

FIDELIS TTRAMatrix (v01.00) Design Statement (v01.00)

Transparent Trustworthy Repository Attributes Matrix

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Scope

This document describes the parameters and drivers behind the design of the FIDELIS Transparent, Trustworthy Repository Attributes Matrix (TTRAM). The [Matrix Template](#) and a brief [Guide](#) are supported by a more detailed [Introduction and Overview](#) paper.

The TTRAM development has proceeded iteratively, informed by community feedback. The process is described in the milestone report [FIDELIS MS12 First Version of TTRAM](#)¹.

¹ FIDELIS MS12 First version of TTRAM (2025). Zenodo. <https://doi.org/10.5281/zenodo.17157958>

Introduction

Different types of trustworthy digital repositories preserving digital objects are key FIDELIS stakeholders. The Transparent Trustworthy Repository Attributes Matrix (TTRAM) provides a structure and reference for the FIDELIS and EDEN projects and for the emerging FIDELIS network. It has been designed to better understand repositories², and how transparency around the broad range of activities and functions they undertake can contribute to trustworthiness.

The first dimension of the Matrix is a 'superset' of high level activities and functions (A|F) drawn from a wide range of relevant standards, requirements and guidelines (See Appendix: Source Criteria). Rather than creating another set of criteria, this approach is inclusive of these existing expert perspectives.

This version of the Matrix focuses on two key variables that influence repository activities and functions: repository types and the different levels of retention, curation and preservation they offer. Repository type information is examined in terms of the characteristics of digital objects, depositors and users that each includes or excludes from their remit.

Together these activities and functions (undertaken by repositories) and variables (repository type, and level of care provided) imply a need for transparency, including information artefacts (policies, procedures) and characteristics of repositories (and the objects they hold) expressed through metadata.

The Matrix supports communication and alignment without restricting the scope or validity of expert groups working elsewhere. Use of the Matrix by partners, early adopters and others maintains a connection between internal project activities and the wide range of rapidly evolving work across the repository and research infrastructure landscape.

² Repositories hold catalogues of digital objects, by extension the Matrix, and the future Network is inclusive of a range of research data infrastructure service providers including registries with catalogues of metadata.

The decision to take a flexible and interactive approach to the Matrix is driven by a number of parameters, including the dependencies and interdependencies covered in Appendix A. Within the project, the Matrix enables a clearer perspective on repository types to support network design, and further alignment with existing criteria. The authors and adopters of the source criteria are also stakeholders in the future FIDELIS Network³. Work on describing retention, preservation, quality and reappraisal will be integrated from the EDEN project and EOSC Task Forces.

The Matrix supports information collection, alignment, classification, communication and assistance rather than replacing current work. Future iterations of the Matrix will be augmented and refined with additional variables including how repositories can enable the TRUST, CARE and FAIR Principles.

The project members, stakeholders and future Network members can expand and elaborate the Matrix for a broad range of needs. In the future this will allow us to analyse how the information and types influence repository goals including 'trustworthiness', but also the degree to which the repository enables a range of principles⁴ or meets a range of criteria⁵. While transparency is a dependency for trust, no binary assignment of trustworthiness status is possible in isolation from an understanding of the parties involved and their needs.

³ FIDELIS Network: <https://eden-fidelis.eu/fidelis-network-tdrs>

⁴ e.g. FAIR, CARE and TRUST

⁵ Including, but not limited to those used to develop the superset of activities and functions. See L'Hours, H., & Bell, D. (2023). Metadata and Data Services Activities-Functions Crosswalk (v01.00). Zenodo. <https://doi.org/10.5281/zenodo.7690658>

Matrix Structure & Content

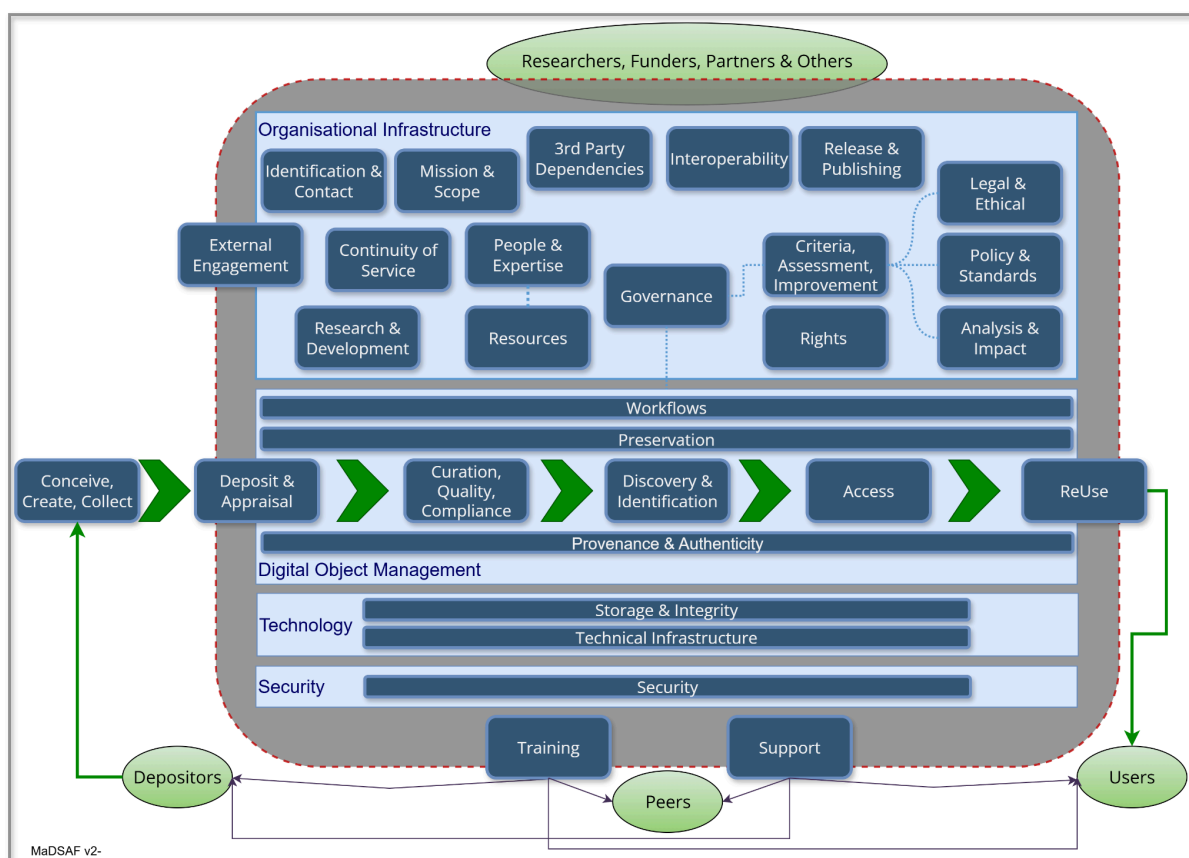
In the Matrix spreadsheet template Activities and Functions (A|F) are listed and a brief description provided. Suggested examples are then provided on what information could or should be made transparent and how this is influenced by the levels of retention, curation and preservation (LoRCAP) and the depositors, users and objects included or excluded by each repository type.

The Matrix is composed of:

- 30 rows representing common repository activities/functions
- A column for related transparent information
- Two columns of repository variables:
 - Levels of Retention, Curation and Preservation (LoRCAP)
 - Depositors, Users and Objects covered by different repository types.

		Metadata, Policies, Procedures, Standards, References, Legislation etc	Variables	
Activity/ Function (A F)	Description	Transparent Information	Levels of Retention, Curation & Preservation (LoRCAP)	Depositors, Users and Objects (Included & Excluded)

Activities & Functions (A|F)



The metadata and data services activities and functions (MaDSAF)⁶ are derived from a review⁷ of current requirements, standards and criteria to select a manageable 'superset'.

The applicability and priority of each A|F will vary in different scenarios, but all have potential relevance to repositories seeking to identify best practices and manage compliance. Some overlap is inevitable, for example 'workflow' management is treated as its own activity, though all other activities will be associated with a range of workflows, business processes and procedures.

⁶ Metadata and Data Services Activities-Functions Overview <https://doi.org/10.5281/zenodo.7689089>

⁷ Metadata and Data Services Activities-Functions: Crosswalk <https://doi.org/10.5281/zenodo.7690657>

Group	VO/ID	Heading	Applicability beyond 104	CoreTrustSeal 2023-25 Map	FAIRRenabling	65-2022 Desirable Characteristics of Data Repositories	Niui Characteristics	COAR 2022 Map	FAIRsFAIR service assessment framework	NDSA Levels of Preservation V2 Map	TRUST Principles for Digital Repositories
Digital Object Management	SP01	Conceive, Create, Collect	All							NDSA, Domain Level 2: Protect, verify file formats and other essential content characteristics	
Digital Object Management	SP02	Deposit & Appraisal	All	Deposit & Appraisal (R08)				2. Access: 2.8 In cases where the repository collects sensitive data, it will implement tools to ensure the data is			
Digital Object Management	SP03	Curation, Quality & Compliance	All	Quality Assurance (R10)		Organisational infrastructure: Retention Policy: The repository provides documentation on policies for data retention and digital object management. Metadata: The repository ensures datasets are: A. Unique Persistent Identifier: Assigns datasets a globally unique persistent identifier (DOI or accession number) to support data integrity and provenance. B. Curator and Quality Assurance: Provides, or has a mechanism for others to provide, expert curation and quality assurance to improve the accuracy and integrity of datasets and metadata. C. Long-term Sustainability: Has a plan for long-term management of data, including maintaining integrity, authenticity, and availability of datasets, building on a stable		2. Discoverability: 1.1 The repository enables users to apply basic quality control measures to its records, as well as more granular elements (e.g. to support multilingualism, interoperability, discoverability, and digital preservation). 1.2 The repository enables its records to be used in a wide range of contexts, as well as more granular elements (e.g. to support		NDSA, Levels 1-4: Document file formats and other essential content characteristics, along with providing awareness of the data holdings and when these were deposited.	Responsibility: Adhering to the designated community's metadata and curation standards, along with providing awareness of the data holdings and when these were deposited.
Digital Object Management	SP04	Discovery & Identification	All	Discovery & Identification (R12)		AI: Metadata are assigned a globally unique and persistent identifier (e.g. DOI or accession number) to support data integrity and provenance. AI: Metadata are retrievable by their identifier using a standardised communications protocol. AI: Metadata are associated with detailed provenance.		2. Discoverability: 1.1 The repository enables its records to be used in a wide range of contexts, as well as more granular elements (e.g. to support			Responsibility: Providing data services, e.g. search and machine metadata, data download or service-level processing.
Digital Object Management	SP05	Access	All			Organisational infrastructure: Free and Easy Access: Provides broad, equitable, and reasonably open access to datasets and their metadata free of charge in		2. Access: 1.2 The landing page for each			
Digital Object Management	SP06	Reuse	Reuse-Deposit Services	Reuse (R13)		Digital Object Management: Metadata: The repository ensures datasets are accompanied by metadata to enable discovery, reuse, and citation of datasets.		2. Access: 1.2 The landing page for each			
Digital Object Management	SP07	Workflows	All	Workflows (R11)				2. Access: 1.2 The landing page for each			
Digital Object Management	SP08	Preservation	Preservation Services	Preservation Plan (R09)		Organisational infrastructure: Retention Policy: The repository provides documentation on policies for data retention within the repository. Organisational Infrastructure: Long-term Management of Data: The repository has a plan for long-term management of data, including maintaining integrity, authenticity, and availability of datasets, building on a stable		2. Access: 1.2 The landing page for each			
Digital Object Management	SP09	Provenance and Authenticity	All	Provenance & Authenticity (R07)		AI: Metadata are associated with detailed provenance.		2. Access: 1.2 The landing page for each			
Digital Object Management	SP10	Support	All					2. Access: 1.2 The landing page for each			

Screenshot: Activities & Functions Review

MaDSAF evolved from FAIRsFAIR⁸ project work on FAIR Ecosystem Components⁹, it was reviewed and recommended by the EOSC Long term data preservation (LTDP) Task Force¹⁰ and was actively promoted by FAIR-IMPACT¹¹ project work to develop a coherent approach to repository transparency. Reference sources include existing criteria developed by standards bodies, networks and umbrella organisations. It seeks to support alignment rather than replace current work. As per existing trustworthy digital repository (TDR) standards¹², the items are grouped by organisation, digital object management, technology and security. It supports a lifecycle perspective, and aligns with the OAIS¹³ functional model.

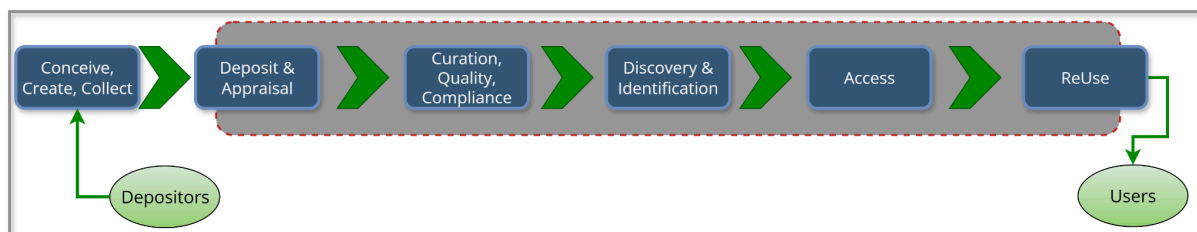


Diagram: Repository Lifecycle Phase Activities/Functions

⁸ FAIRsFAIR project: <https://www.fairsfair.eu/>

⁹ FAIR Ecosystem Components <https://doi.org/10.5281/zenodo.3565427>

¹⁰ EOSC LTDP Task Force: <https://eosc.eu/advisory-groups/long-term-data-preservation/>

¹¹ FAIR-IMPACT project: <https://fair-impact.eu/wp5-metrics-certification-and-guidelines>

¹² CoreTrustSeal, nestor Seal (DIN31644) and ISO16363 (Audit and certification of trustworthy digital repositories)

¹³ ISO 14721 Space Data System Practices — Reference model for an open archival information system (OAIS). <https://www.iso.org/standard/87471.html> & <https://public.ccsds.org/Pubs/650x0m3.pdf>

Each A|F can be expanded to reflect more detailed business processes and workflows (e.g. based on existing criteria or for a specific repository mission/scope) as necessary.

Transparent Information

As organisational practices mature, business information transitions from individuals' knowledge into more formal documentation including text-based information artefacts like policies and standard operating procedures, but also more structured metadata including controlled vocabularies and ontologies. Though there is a cost to formalising, clarifying and maintaining this business information, and in making it public, there are also benefits. These benefits include supporting peer organisations, demonstrating good practice to funders, increased interoperability with partners and clarity to depositors and users of digital objects. This information also provides essential evidence for assessment and certification, as well as helps to facilitate trust.

Variables

During the project we will populate the Matrix with information about variables that influence how different repositories approach the activities and functions. The first set of variables focus on depositor, user and object characteristics related to repository 'type' and the levels of retention, initial curation and active preservation being offered. Together these activities/functions and contextual variables help us identify what information should be made transparent.

The aspects of these variables that may influence what information should be made transparent for each activity/function include whether a repository sets minimal metadata as a condition or deposit, the ability to curate deposited formats into formats for reuse, or the presence of technical and community-watch functions to guide active preservation.

Levels of Retention, Curation & Preservation (LoRCAP)

The EOSC Long Term Data Preservation Task Force needed to address a broad range of assumptions and some inconsistencies around the meaning of 'preservation' and the

purpose of repositories. The task force recommended the CoreTrustSeal's levels of retention, curation and preservation¹⁴ approach:

Z. Level Zero

Content distributed as deposited. Unattended deposit-storage-access. Data content and supporting metadata are stored for a given time period,

D. Deposit Compliance

Data content and supporting metadata deposited are checked for compliance with defined criteria

C. Initial Curation

The digital objects are curated by the repository to meet defined criteria

A. Active preservation

Long-term responsibility for ensuring that the data and metadata can be understood and rendered as required by the designated community for reuse

These include reference points relevant to bit-level, logical and semantic preservation¹⁵. Re-appraisal may change the level applied to a digital object over time.

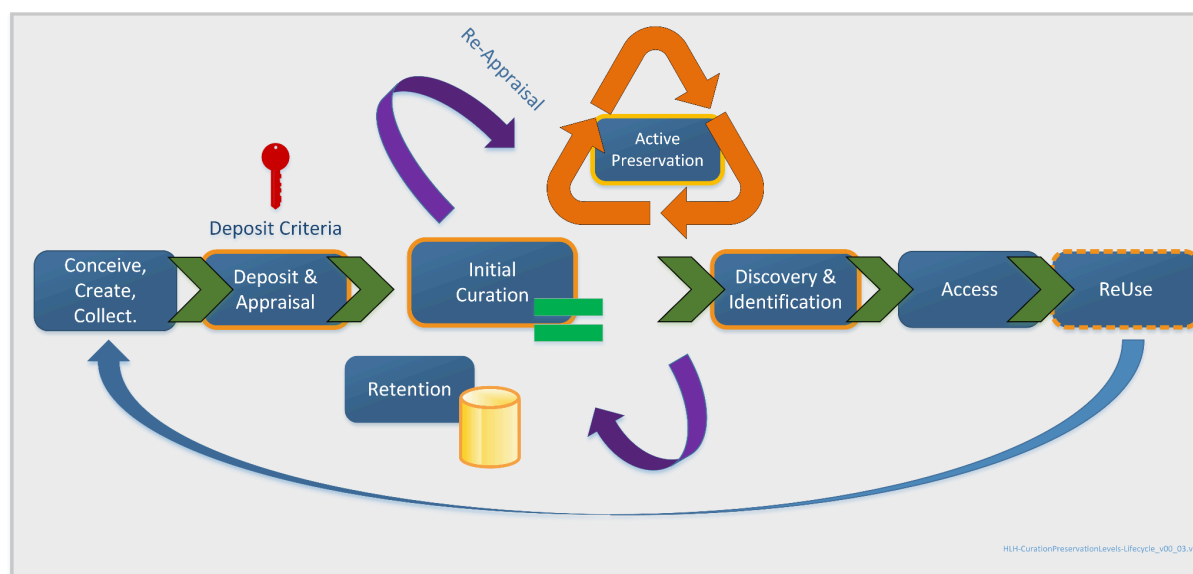


Diagram: Levels of Curation & Preservation embedded in the lifecycle.

¹⁴ CoreTrustSeal Standards and Certification Board. (2024). Curation & Preservation Levels: CoreTrustSeal Position Paper. Zenodo. <https://doi.org/10.5281/zenodo.11476980>

¹⁵ See CSC's digital preservation website: <https://csc.fi/en/our-expertise/digital-preservation/>

Types of Repository: Depositors, Users and Objects

Common typologies used to refer to repositories include 'institutional', 'national', 'generic' and 'disciplinary'. This Matrix variable seeks to identify how these types influence which depositor, user and digital object characteristics are included or excluded based on repository type.

Institutional repositories may limit the depositor community to members of a specific organisation. A repository with a regional or national remit may set geographic-based limits on their digital objects or the depositor or user community.

Generic repositories may accept a broader range of digital object types. Repository specialties (including a focus on disciplines, domain or specific data types) may imply specialist skills or limitation to the digital objects held, or the depositor and user communities served. The aspects of these variables that may influence what information should be made transparent for each activity/function include whether a repository focuses on a particular disciplinary community and/or contains research data, literature/publications, or code.

Appendix A: Dependencies & Interdependencies

FIDELIS Project & Network

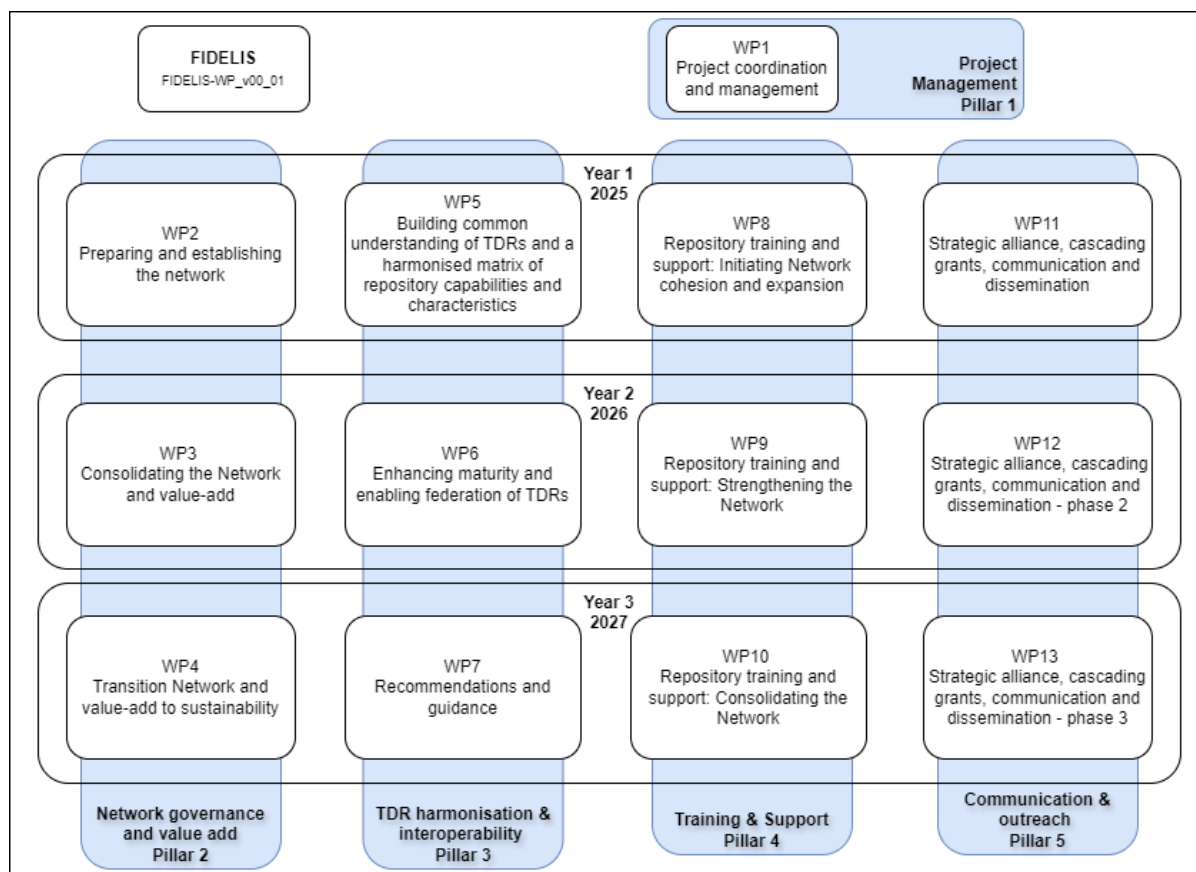


Diagram: *FIDELIS Pillars and Work Packages*

FIDELIS Pillar 3 on trustworthy digital repository harmonisation & interoperability will deliver a *matrix of capabilities and characteristics* (WP5 Year 1) with *tiered definitions, concepts, characteristics and criteria* (T5.1) to be aligned with the wider landscape towards *preparing for federation* (T5.2). The matrix will provide the foundation for *maturity and federation* (WP6 Year 2) and *recommendations and guidance* (WP7 Year 3). The matrix will provide a reference point for the design and content of *training and support* (Pillar 4) and *communications, outreach and cascading grants* (Pillar 5). The matrix will be a dependency for *network governance and value add* (Pillar 2).

EOSC EDEN Project

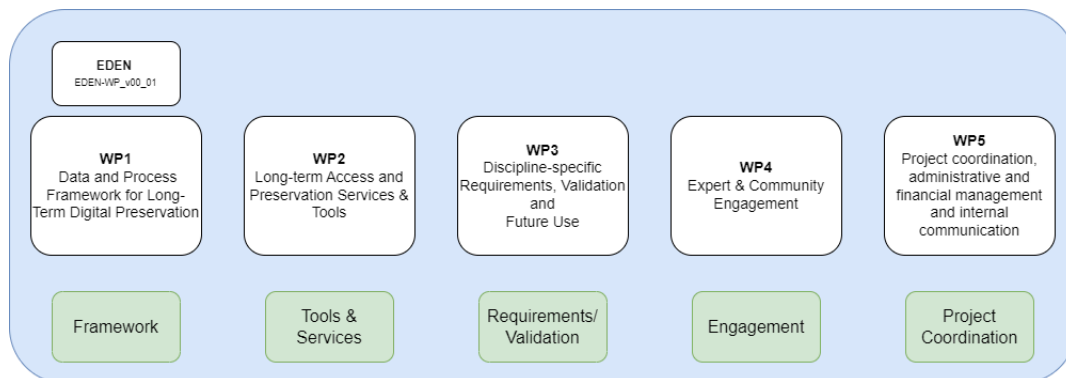


Diagram: *EDEN Work Packages*

Under the sibling project, EOSC EDEN, a *data and process framework* (WP1) specifies core preservation processes¹⁶ with implications for a range of activities and functions that ensure continued accessibility and usability of digital objects including technology watch, community engagement, file format identification, transformations and emulation. This will inform a selection and (re)appraisal lifecycle model that incorporates metrics relating to fitness for re-use. This implies that the FIDELIS Matrix should include a process-driven structure to incorporate the framework elements, and include a lifecycle perspective.

EOSC EDEN *Tools & Services* (WP2) covers use case implementation and testing for a services and tools registry, machine-interoperable services and protocols for information package exchange. This implies the need for an informatics approach. The Matrix can support this through a consistent object model that references repositories as organisational actors with responsibility for catalogues of digital objects.

EOSC EDEN will expand the Framework to incorporate and validate *discipline-specific* and other specialist requirements (WP3). This implies that the Matrix should accommodate a set of general purpose activities and functions while supporting customisation/extension to cover more specific local circumstances and criteria.

¹⁶ EOSC EDEN T1.2, Lindlar, M., Caron, B., Benauer, M., Kylander, J., Dekeyser, K., Addis, M., Levlin, M., Laukkanen, M., Lehtonen, J., Burger, F., Koho, T., Schwab, F., Molloy, L., & Zhang, F. (2025). M1.1 Report on Identification of Core Preservation Processes. Zenodo. <https://doi.org/10.5281/zenodo.16992451>

EOSC EDEN *expert and community engagement* (WP4) will include a curation network. This implies that the Matrix (incorporating the Framework) should provide a common reference point for EOSC EDEN alongside the FIDELIS network development and *repository training and support* (Pillar 4).

EOSC and EOSC Task Forces

EOSC EDEN will incorporate recommendations from previous EOSC Association¹⁷ Task Forces on Long Term Preservation¹⁸ and FAIR Metrics & Data Quality¹⁹. The Retention Task Force²⁰ (successor to the Preservation TF) has a specific remit to align with EOSC EDEN and FIDELIS. The emerging EOSC Nodes and Data Spaces will both inform EOSC EDEN/FIDELIS. This implies that the Matrix should cover a broad range of activities and functions that are influenced by a range of variables that impact the characteristics of repositories, registries and the digital objects' data, and metadata that they care for.

European Commission, Horizon Europe and the Annotated Model Grant Agreement

The Annotated Model Grant Agreement²¹ (AGA) contains several sections that are relevant for Open Science and Research Data Management, in particular "ANNEX 5 SPECIFIC RULES ON COMMUNICATION, DISSEMINATION AND VISIBILITY (all programmes)". The repository trust aspects of the AGA have been the subject of an initial study²² and a follow up²³.

¹⁷ EOSC Association: <https://eosc.eu/>

¹⁸ EOSC LTDP TF: <https://eosc.eu/advisory-groups/long-term-data-preservation/>

¹⁹ EOSC FAIR Metrics & Data Quality TF: <https://eosc.eu/advisory-groups/fair-metrics-and-data-quality/>

²⁰ EOSC Long-Term Data Retention TF: <https://eosc.eu/advisory-groups/long-term-data-retention-task-force/>

²¹ The AGA - Annotated Model Grant Agreement

https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/aga_en.pdf

²² Jahn, N., Laakso, M., Lazzeri, E., & McQuilton, P. (2023). Study on the readiness of research data and literature repositories to facilitate compliance with the Open Science Horizon Europe MGA requirements (Version 1.0). Zenodo. <https://doi.org/10.5281/zenodo.7728016>

²³ Lazzeri, E. (2024). Update of the Study on the readiness of research data and literature repositories to facilitate compliance with the Open Science Horizon Europe MGA requirements (1.0). Zenodo. <https://doi.org/10.5281/zenodo.13919643>

The Commission is a key stakeholder for FIDELIS and the funded project expectations influence many aspects of the EOSC. The AGA covers the expectations that repositories enable compliance, but do not address monitoring of compliance by researchers.

The FIDELIS project is not assessing repositories for compliance. In the context of the FIDELIS Matrix the focus is on the relevant repository activities/functions and the implied repository and digital object characteristics.

“Open”

Rather than open science in general the AGA focus is on whether repositories are capable of offering access to digital objects without restriction (presumably without authentication/authorisation, a click through licences/ terms and conditions etc). It doesn't specifically address machine-actionable access to objects.

NB: the word 'closed' is included in the phrase “As open as possible, as closed as necessary” to indicate that some digital objects justifiably cannot be made open. However, within repository metadata (including re3data schema²⁴) the word is variously used to describe a repository that has ceased to exist, or has ceased to accept deposits, or a repository that does not accept 'external' deposits. In the context of the FIDELIS Matrix it may be clearer to refer to “as open as possible, as protected as necessary”.

The AGA doesn't address expectations of repositories enabling access to digital objects that need to be “as protected as necessary” or any repository responsibilities to check that objects which should be protected are not inadvertently made 'open'.

“Metadata”

The AGA sets requirements for individual metadata items (with no specific information about schema, profiles or element structure) that repositories should make available with digital objects (differentiating between 'data' and 'literature'). These are relevant (and the EC is an important stakeholder) but only represent one of many sets of

²⁴ Rücknagel, J., Vierkant, P., Ulrich, R., Kloska, G., Schnepf, E., Fichtmüller, D., Reuter, E., Semrau, A., Kindling, M., Pampel, H., Witt, M., Fritze, F., van de Sandt, S., Klump, J., Goebelbecker, H.-J., Skarupianski, M., Bertelmann, R., Schirmbacher, P., Scholze, F., Kramer, C., Fuchs, C., Spier, S., Kirchhoff, A. (2015): Metadata Schema for the Description of Research Data Repositories: version 3.0, re3data, 29 p. <https://doi.org/10.2312/re3.008>

metadata expectations that different actors will expect from repositories. These items can be incorporated into the Matrix as repository or object characteristics. Some aspects of crosswalks to specific schema or validation of metadata availability may be in scope for the EDEN project.

"Trust"

The AGA 'essential criteria' for trust include the presence of repository policies on curation, preservation and security. None of these are defined or contextualised and the studies only check for their existence, not their content. However, the implication is that a repository can be trustworthy without these 'essential' criteria in place if it is already certified (ISO, DIN, CoreTrustSeal, Dini), or if it is 'community endorsed' and 'internationally recognised'. These may all be relevant, but need to be addressed in a more specific and concrete way in the FIDELIS Matrix. Aspects of the EDEN work on curation/preservation will be relevant here.

As the updated report on the AGA and repository readiness states " 'community endorsement', 'international recognition' and 'certification' need a broader common understanding" and "policy requirements for the preservation, curation, and security of repository contents lack common standards and best practices."

The approach of the AGA and the associated study to 'content type' (data, literature, software, other and 'catch all') and 'discipline' (with a definition that focuses on depositors rather than the content of the collection or the intended users) must also be integrated into the FIDELIS perspective on these concepts.

One obvious beneficial outcome of an ideal scenario of a functioning Network and a Matrix that includes a preservation framework would be that repositories could present transparent, machine-actionable information about themselves in a way that allowed their compliance with the AGA to be more easily assessed.

Appendix B:

Source Criteria Used to Define the Activities & Functions²⁵

CoreTrustSeal Trustworthy Digital Repositories Requirements 2023-2025 Extended Guidance

CoreTrustSeal Standards and Certification Board, 2022

<https://doi.org/10.5281/zenodo.7051096>

CoreTrustSeal+FAIRenabling: Alignment between the FAIR Principles and CoreTrustSeal 2023-25

L'Hours, Recker, Kleemola, 2023. <https://doi.org/10.5281/zenodo.7564703>

which in turn references:

The FAIR Guiding Principles for scientific data management and stewardship

Wilkinson, M., Dumontier, M., Aalbersberg, I. et al. Sci Data 3, 160018 (2016)

<https://doi.org/10.1038/sdata.2016.18>

Desirable characteristics of Data Repositories for Federally Funded Research

Guidance by the Subcommittee on Open Science of the National Science and Technology Council, May 2022. <https://hdl.handle.net/10088/113528>

Supplemental Information to the NIH Policy for Data Management and Sharing: Selecting a Repository for Data Resulting from NIH-Supported Research

Office of The Director, National Institutes of Health, October 29, 2020

<https://grants.nih.gov/grants/guide/notice-files/NOT-OD-21-016.html>

COAR Community Framework for Good Practices in Repositories

Version 2 - July 19, 2022. <https://doi.org/10.5281/zenodo.7108101>

FAIRsFAIR Service Assessment Framework

Ramezani, Sara, Aalto, Tero, Gruenpeter, Morane, Herterich, Patricia, Hooft, Rob, & Koers, Hylke, 2021. <https://doi.org/10.5281/zenodo.6656431>

²⁵ Repository & (meta)data Services Functions & Activities: Crosswalk
<https://doi.org/10.5281/zenodo.7690658>

National Digital Stewardship Alliance (NDSA) Levels of Preservation

Version 2, 2019. <https://ndsa.org/publications/levels-of-digital-preservation/>

The TRUST Principles for digital repositories

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>

Identifying ELIXIR Core Data Resources

Durinx C, McEntyre J, Appel R et al. Identifying ELIXIR Core Data Resources [version 2; peer review: 2 approved]. F1000Research 2017, 5(ELIXIR):2422 <https://doi.org/10.12688/f1000research.9656.2>

Digital Preservation Coalition Rapid Assessment Model (DPC RAM)

Version 2. 2021. <https://www.dpconline.org/docs/miscellaneous/our-work/dpc-ram/2005-dpc-ram-worksheet>

Digital Library Federation (DLF) Levels of Born Digital Access

DLF Born Digital Access Working Group 2020-02-05. <https://osf.io/hqmy4>



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²⁶ <https://www.data-archive.ac.uk/>

²⁷ <https://ukdataservice.ac.uk/>

²⁸ <https://www.essex.ac.uk/about/faculty-of-social-sciences>

²⁹ <https://www.fsd.tuni.fi/en/>

³⁰ <https://www.tuni.fi/en/>

³¹ <https://www.gesis.org>

³² <https://www.sib.swiss/>

³³ <https://dans.knaw.nl/en/>

³⁴ <https://www.fsd.tuni.fi/en/>

³⁵ <https://www.tuni.fi/en/>

³⁶ <https://elixir-europe.org/about-us/who-we-are/hub>

³⁷ <https://en.uit.no/>

³⁸ <https://csc.fi/en/>



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