperable, Reusable
INFRA	Infrastructures (in this context specific to Horizon Europe call names)
LTP	Long-term Preservation
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting
OAIS	Open Archival Information System
OAuth	Open Authorization
OPeNDAP	Open-source Project for a Network Data Access Protocol
ORCID	Open Researcher and Contributor Identifier
PID	Persistent Identifier
RAiD	Research Activity Identifier
ROR	Research Organisation Registry
SRIA	Strategic Research and Innovation Agenda
SSHOC	Social Sciences and Humanities Open Cloud
TDR	Trustworthy Digital Repository
THREDDS	Thematic Real-time Environmental Distributed Data Services
TRUST	Transparency, Responsibility, User focus, Sustainability and Technology
WIDERA	Widening European Research Area (Horizon Europe call)
WP	Work Package

Executive Summary

This working paper is a bottom-up initiative of a group of stakeholders from the European repository community. Its purpose is to outline an aspirational vision of a European Network of FAIR-enabling Trustworthy Digital Repositories (TDRs). This initiative originates from the workshop entitled “Towards exploring the idea of establishing the Network”¹. The paper was created in close connection with the wider community, as its core was built on community feedback and the first draft of the paper was shared for community-wide consultation. This paper will serve as input for the EOSC Task Force on Long Term Digital Preservation². One of the core activities mentioned in the charter of this Task Force is to produce recommendations on the creation of such a network.

So far there is no coordinated bottom-up effort to create a European Network of FAIR-enabling TDRs. A clear desire for such a network has previously been expressed by the community. For example, over 70% of attendees at the aforementioned workshop indicated a clear wish for this network to come into existence¹. Such a network can unite the repository community beyond finite project efforts, and offer a coordination and networking mechanism for addressing common challenges, like the need for long-term sustainability resources.

The working paper puts together a vision of how such a Network could be based on the community’s needs and its most important functions: Networking and knowledge exchange, stakeholder advocacy and engagement, and coordination and development. The specific activities hosted under these umbrella functions could address the wide range of topics that are important to TDRs. Beyond these functions and the challenges they address, the paper presents a framework to highlight aspects of the Network to further explore in the next steps of its development.

The Annexes present essential information on the background of recent and current efforts from which the Network arises, as well as the technical basis of TDRs that the Network will address. Although the Network aims to assist alignment, coordination and standardisation where possible and needed, it is important to note that the author team recognises that “not one size fits all” and the repositories’ unique characteristics are acknowledged.

The envisioned Network will be embedded in a European context, but with a clear global outlook and alignment. Once the Network is firmly established and has become successful, global expansion might be considered.

¹ Ilona von Stein, Ingrid Dillo, Christian Cuciniello, Linas Cepinskas, Maaïke Verburg, Hervé L'Hours, Tuomas Alaterä, & Henri Ala-Lahti. (2022, January 14). Towards a network of European FAIR-enabling Trustworthy Digital Repositories. Zenodo. <https://doi.org/10.5281/zenodo.5849658>

² EOSC Task Force on Long Term Digital Preservation: <https://www.eosc.eu/advisory-groups/long-term-data-preservation>

Introduction

Trustworthy Digital Repositories (TDRs) are a critical element in the research ecosystem, providing a key infrastructural component in the research data lifecycle. TDRs provide secure and sustained access to digital research objects, enabling researchers to both share research outputs with their communities and the public, as well as access, potentially reuse and refer to the outputs of other researchers.

As the European Open Science Cloud (EOSC) continues to take shape, the value and function of TDRs for EOSC also grows. TDRs enable active preservation which is critical for ensuring that all the desired characteristics of digital research objects are maintained over time. They can also provide a baseline FAIRness of the digital research objects in their care. However, the landscape of TDRs reveals a wide variety of maturity levels and practices, because TDRs have often been created to serve specific purposes and communities at a given time and place. To foster best practices and support the continued development of a rich array of TDRs that can function well in the EOSC, peer networks and opportunities for alignment are required. This paper articulates a shared community vision to launch a European network of FAIR-enabling Trustworthy Digital Repositories (hereinafter referred to as 'the Network'). Drawing on previous work and experiences from the digital repository community, this paper explores the drivers behind the shared vision, delineates the challenges faced by TDRs in the current environment, and articulates how such a Network could address those challenges.

Some of the groundwork for this initiative has already been laid, and has been outlined in [Annex I](#). Recently, the EU-funded FAIRsFAIR³, SSHOC⁴, and EOSC-Nordic⁵ projects took the initiative of organising a workshop to explore the idea of a Network⁶. The structure and content of this workshop in January 2022 was derived from the work in each of these projects towards supporting repositories that seek certification as a TDR. The main goal of the workshop was to come together with the various stakeholders in this community, and brainstorm ways to sustain the efforts to empower trustworthy and FAIR-enabling repositories in the EOSC ecosystem.

Having identified the need for a single voice for advocacy and representation within the context of EOSC, this paper emerges from the workshop, representing a bottom-up, community-led initiative by a range of stakeholders in the European TDR landscape to outline a framework for this Network.

³ FAIRsFAIR project, <https://www.fairsfair.eu/>

⁴ SSHOC project, <https://sshopencloud.eu/>

⁵ EOSC Nordic project, <https://www.eosc-nordic.eu/>

⁶ Ilona von Stein, Ingrid Dillo, Christian Cuciniello, Linas Cepinskas, Maaïke Verburg, Hervé L'Hours, Tuomas Alaterä, & Henri Ala-Lahti. (2022, January 14). Towards a network of European FAIR-enabling Trustworthy Digital Repositories. Zenodo. <https://doi.org/10.5281/zenodo.5849658>

Challenges and Network functions

The community has identified a number of horizontal and cross-cutting needs and challenges among both mature and certified repositories, as well as repositories that are not certified yet, but intend to become FAIR-enabling TDRs. This section outlines how these needs and challenges could be addressed by the different functions of the envisioned Network. A graphical representation of the Network is presented in Figure 1.

Networking and Knowledge Exchange

Being a community-led initiative with substantial experience acquired, the Network will ensure a bottom-up approach and will foster knowledge exchange and peer-to-peer support by providing networking spaces and mechanisms to facilitate the engagement of Network members in the work necessary to provide support for TDRs.

With most efforts having taken place in the context of EU-funded projects and relevant initiatives with an end date, continuous validation by the community and further engagement is not secured. Digital repositories across Europe are in need of a common space identifying common needs and challenges, discussing with peers, exchanging knowledge and best practices, as well as networking for reaching common solutions. The feedback from FAIR-supported repositories highly emphasised this need⁷.

The Network will provide enduring mechanisms necessary to establish sustainable knowledge exchange and collaboration on FAIR-enabling technologies, practices, and challenges across TDRs in Europe and beyond.

Stakeholder Advocacy and Engagement

The role of TDRs in the research landscape is growing alongside the ambitions of Open Science. A coordinated approach is required to advocate for repositories in this changing environment, and to ensure that the interests of repositories are taken into consideration in policy-making and funding programmes. In many cases, funding for TDRs is project-based and therefore finite, not allowing for long-term sustainability. This is a challenge to the very definition of repositories: the goal of long term sustained access can only be achieved if the supporting organisational infrastructure is also sustainable. Advocating for sustainable business models is key to providing a basis for TDRs to implement activities and solutions in order to become more FAIR-enabling⁸.

The core of the Network is formed by its repository members. To ensure effective advocacy and engagement, the Network will pursue tailored strategies and approaches, e.g.:

- **adapting engagement strategies** to important stakeholder groups for the TDRs, such as policymakers, funders and end-users (e.g., in their

⁷ <https://www.fairsfair.eu/articles-publications/repository-reflections-fairsfair-repository-support-programme-part-2-advice>

⁸ OECD (2017), "Business models for sustainable research data repositories", OECD Science, Technology and Industry Policy Papers, No. 47, OECD Publishing, Paris, <https://doi.org/10.1787/302b12bb-en>.

conferences and other relevant activities, through champions/ambassadors, together with advocacy activities);

- facilitating **cross-stakeholder activities**;
- using **advocacy/engagement mechanisms** at different levels (management, funding, policy, support);
- identifying **relevant national initiatives** and getting in touch with them to help them discuss their activities and exchange good practices;
- addressing relevant themes like **FAIR, TRUST, and CARE** practices

In all of the abovementioned activities, disciplinary and geographical aspects will be taken into account.

The lack of a common representative body to address the challenges described above, and to advocate for their inclusion in key policy and funding agendas, is a need which has been identified by the community in the workshop that preceded this paper. Furthermore, alignment with and input to the EOSC ecosystem and developments, as well as linking to the global community and digital repositories outside of Europe are challenges that cannot be addressed without consistent and coordinated advocacy efforts.

The value of the Network is multi-layered and valuable for several interlinked stakeholders within the wider European community. In this sense, the Network aspires to be extroverted and engage with a wide range of stakeholders, such as researchers, funders, the EOSC, the larger community of research data management experts, etc. The Network will support existing and aspiring TDRs with enduring mechanisms for advocating their needs and interests in their common endeavour to ensure a sustainable ecosystem of FAIR-enabling and trustworthy services and tools in the EOSC and beyond. It will also further improve the perspectives of European repositories in a global context by building a connection with relevant international bodies such as COAR, RDA and WDS. In this way it will increase the visibility of the European repositories in a global context and disseminate their specific needs, so that they are properly taken into account in the relevant international discussions.

Coordination and Development

The Network will assist members in their efforts to implement trustworthy and FAIR-enabling practices by developing and providing common frameworks for best practices for research data repository policies and routines. It will do so by focusing on resources that can be useful for all types of TDRs, while at the same time acknowledging disciplinary differences. Examples of means to be used include guidelines for preferred file formats for long term preservation, preservation policies and plans, README file templates (e.g. Domain Data Protocols), licensing, metadata standards including controlled vocabularies, as well as legal and ethical compliance. The Network will further aim to assist existing and aspiring TDRs in adapting technical guidelines, building on community-based best practices from RDA. This will be achieved through providing the space for discussion and agreeing on sustainable and

efficient ways of implementation, taking into account the heterogeneity of the TDR landscape.

The degree of standardisation and maturity of interoperability varies significantly across scholarly domains, research methods, and types of data. Even for areas with established standards and best-practice recommendations, TDRs need support in translating these guidelines into workflows and practices for depositors and curators. Lack of resources is often a factor that prevents digital repositories from being sufficiently connected to their peers, participating in common actions, updating their practices and technology to meet certification requirements, and reaching a common understanding and interoperability according to ever-growing and changing needs of the research community.

Standardisation and interoperability are significant points of collaboration and support for existing and new repositories in the context of the EOSC ecosystem and beyond, provided by historic and existing projects and initiatives like FAIRsFAIR and SSHOC, as well as national initiatives in the form of curation networks, etc. The Network will complement these efforts by providing sustainable support on a more permanent and practical level, by operationalising guidelines and helping TDRs implement these.

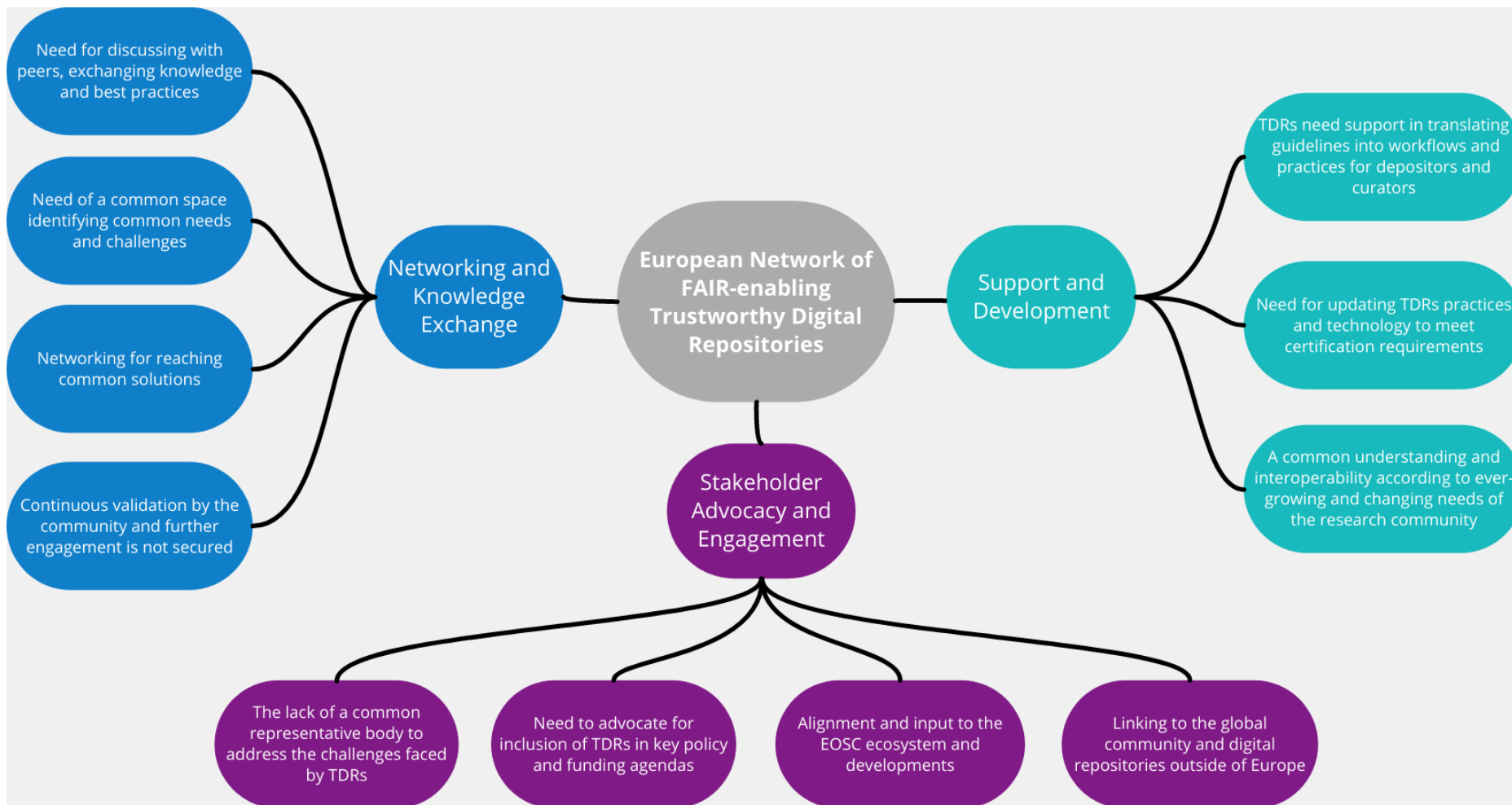


Figure 1. Graphical representation of the European Network of FAIR-enabling Trustworthy Digital Repositories. The functions of the Network are represented by the three bubbles directly linked to the Network. The community challenges that the Network addresses are presented with connections to the related functions.

Next steps: a framework for the Network

A European Network of FAIR-enabling TDRs could serve as a central point of contact and coordination for supporting activities of existing and aspiring TDRs within Europe, and later, for connecting this network beyond Europe. For the design of the organisational structure and business model, inspiration will be drawn from principles like the Principles of Open Scholarly Infrastructure.⁹ On a broader level, the overarching core values of the Network should be defined to steer the decisions made and steps taken. For these core values, factors such as diversity, equity, and inclusion will be considered.

Membership

The main purpose of the Network is to both coordinate existing FAIR-enabling TDRs, and to increase the number of such repositories in the European research landscape. For this reason, the Network will be inclusive: it will be open to TDRs as well as to digital repositories that have not been certified as trustworthy, but aspire to be. 'FAIR-enabling' is a carefully chosen term, because it suggests that FAIR is a process, and not a yes/no designation, and further, that repositories can take steps to promote and support FAIR digital objects. Membership will be open to a range of repository types, from domain or discipline-specific, to institutional, to regional/national, to generic.

Next steps:

- Outline the **benefits** of membership
- Clarify any **conditions** of membership or expectations/responsibilities of membership
- Determine a **membership structure**
- Determine the **procedure** for applying for/being accepted as members
- Determine any required **fee structure**, and how this relates to income streams, projected expenditure, and governance

Business model

Many existing repositories struggle with their financial sustainability⁸, so the Network's business model should be designed to fit the community, should be sustainable, and flexible for future changes in needs, desires, and scope.

⁹ Bilder G, Lin J, Neylon C (2020), The Principles of Open Scholarly Infrastructure, retrieved 18 Aug 2022, <https://doi.org/10.24343/C34W2H>

Next steps:

- Identify any potential **funding opportunities** to get the Network off the ground
- Explore different business models to **identify potential income streams** that fit the community
- **Define a business model** that has the potential to scale and can be viable over the long term.

Governance model

The Network requires a governance model that gives voice to the diversity of the membership. A robust governance structure will help the Network to grow in size and influence, and to adapt to the complex and continuously evolving data landscape.

Next steps:

- Explore a range of governance models to **identify key characteristics** of healthy and effective governance in similar networks
- Consider where and how **expertise** will be used in the governance structure
- Define the **key role profiles** for members of governing bodies

Annex I - Background on current state of affairs

The desired European network depicted in this paper by no means needs to be built from the ground up. The current landscape already contains many effective efforts and collaborations on which this Network can be built. This section provides an insight into the history of collaboration between the main stakeholders, state of the art, and the need for sustainability and continuity of these efforts.

Open Science, FAIR, and TRUST principles in Horizon Europe and the EOSC

Improving the practice of research and innovation through Open Science, attention to Research Data Management, and the FAIR, TRUST¹⁰ and CARE¹¹ principles, as well as developing proper enablers is a priority in the Horizon Europe programme¹². The operationalisation of Open Science is supported through several means and requirements in the context of Horizon Europe (e.g. WIDERA¹³ and INFRA¹⁴ calls). Special attention is paid with regard to RDM as, further to a mandate for a Data Management Plan (DMP), beneficiaries must ensure that their data are deposited in a trusted repository, ensure open access under CC BY, CC 0, or equivalent, and provide information via the repository about any research output/tools/instruments needed to re-use or validate the data. Equally in this case open metadata under CC 0 or equivalent and in line with the FAIR principles is a mandatory aspect.

The Strategic Research & Innovation Agenda (SRIA) of the EOSC defines long term preservation and long term availability of research data and tools as main challenges to be addressed towards the goal of enhancing reuse of data. FAIR-enabling infrastructure is crucial for tackling the barrier of scientific results being unfindable, inaccessible, not interoperable, and often used only once. This creates a need for FAIR-enabling standards, tools, services, and practices, such as those that data repositories support and offer. Moreover, the FAIR guiding principles towards making science transparent and reproducible support the importance of long term preservation and availability of research data, tools, services, and practices to enable a sustainable EOSC.

Under the EOSC framework, a sub-group of the EOSC Task Force on Long Term Digital Preservation¹⁵ focuses on making recommendations on the creation of a European network of Trustworthy Digital Repositories following FAIR-enabling principles with disciplinary and geographical spread, as well as for EOSC data services to connect to this network, together with a roadmap to further mature the long term preservation aspects of these repository services. According to the current planning of the subgroup, these recommendations will be available in October 2022.

¹⁰ Lin, D., Crabtree, J., Dillo, I. et al. The TRUST Principles for digital repositories. *Sci Data* 7, 144 (2020). <https://doi.org/10.1038/s41597-020-0486-7>

¹¹ Carroll, S. R., Garba, I., Figueroa-Rodríguez, O. L., Holbrook, J., Lovett, R., Materechera, S., ... Hudson, M. (2020). The CARE Principles for Indigenous Data Governance. *Data Science Journal*, 19(1), 43. DOI: <http://doi.org/10.5334/dsj-2020-043>

¹² European Commission, Directorate-General for Research and Innovation, Horizon Europe, open science : early knowledge and data sharing, and open collaboration, 2021, <https://data.europa.eu/doi/10.2777/18252>

¹³ Horizon Europe Work programme 2021-2022, Widening participation and strengthening the European Research Area, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-11-widening-participation-and-strengthening-the-european-research-area_horizon-2021-2022_en.pdf

¹⁴ Horizon Europe Work programme 2021-2022, Research Infrastructures, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-3-research-infrastructure_s_horizon-2021-2022_en.pdf

¹⁵ EOSC Task Force on Long Term Digital Preservation, <https://www.eosc.eu/advisory-groups/long-term-data-preservation>

Existing certified repositories

The European pool of repositories that have obtained certification form a clear core unit of the proposed Network. Some different certification standards currently exist, based on the Open Archival Information System (OAIS) Reference Model for digital preservation. Categorising according to the three levels of TDR certification proposed by the European Framework for Audit and Certification¹⁶ (Core, Extended, and Formal), CoreTrustSeal¹⁷ provides certification at the Core level, nestor seal¹⁸ (based on DIN31664¹⁹) provides Extended certification, and ISO16363²⁰ provides Formal certification. At the time of writing this paper, over 150 repositories have been (re)certified worldwide using one of these certification standards, around 100 of them in Europe. This is a sizable community of TDRs spread around Europe on which the Network can be based.

As of yet, there is no formal certification standard with explicit focus on FAIR. There is an expectation that this line of focus will develop over the upcoming years to put more emphasis on repositories being FAIR-enabling. The EOSC FAIR Metrics and Data Quality Task Force²¹ will implement FAIR metrics for EOSC by assessing their applicability across research communities and testing a range of tools to enable uptake. For now, it is important for this Network that there is a shared vision of importance regarding the enabling of FAIR (meta)data. Nevertheless, the Network will also work on relevant guidance towards repositories with regard to TRUST and CARE, building on existing initiatives and guidance.

The Network and related networks and associations

The Network will of course enter a landscape that is active with related initiatives, projects, networks and associations. The Network does not intend to compete with these but instead focus on collaboration and alignment. The Network is unique in the sense that it is focusing on support and advocacy in Europe, as well as the technical linkages with data services in the EOSC core. Membership is focused on certified and aspiring FAIR-enabling TDRs in Europe. These features make the Network a complement to bodies such as COAR, CoreTrustSeal, and WDS.

The Confederation of Open Access Repositories (COAR) is an association with an international focus and with members and partners from around the world representing libraries, universities, research institutions, government funders and others.

CoreTrustSeal (CTS) is an international, community-based, non-governmental, and non-profit organisation promoting sustainable and trustworthy data infrastructures by offering to any interested data repository a core level certification, based on the CoreTrustSeal Trustworthy Data Repositories Requirements catalogue and procedures. Currently there are about a hundred CTS certified repositories in Europe.

The World Data System (WDS) is a body of the International Council of Science (ISC) and aims to facilitate scientific research by coordinating and supporting trusted scientific data

¹⁶ European Framework for Audit and Certification of Digital repositories <http://www.trusteddigitalrepository.eu/Welcome.html>

¹⁷ CoreTrustSeal, <https://www.coretrustseal.org/>

¹⁸ Nestor, https://www.langzeitarchivierung.de/Webs/nestor/EN/Home/home_node.html

¹⁹ DIN31664 standard, <https://nbn-resolving.org/urn/resolver.pl?urn=urn:nbn:de:0008-2013100803>

²⁰ ISO16363 certification of Trustworthy Digital Repositories, <http://www.iso16363.org/>

²¹ EOSC FAIR Metrics and Data Quality Task Force: <https://www.eosc.eu/advisory-groups/fair-metrics-and-data-quality>

services for the provision, use, and preservation of relevant datasets, while strengthening their links with the research community. WDS is developing worldwide ‘communities of excellence’ by certifying scientific data services – WDS Members – using internationally recognised standards through the CoreTrustSeal. More than 20 CTS certified European repositories have joined the WDS and have thus committed to the WDS Data Sharing Principles which embody the spirit of Open Science.

With all of these bodies the Network should be in continued close contact. Furthermore, the Network should collaborate and draw upon other relevant networks and associations like the Research Software Alliance (ReSA), CODATA, GOFAIR, and the Research Data Alliance (RDA). The latter, for example, has a number of activities targeted at TDRs, such as an Interest Group on Certification of Digital Repositories²², and Working Group on Data Repository Attributes²³.

Existing networks on smaller scale

Next to the already existing pool of certified repositories, there are multiple other initiatives to build the Network on. In a disciplinary context we have the repository networks and support programmes within e.g. CLARIN and CESSDA, as well as the SSHOC project. In the regional context the EOSC-Nordic project as well as the Dutch and French²⁴ national certification support programmes serve as examples. Furthermore, projects like DICE and ARCHIVER are expected to provide technical long term preservation solutions that can be implemented by TDRs.

Collaboration in EU funded projects

FAIRsFAIR

In its lifetime (March 2019 - February 2022), FAIRsFAIR has worked towards supplying practical solutions for the use of the FAIR data principles throughout the research data life cycle, thus actively contributing to the development of global standards for FAIR certification of data repositories. It did so through several activities²⁵, including a repository support webinar series, as well as by establishing a Support programme for Data Repositories based on a two-pronged approach to developing standards for the FAIR certification of repositories: *Support for data repositories towards achieving CoreTrustSeal certification and Support for the “FAIRification” of repositories and improvement of data FAIRness and interoperability*. Through these programmes, 10 repositories were selected to receive support on working towards CoreTrustSeal certification, and 12 on interoperability improvement. The repository webinar series targeted a broader community of repository managers to become familiar with FAIR-enabling practices over the course of nine hour-long webinars.

²² <https://www.rd-alliance.org/groups/rdawds-certification-digital-repositories-ig.html>

²³ <https://www.rd-alliance.org/groups/data-repository-attributes-wg>

²⁴ Certification of digital repositories has been a priority of RDA France since its inception in March 2018. A Working Group on Certification of Data Repositories (<https://www.ouvrirlascience.fr/certification-des-entrepots-et-services-de-donnees/>, in French) common to the Data College of the national Committee for Open Science and RDA France has been active since August 2020 to disseminate information about certification and support French repositories on their way to certification or improving their practices based on the certification criteria.

²⁵ FAIRsFAIR support programmes for Data Repositories, <https://www.fairsfair.eu/application-results-open-call-data-repositories>

In the FAIRsFAIR Repository Support Programme for certification²⁶ (February 2020 - January 2022), the 10 selected repositories received dedicated support for pre-submission to the CoreTrustSeal certification process in the form of several workshops, support calls, and evaluations of self-assessments. The programme also offered a financial incentive (€10.000,-) for implementing improvements towards achieving certification. The experiences and lessons learned from the FAIRsFAIR support team²¹ as well as the supported repositories²⁰ have been publicly documented and include recommendations for other initiatives looking to develop a similar programme, as well as repositories looking to partake in one or apply for certification. The CoreTrustSeal Board has expressed their support and engagement towards the work of FAIRsFAIR and other FAIR initiatives, including the repository certification support programme²¹.

FAIRsFAIR has also worked²⁷ to align the CoreTrustSeal Requirements with the FAIR Data Principles in the *CoreTrustSeal+FAIRenabling Capability Maturity model*²⁸. This Capability-Maturity model allows repositories to self-assess their practice and associated evidence with a view to their development and improvement. This work is an active contribution to increasing the presence of FAIR-enabling TDRs. There is a vision to propose a +FAIR certification to CoreTrustSeal for its scheduled review in 2025.

Finally, FAIRsFAIR directly committed to starting the discussion on a European network of FAIR-enabling TDRs. Initial introductions and suggestions were made in the *Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories (TDRs)*,²⁹ from which the January 2022 workshop was planned to discuss further sustainability of efforts towards making data repositories more trustworthy and FAIR-enabling. This was conceived in an attempt to provide a mechanism for the community to uncover the means and mechanisms towards empowering FAIR-enabling TDRs.

SSHOC

The SSHOC project (Jan 2019 - Apr 2022) ran a CoreTrustSeal certification support program for Social Sciences & Humanities (SSH) repositories. Three certification trails were established:

- renewal of existing CoreTrustSeal certification,
- new, initial CoreTrustSeal certification, and
- self-assessment using the CoreTrustSeal requirements.

Support modes included awareness raising and communication, events, and, most importantly, one-on-one support provided to selected repositories. Following an open call, 14 repositories were selected for the support program that started in 2020. Eight repositories

²⁶ Maaïke Verburg, Ilona von Stein, Linas Cepinskas, Hervé L'Hours, Patricia Herterich, Joy Davidson, Kevin Ashley, Olivier Rouchon, Andrea Greco, Serenella Muradore Gallas, & Sara Pittonet Gaiarin. (2021). D4.3 Report on the certification support and guidance for repositories and reviewers (V1.0_DRAFT). Zenodo. <https://doi.org/10.5281/zenodo.5137552>

²⁷ Hervé L'Hours, Maaïke Verburg, Jerry de Vries, Linas Cepinskas, Ilona von Stein, Robert Huber, Joy Davidson, Patricia Herterich, & Benjamin Mathers. (2022). Report on a maturity model towards FAIR data in FAIR repositories (D4.6) (2.0). Zenodo. <https://doi.org/10.5281/zenodo.6421728>

²⁸ CoreTrustSeal+FAIRenabling Capability Maturity model, [https://fairsfair.eu/coretrustseal-fairenabling-capability-maturity-model#:~:text=The%20CoreTrustSeal%2BFAIRenabling%20Capability%20Maturity%20Model%20consists%20of%20a%20tabular.of%20\(meta\)data%20services](https://fairsfair.eu/coretrustseal-fairenabling-capability-maturity-model#:~:text=The%20CoreTrustSeal%2BFAIRenabling%20Capability%20Maturity%20Model%20consists%20of%20a%20tabular.of%20(meta)data%20services).

²⁹ Ilona von Stein, Hervé L'Hours, Linas Cepinskas, Benjamin Mathers, Ingrid Dillo, Maaïke Verburg, Mustapha Mokrane, Patricia Herterich, & Olivier Rouchon. (2021). D4.4 Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories (1.0_DRAFT). Zenodo. <https://doi.org/10.5281/zenodo.5726691>

had the goal of submitting a CoreTrustSeal application. By the end of the project, six of them had submitted or were close to submitting their application.³⁰

EOSC-Nordic

The EOSC-Nordic project (September 2019 - August 2022) was charged to implement FAIR in the Nordic and Baltic region and to provide “support for adoption of FAIR data standards” and “support for adoption of FAIR certification schema”. This has been achieved by disseminating the benefits of FAIR and providing evaluation-based recommendations on how to FAIRify data repositories, and assist selected repositories in self-assessments for the CoreTrustSeal certification.

FAIR-IMPACT

FAIR-IMPACT is a newly funded EU project (June 2022 - May 2025) with the goal to support the implementation of FAIR-enabling practices across scientific communities and research outputs at European, national and institutional level. FAIR-IMPACT’s scope targets a wide range of stakeholders, including repositories, and is extended across domains, geographic areas, and stakeholder groups at multiple levels. Operating in this wide landscape, FAIR-IMPACT aims to identify the optimal components for enabling FAIR (practices, policies, tools, and technical specifications), and define the support, governance, and coordination mechanisms needed to ensure their adoption and continued utility in a FAIR EOSC.

FAIR-IMPACT will build on and extend current FAIR metrics, assessment tools and Trustworthy Digital Repository (TDR) requirements to meet the needs of more thematic domains and a wider range of digital research objects. In this context, a dedicated task will support the development of guidelines and mechanisms improving connections between repository registries and discovery portals, repository trustworthiness mechanisms and FAIR digital object assessments. The aim is to enable seamless discovery of repositories (including their trustworthiness) and datasets and code (including their FAIRness).

³⁰ Mari Kleemola. (2022). D8.3 Trustworthy Digital Repository status update and certification solutions for SSHOC repositories. Zenodo. <https://doi.org/10.5281/zenodo.6530203>

Annex II - Technical basis

The Network will explore the grounds, methods and mechanisms for fostering technical alignment and interoperability of the technical basis of TDRs. Possible technical aspects to be addressed include integration with persistent identifier (PID) services (e.g., DOI, Handle, ORCID, RAiD, ROR) and authentication services (e.g., OAuth, OpenID Connect, Shibboleth), protocols for metadata harvesting and indexing (e.g., OAI-PMH), semantic technologies to improve interoperability, approaches for data portability across repositories (e.g., BagIt), and specialised data server technology and APIs (e.g., GeoServer, THREDDS, OPeNDAP).

The realisation of the machine-actionable aspects of the recommendations formulated in the FAIR principles relies primarily on the technical support provided by the software and tools used by TDRs. At the same time, the TDRs are a heterogeneous community, also with regard to their technical infrastructure, ranging from locally developed legacy systems to community-driven cutting-edge repository applications. Although a number of standards and recommendations dealing with technical aspects of FAIR-enabling services and tools have been established, many repositories lack support for implementing these technical guidelines.

Next to this, the Network could also explore and possibly adopt and expand existing technical propositions. For example: the vision that already exists for quite some years to technically integrate a network of TDRs with data services and repositories within the EOSC. A lot of work in this area has already been done in subsequent EU-funded projects.³¹ A distributed architecture consisting of data services and repositories and TDRs that interact in a point-to-point manner, without intermediation. Communication and data flow between these services and TDRs, in response to on-demand archiving requests for a specific scholarly artefact, leverage open standards or specifications. As such, the architecture potentially allows multiple data services and repositories to uniformly request long term preservation services from multiple TDRs, as well as those TDRs to obtain repository content in a consistent manner. Such a service would allow researchers to transfer research data from a short and medium-term repository into a TDR, at the mere click of a button.

³¹ EUDAT2020 project, <https://www.eudat.eu/projects/eudat2020>, EOSC-hub, <https://www.eosc-hub.eu/>, DICE Project, <https://www.dice-eosc.eu/>

References

Bilder G, Lin J, Neylon C (2020), The Principles of Open Scholarly Infrastructure, retrieved 18 Aug 2022, <https://doi.org/10.24343/C34W2H>

Carroll, S. R., Garba, I., Figueroa-Rodríguez, O. L., Holbrook, J., Lovett, R., Materechera, S., ... Hudson, M. (2020). The CARE Principles for Indigenous Data Governance. *Data Science Journal*, 19(1), 43. <http://doi.org/10.5334/dsj-2020-043>

Certification of digital repositories has been a priority of RDA France since its inception in March 2018. A Working Group on Certification of Data Repositories (<https://www.ouvrirlascience.fr/certification-des-entrepots-et-services-de-donnees/>, in French)

CoreTrustSeal, <https://www.coretrustseal.org/>

CoreTrustSeal+FAIRenabling Capability Maturity model, [https://fairsfair.eu/coretrustseal-fairenabling-capability-maturity-model#:~:text=The%20CoreTrustSeal%2BFAIRenabling%20Capability%20Maturity%20Model%20consists%20of%20a%20tabular.of%20\(meta\)data%20services](https://fairsfair.eu/coretrustseal-fairenabling-capability-maturity-model#:~:text=The%20CoreTrustSeal%2BFAIRenabling%20Capability%20Maturity%20Model%20consists%20of%20a%20tabular.of%20(meta)data%20services)

Data Infrastructure capacity for EOSC, DICE Project, <https://www.dice-eosc.eu/>

Data repository Attributes WG, <https://www.rd-alliance.org/groups/data-repository-attributes-wg>

DIN31664 standard, <https://nbn-resolving.org/urn/resolver.pl?urn=urn:nbn:de:0008-2013100803>

EOSC FAIR Metrics and Data Quality Task Force: <https://www.eosc.eu/advisory-groups/fair-metrics-and-data-quality>

EOSC Nordic project, <https://www.eosc-nordic.eu/>

EOSC Task Force on Long Term Digital Preservation, <https://www.eosc.eu/advisory-groups/long-term-data-preservation>

European Commission, Directorate-General for Research and Innovation, Horizon Europe, open science : early knowledge and data sharing, and open collaboration, 2021, <https://data.europa.eu/doi/10.2777/18252>

European Framework for Audit and Certification of Digital repositories <http://www.trusteddigitalrepository.eu/Welcome.html>

FAIRsFAIR support programmes for Data Repositories, <https://www.fairsfair.eu/application-results-open-call-data-repositories>

Fostering FAIR Data Practices in Europe, FAIRsFAIR project, <https://www.fairsfair.eu/>

Grootveld, Marjan, Davidson, Joy, Whyte, Angus, & Van Horik, René. (2020). D3.5 Description of FAIRsFAIR's Transition Support Programme for Repositories (1.0 DRAFT). Zenodo. <https://doi.org/10.5281/zenodo.4058340>

Hervé L'Hours, Maaïke Verburg, Jerry de Vries, Linas Cepinskas, Ilona von Stein, Robert Huber, Joy Davidson, Patricia Herterich, & Benjamin Mathers. (2022). Report on a maturity model towards FAIR data in FAIR repositories (D4.6) (2.0). Zenodo. <https://doi.org/10.5281/zenodo.6421728>

Horizon Europe Work programme 2021-2022, Research Infrastructures, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-3-research-infrastructures_horizon-2021-2022_en.pdf

Horizon Europe Work programme 2021-2022, Widening participation and strengthening the European Research Area, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2021-2022/wp-11-widening-participation-and-strengthening-the-european-research-area_horizon-2021-2022_en.pdf

Ilona von Stein, Hervé L'Hours, Linas Cepinskas, Benjamin Mathers, Ingrid Dillo, Maaïke Verburg, Mustapha Mokrane, Patricia Herterich, & Olivier Rouchon. (2021). D4.4 Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories (1.0_DRAFT). Zenodo. <https://doi.org/10.5281/zenodo.5726691>

Ilona von Stein, Hervé L'Hours, Linas Cepinskas, Benjamin Mathers, Ingrid Dillo, Maaïke Verburg, Mustapha Mokrane, Patricia Herterich, & Olivier Rouchon. (2021). D4.4 Coordination Plan for a sustainable network of FAIR-enabling Trustworthy Digital Repositories (1.0_DRAFT). Zenodo. <https://doi.org/10.5281/zenodo.5726691>

Ilona von Stein, Ingrid Dillo, Christian Cuciniello, Linas Cepinskas, Maaïke Verburg, Hervé L'Hours, Tuomas Alaterä, & Henri Ala-Lahti. (2022, January 14). Towards a network of European FAIR-enabling Trustworthy Digital Repositories. Zenodo. <https://doi.org/10.5281/zenodo.5849658>

ISO16363 certification of Trustworthy Digital Repositories, <http://www.iso16363.org/>

Lin, D., Crabtree, J., Dillo, I. et al. The TRUST Principles for digital repositories. Sci Data 7, 144 (2020). <https://doi.org/10.1038/s41597-020-0486-7>

Maaïke Verburg, Ilona von Stein, Linas Cepinskas, Hervé L'Hours, Patricia Herterich, Joy Davidson, Kevin Ashley, Olivier Rouchon, Andrea Greco, Serenella Muradore Gallas, & Sara Pittonet Gaiarin. (2021). D4.3 Report on the certification support and guidance for repositories and reviewers (V1.0_DRAFT). Zenodo. <https://doi.org/10.5281/zenodo.5137552>

Mari Kleemola. (2022). D8.3 Trustworthy Digital Repository status update and certification solutions for SSHOC repositories. Zenodo. <https://doi.org/10.5281/zenodo.6530203>

Nestor, https://www.langzeitarchivierung.de/Webs/nestor/EN/Home/home_node.html

OECD (2017), "Business models for sustainable research data repositories", OECD Science, Technology and Industry Policy Papers, No. 47, OECD Publishing, Paris, <https://doi.org/10.1787/302b12bb-en>.

RDA/WDS Certification of Digital repositories IG, <https://www.rd-alliance.org/groups/rdawds-certification-digital-repositories-ig.html>

Recommendations on certifying services required to enable FAIR within EOSC European Commission, Directorate-General for Research and Innovation, Jones, S., Aronsen, J., Beyan, O., et al., *Recommendations on certifying services required to enable FAIR within EOSC*, Genova, F. (editor), Publications Office, 2021, <https://data.europa.eu/doi/10.2777/127253>

Repository reflections on the FAIRsFAIR Repository Support Programme Part 2: Advice for future support initiatives, <https://www.fairsfair.eu/articles-publications/repository-reflections-fairsfair-repository-support-programme-part-2-advice>.

Social Sciences and Humanities Open Cloud, SSHOC project, <https://sshopencloud.eu/>

Strategic Research & Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC), https://www.eosc.eu/sites/default/files/EOSC-SRIA-V1.0_15Feb2021.pdf

Wilkinson, M., Dumontier, M., Aalbersberg, I. et al. The FAIR Guiding Principles for scientific data management and stewardship. *Sci Data* 3, 160018 (2016). <https://doi.org/10.1038/sdata.2016.18>