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A for Accessibility: Semantic Artifacts

Chairs: Clement Jonquet, Joonas Kesäniemi

FAIRfest 20 February 2025
The Hague, The Netherlands (Madurodam)
Celebrating the advancements in FAIR solutions for EOSC

Welcome & Agenda

14:00 - 14:05	Introduction to the session	Clement Jonquet, *INRAE*
14:05 - 14:20	A is for Access: not just protocols, semantics matter! Keynote	Carole Goble, *University of Manchester*
14:20 - 14:30	Research Software MetaData (RSMD) guidelines, the CodeMeta standard and the RSAC services	Morane Gruenpeter, *Software Heritage*
14:30 - 14:40	FAIR mappings recommendations and the MSCR service	Yann Le Franc, *e-Science Factory* & Joonas Kesäniemi, *CSC*
14:40 - 14:50	FAIR Semantic Artefact and their Catalogues	Clement Jonquet, *INRAE*
14:50 - 15:00	DTR on the roadmap of implementing FDOs	Hans Lienhop, *GDWG*
15:00 - 15:30	Panel Discussion	Clement Jonquet (moderator) Morane Gruenpeter Yann Le Franc Joonas Kesäniemi Baptiste Cecconi Sophie Aubin Carole Goble

Any Questions? Submit them on Mentimeter!

Join at menti.com!

Use code 6927 7068

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Introduction

Clement Jonquet, INRAE

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‘A’ for Accessibility: Semantic Artefacts

Clement Jonquet

clement.jonquet@inrae.fr

FAIRfest (FAIR-IMPACT & FAIRCORE4EOSC final project meeting)

The Hague, February 20th 2025

Funded by the European Union

transformative contributions of FAIR-IMPACT and FAIRCORE4EOSC projects to **advancing FAIR principles in the domain of semantics**: metadata & ontologies, mappings, and research software

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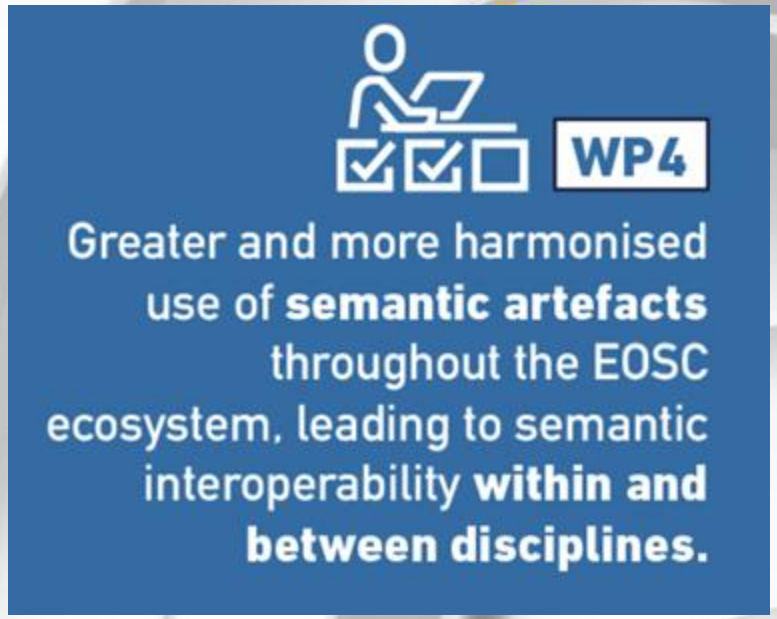


WP4 work on Semantic Artefact and their Catalogues

*WP4 will develop and foster the uptake of a semantic **framework** for the governance, creation, mapping, sharing, reuse, FAIRness assessment and interoperability of **semantic artefacts** for EOSC.*

Funded by the European Union

Main focus of FAIR-IMPACT's WP4

…implementation of FAIR-enabling practices ***across communities and research outputs***

WP4's use cases include

- Agri-food (INRAE with AgroPortal, EMPHASIS, ANAEE)
- Ecology/biodiversity (LifeWatch with EcoPortal)
- Earth sciences (CNRS with DataTerra EarthPortal)
- Photons and neutrons (UKRI-STFC)
- Social sciences and humanities (DANS)
- Astronomy (Obs. Paris)

…projecting the FAIR principles to other ***types of research objects***

WP4's research objects

Our work on Semantic Artefacts and their Catalogues

Semantic Artefact Catalogues

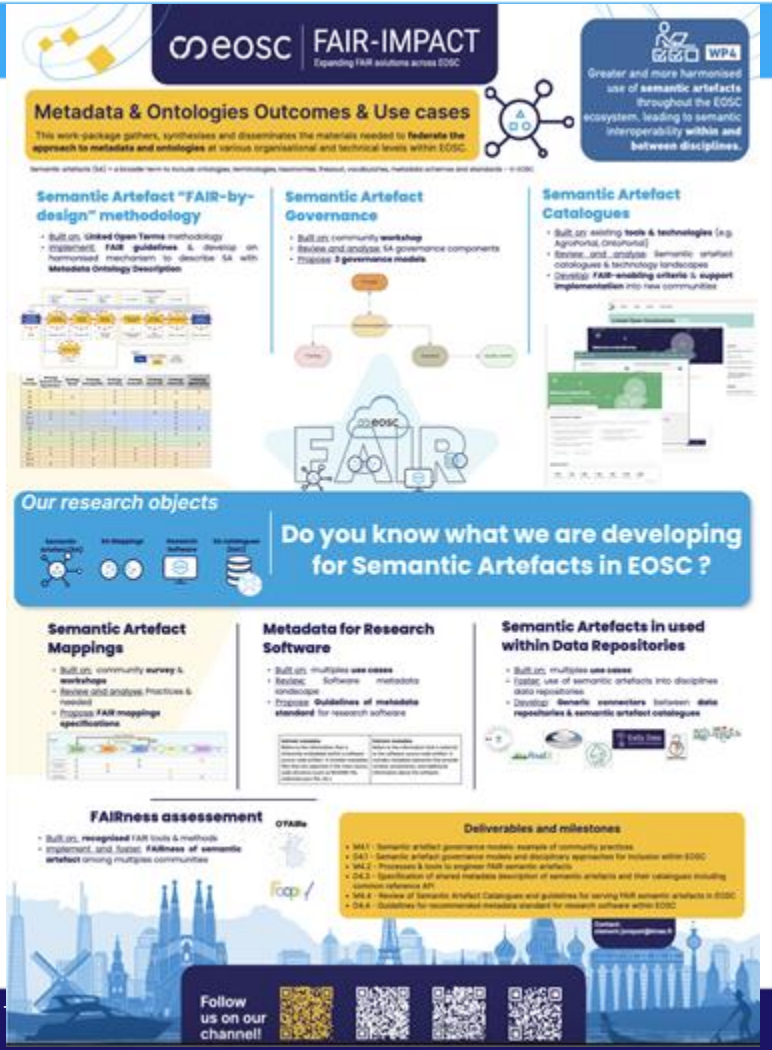
- Existing catalogues being consolidated in communities
- New catalogues being deployed in other communities/projects
- *Semantic Artefact « FAIR-by-design » methodology*
- FAIRenabling tools and methods being transferred
- Exhaustive review of current and retired catalogues and FAIR-enabling criteria
- *Catalogues being exploited in data repositories (9 use cases)*
- A metadata standard for semantic artefacts (MOD)
- A standard API for semantic artefact catalogues (MOD-API)
- Early work on federation of 4 catalogues
- *3 possible models for semantic artefact governance*
- *Toward specifications for FAIR mappings*

Semantic Artefact

Mappings

FAIR-IMPACT's WP4 in the Marketplace

- Find ~~Guillaume~~, Nina, Baptiste, Morane, Yann, Carole and me



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‘A’ for Accessibility: Semantic Artefacts

PANEL

Funded by the European Union

Panelists

Clement Jonquet (moderator)

Joonas Kesäniemi (moderator)

Morane Gruenpeter

Yann Le Franc

Baptiste Cecconi

Sophie Aubin

Carole Goble

Tommi Suominen

Questions

- What was your perspective before FAIR-IMPACT / FAIRCORE4EOSC and how has it evolved 5 years later? (with or without our contributions)

- What results from FAIR-IMPACT / FAIRCORE4EOSC do you see as defining milestones for the future of semantics within EOSC?

- Starting from the EOSC SRIA (v1) and Interoperability Framework requirements, have we achieved something useful?

Questions

- FAIR-IMPACT focused heavily on FAIR principles and semantics (symbolic AI approaches) during a time of rapid advancements in data science and statistical AI. How do you see these approaches complementing one another?

Questions

- FAIR-IMPACT: what didn’t go as planned? If we could start over, what would we do entirely differently? Are there opportunities or challenges we may have overlooked?

- What research directions should we explore in this knowledge and semantic landscape? Any trends, ideas, or intuitions?

Questions

- Semanta: How can we ensure the long-term sustainability of the outcomes produced related to Semantic Artefacts?

- Where do we go next?

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A is for Access: not just protocols, semantics matter!

Carole Goble, University of Manchester

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A is for Access

not just protocols: semantics matter!

Professor Carole Goble
The University of Manchester, UK
ELIXIR Research Infrastructure for Life Sciences, UK Head of Node
Health Data Research UK
Software Sustainability Institute UK
European Virtual Institute for Research Software Excellence
FAIR-IMPACT

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"That's the hard one to talk about"

"A is the boring one"

"semantics is more about FIR than A"

The Turing Way project illustration by Scriberia. Used under a CC-BY 4.0 licence. DOI: 10.5281/zenodo.3332807

Accessibility is the most important part of FAIR

Without access to the object, does the object exist?

No object archives, what will you access?

F serves A

user finds the data or software, they need to know HOW to access it, and CAN they access it.

I and R depend on A

Reuse: usage license to ACCESS

<50% researchers license their data/software (161 respondents – Meznah Aloqalaa)

No licensed use, access is devalued

Refresher… A is for Accessible…

Access
the object and
the metadata of the object

Retrieve (not resolve) by PID
- *metadata always*
- *object, maybe not*

Protocols open, free, implementable standardised
- *programmatic (not Click)*
- *standard APIs, web HTTPs*

Restrictions
- *authentication, authorization*
- *object might be shielded, metadata might be, might not*

1. Access using Metadata: Gatekeeping

https://eosc-entrust.eu/

Open Digital Rights Language

ODRL Information Model 2.2

W3C Recommendation 15 February 2018

FAIR Digital Object

Metadata describing the user and the object

Metadata for tracking and monitoring provenance and access auditing

Disclosure control

FAIR assessment can only happen if you can access the metadata to do the assessment

Look up an object's metadata using Web **protocols**

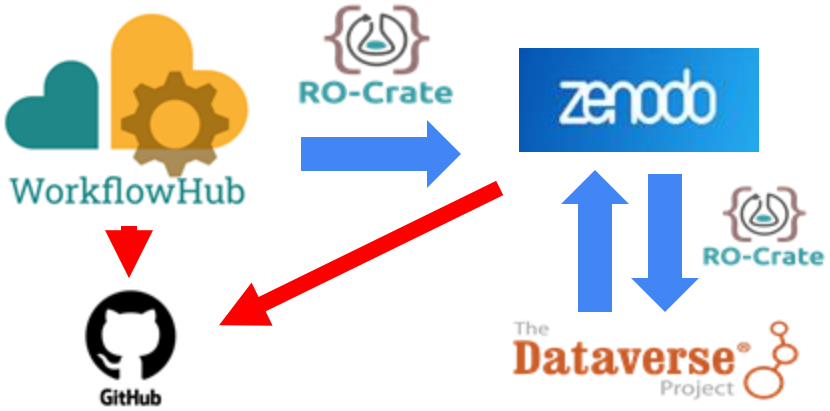
FAIR-IMPACT Support Open Call

https://signposting.org/FAIR/

https://doi.org/10.5281/zenodo.10490289

2. Access to Metadata: by services, forever!

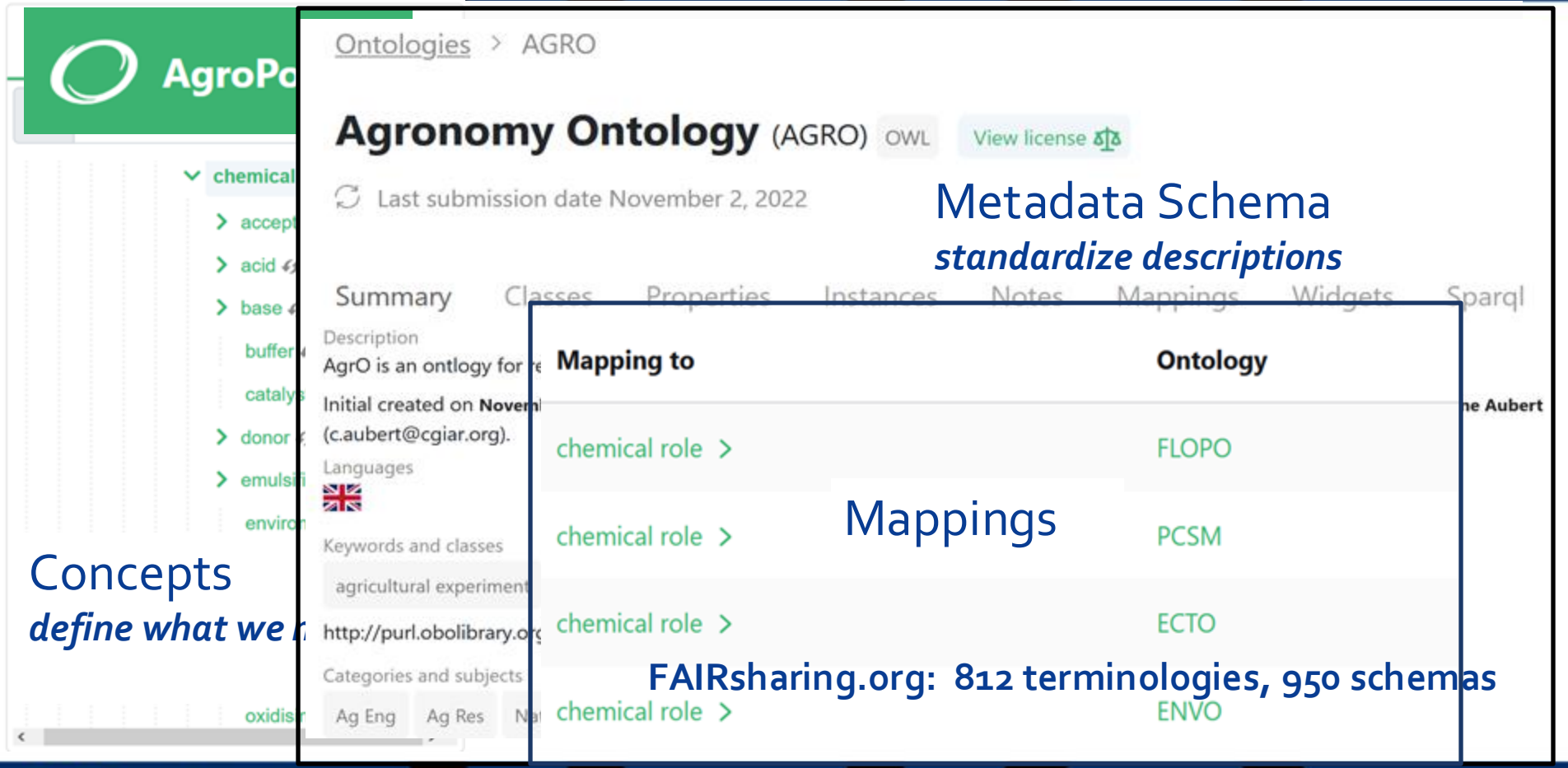
Using (Webby) FAIR Digital Objects to move metadata pointing to objects between services



The registry disappears, can rescue and access the metadata, if not the object itself!

FAIR-IMPACT Support Open Call

3. Accessing Semantic Artefacts



Concepts

define what we

Metadata Schema

standardize descriptions

Mappings

FAIRsharing.org: 812 terminologies, 950 schemas

Schema Crosswalks and Concept Mappings

can be simple, complex, computed

The CodeMeta Project

Software Metadata

- Crosswalk for WikiData Properties
- Crosswalk for DataCite metadata
- Crosswalk for Debian packages
- Crosswalk for DOAP Ontology
- Crosswalk for GitHub API
- Crosswalk for Java's Maven metadata
- Crosswalk for NodeJS package.json
- Crosswalk for Python distutils
- Crosswalk for R Packages
- Crosswalk for Ruby gems

https://codemeta.github.io/crosswalk/

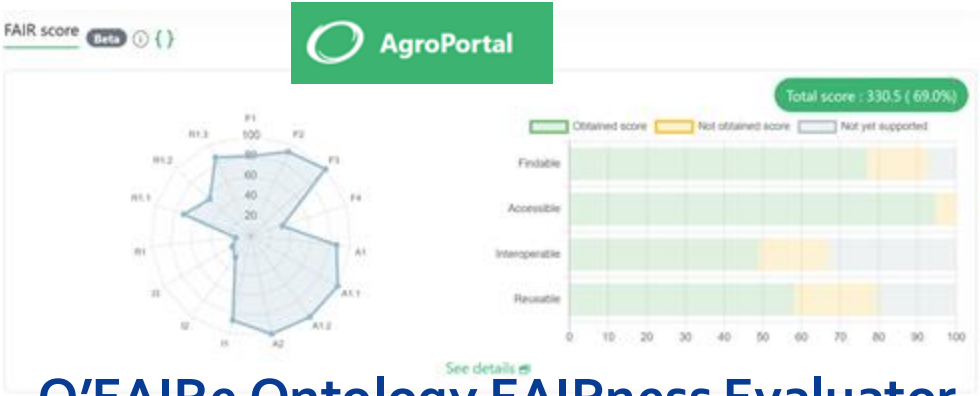
GitHub

codeRepository	html_url
programmingLanguage	languages_url
downloadUrl	archive_url
author	login
dateCreated	created_at
dateModified	updated_at
keywords	topics
license	license
description	description
identifier	id
name	full_name
issueTracker	issues_url

An EOSC FAIR Federation

is an exercise adaptable
metadata
crosswalks and mappings

Semantic Artefacts are also FAIR (including Access)



O'FAIRe Ontology FAIRness Evaluator

EarthPortal
AgroPortal
IndustryPortal
BiodivPortal
SIFR BioPortal
EcoPortal

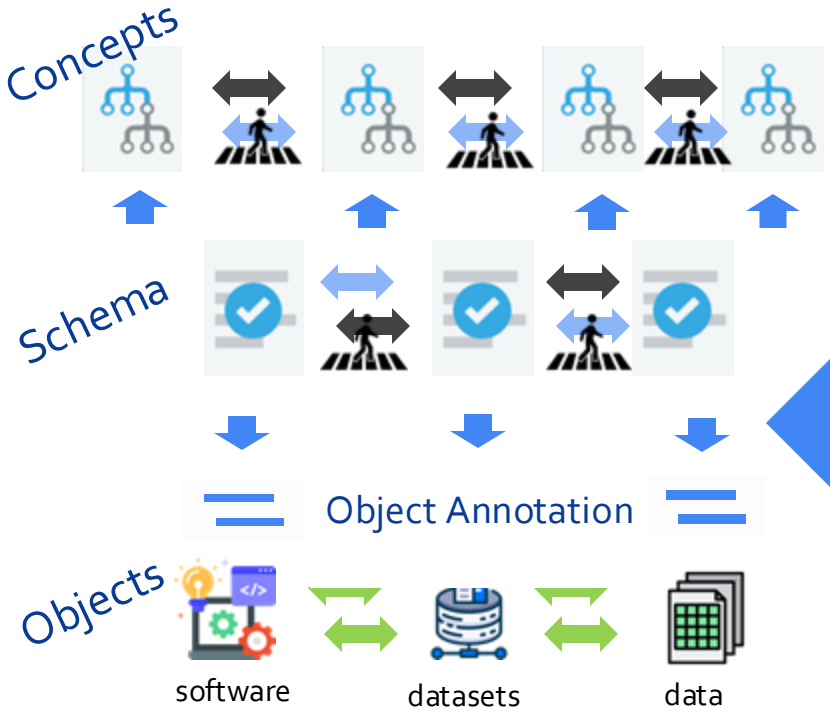
I2. (Meta)data use vocabularies that follow FAIR principles

Metadata retrievable always and forever (even if the object is not)

The Semantic Artefacts and their versions used in the metadata be forever retrievable?

EOSC interoperability Framework *Recommendations , 2021,* doi: 10.2777/620649

Accessing the Dynamic Semantic Artefact Web



versioning & dependencies like FAIR Software: Access by PIDs

- **Different versions (forever)**
- **Levels of granularity**

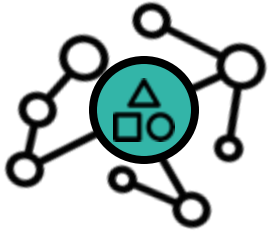
Curation servants

External
infrastructure, governance, methodologies

Accessing Semantic Artefacts: Capability & Capacity

Infrastructure, mapping methodology, governance, services

Semantic Artefact Catalogues
Mapping Entity Repositories
API Access
Catalogue/Repo Federation



Semantic Artefacts for the Semantic Artefacts API Definition

OntoPortal Alliance

EOSC Metadata Schema and Crosswalk Registry

The Metadata for Ontology Description MOD and MOD-API

sssom
SIMPLE STANDARD FOR SHARING ONTOLOGICAL MAPPINGS

EOSC Data Type Registry

RO-Crate

Profile Registries

Developing and implementing the semantic interoperability recommendations of the EOSC Interoperability Framework 2024, https://doi.org/10.5281/zenodo.10843882

Accessible to the Developers of EOSC Infrastructure

Semantic Artefacts need those access protocols to enable smart services

Widely known developer friendly toolbox of reliable high-quality services.

Capability and capacity to use.

Reliability and robustness of services.

Otherwise?

Elastic Search, LLMs, roll my own schema.

HTTP protocol + HTML content = development of web browsers

Strategic Research and Innovation Agenda of the EOSC, Nov 2024, Priority for metadata

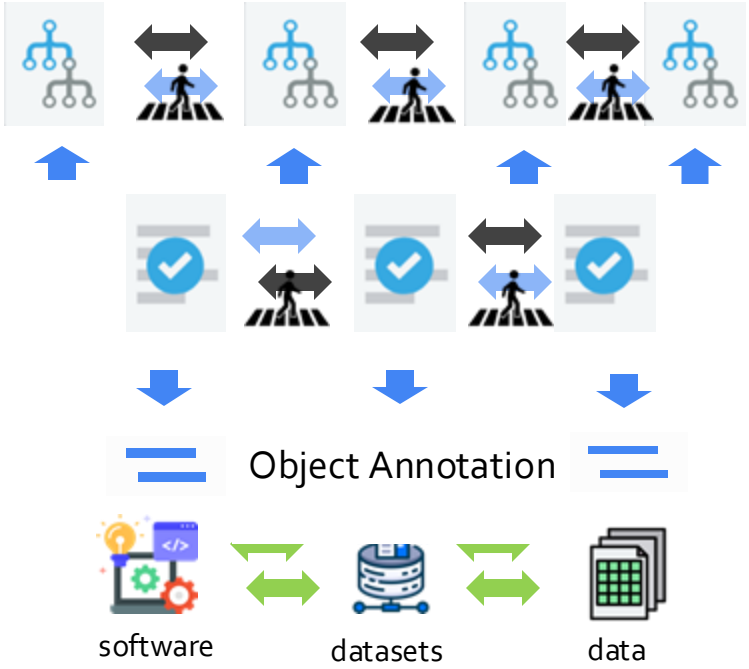
FAIR for AI

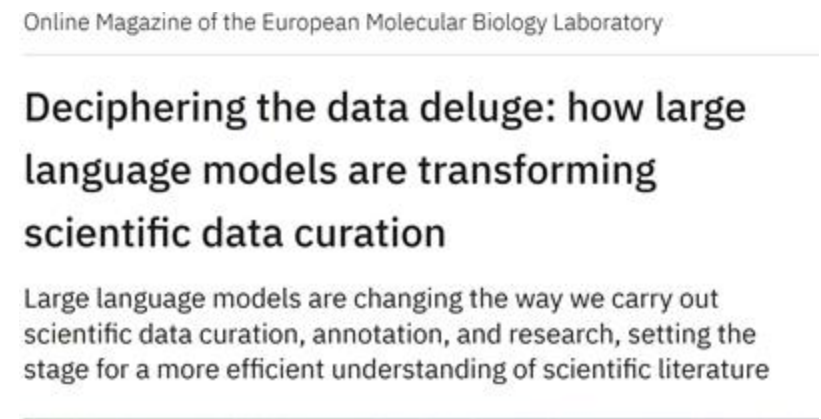
Semantic Artefacts for AI

Embedding in Knowledge Graphs/LLMs

AI for FAIR metadata auto-assistance

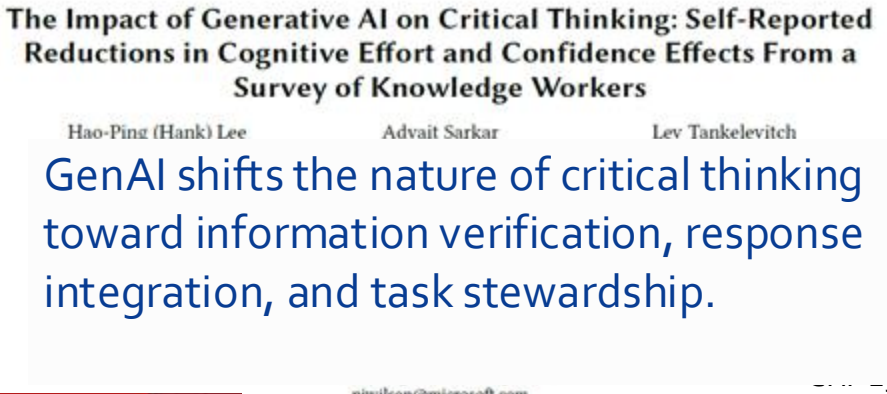
- Sensitive data disclosure control
- Metadata annotation & curation
- Semantic Artefacts themselves




Online Magazine of the European Molecular Biology Laboratory

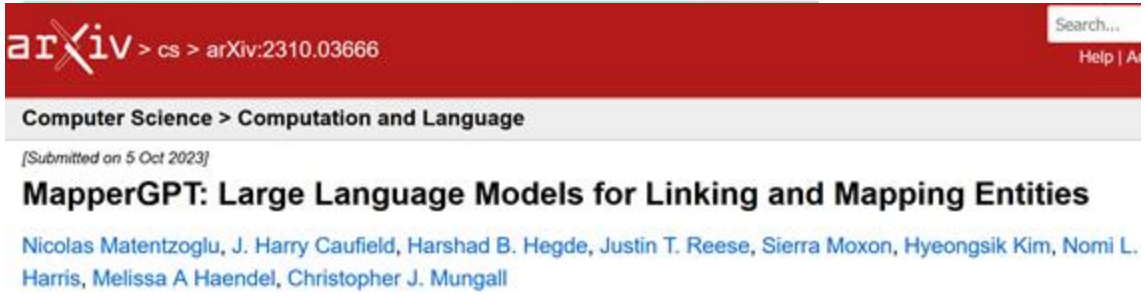
Deciphering the data deluge: how large language models are transforming scientific data curation

Large language models are changing the way we carry out scientific data curation, annotation, and research, setting the stage for a more efficient understanding of scientific literature


The Impact of Generative AI on Critical Thinking: Self-Reported Reductions in Cognitive Effort and Confidence Effects From a Survey of Knowledge Workers

Hao-Ping (Hank) Lee Advait Sarkar Lev Tankelevitch

GenAI shifts the nature of critical thinking toward information verification, response integration, and task stewardship.


arXiv > cs > arXiv:2310.03666

Search... Help | A

Computer Science > Computation and Language

[Submitted on 5 Oct 2023]

MapperGPT: Large Language Models for Linking and Mapping Entities

Nicolas Matentzoglu, J. Harry Caufield, Harshad B. Hegde, Justin T. Reese, Sierra Moxon, Hyeongsik Kim, Nomi L. Harris, Melissa A Haendel, Christopher J. Mungall

Will LLMs and Elastic Search replace or complement Semantic Artefacts and metadata?

Accountability, Quality control, Transparency….

Access for All: Equitability

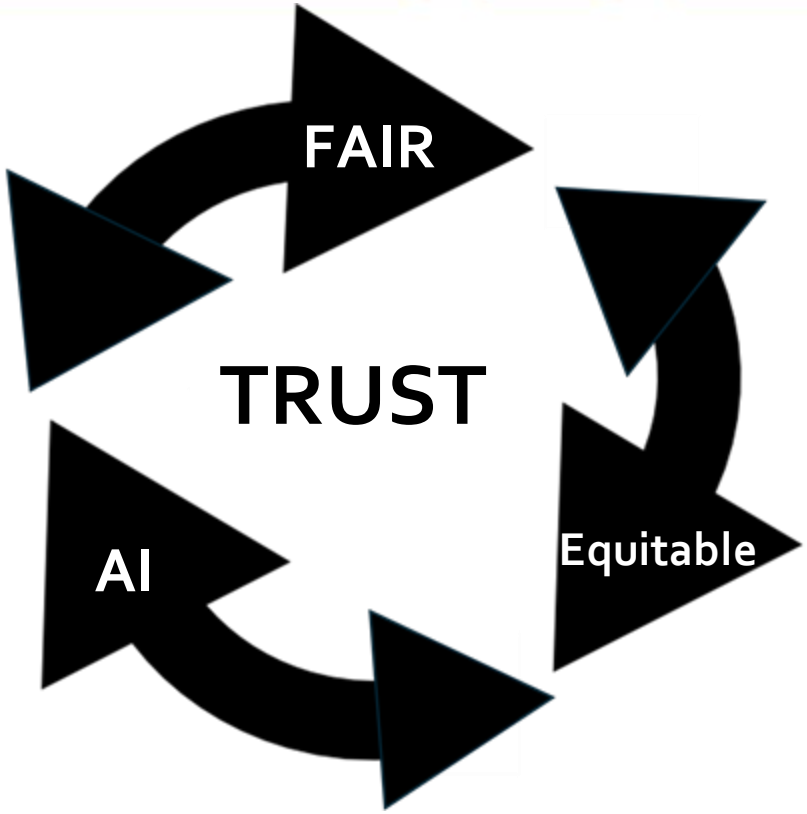
Controlled Access, Inclusive Access, Participation

https://www.gida-global.org/care

Equitable participation in knowledge development, schema specification and metadata curation

Equitable access to Semantic Artefact **infrastructure and services**

Equitable access to **infrastructure training and specialists**



Access is not just protocols. Semantics Matter!

Requires infrastructure and capacity + Equitable access for developers (and everyone else)

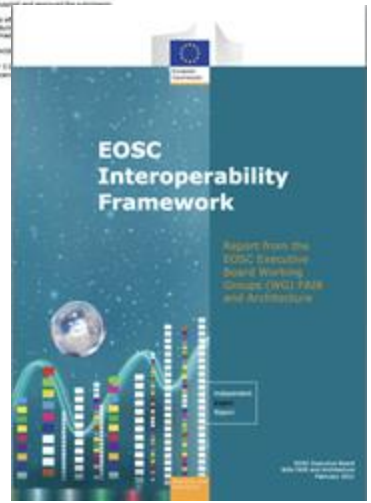
AI is game changing

With thanks!

Morane Gruenpeter

Mark Wilkinson

Nick Juty



Clement Jonquet

Tony Burdett

Meznah Aloqalaa

Fotis Psomopoulos

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Research Software MetaData (RSMD) guidelines, the CodeMeta standard and the RSAC services

Morane Gruenpeter, Software Heritage

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CodeMeta: Semantic artefacts for Research Software

Morane Gruenpeter (Inria)
FAIRCORE4EOSC WP6 lead
FAIR-IMPACT T4.3 lead

Software Heritage

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité
Inria

eosc | FAIR-IMPACT

Funded by the European Union

Software is a Pillar of Open Science

Research Software

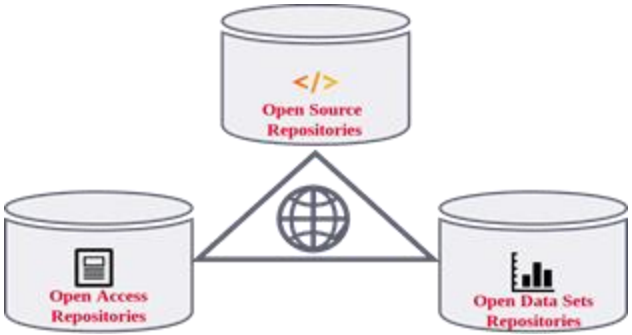
➔ created

- **during the research process**
- **for a research purpose**

Software in research

➔ used for research

FAIR4RS output: Gruenpeter et al. Defining Research Software: a controversial discussion (Version 1). Zenodo. https://doi.org/10.5281/zenodo.5504016

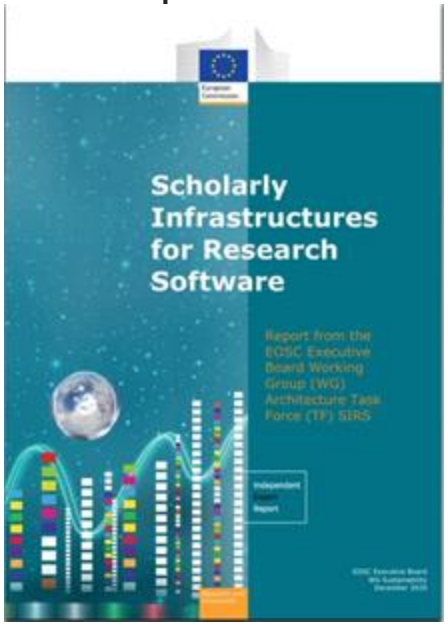


Three pillars of Open Science
Software Heritage CC-By 4.0 2019

Software has multiple facets:

- a **tool**
- a research **outcome** or result
- **the object** of research

Implementing an EOSC vision to software metadata



SIRS report: European Commission, Directorate-General for Research and Innovation, *Scholarly infrastructures for research software : report from the EOSC Executive Board Working Group (WG) Architecture Task Force (TF) SIRS*, Publications Office, 2020, **https://data.europa.eu/doi/10.2777/28598**

- ➔ Creating the Research Software MetaData guidelines
  - RSMD guidelines
- ➔ Contributing to the CodeMeta initiative
  - ◆ Implementing a community **governance model**
    - The establishment of a Project Management Committee
  - ◆ Refactoring CodeMeta vocabulary, tools and mappings

How to describe software? We need metadata…

Software development platforms

(on platform page)

- GitHub
- Bitbucket
- SourceForge
- …

Catalogs and registries

- ASCL
- swMath
- OpenAire
- libraries.io
- Research Software Directory - escience center
- …

Scholarly repositories

- Zenodo (InvenioRDM)
- HAL
- …

Package managers

- PyPI
- NPM
- …

Intrinsic metadata

In the source code (as a file)

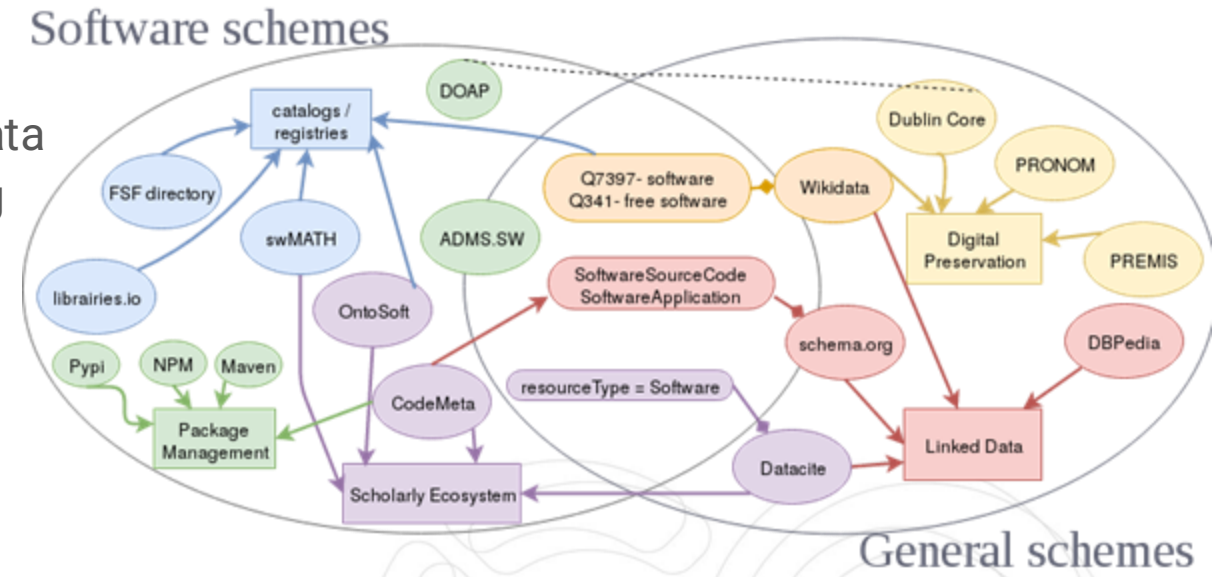
- README
- LICENSE
- AUTHORS
- Package manager file
- codemeta.json / CFF file
- …

Scholarly publishers

- IPOL
- eLife
- Dagstuhl
- Episciences
- …

CodeMeta Initiative

- A subset of schema.org
- An academic community discussing software metadata
- A crosswalk table - mapping the metadata landscape



Gruenpeter M. and Thornton K. (2018) Pathways for Discovery of Free Software (slide deck from LibrePlanet 2018). https://en.wikipedia.org/wiki/File:Pathways-discovery-free.pdf accessed on 6.11.2020.

We have a version 3.0 🚀

3.0 Latest

Compare

progval released this Jul 13 · 1 commit to master since this release 3.0 19a4de2

Vocabulary changes:

- Renamed `codemeta:contIntegration` to `codemeta:continuousIntegration` (#302 by **@tmorrell**)
- Renamed `codemeta:embargoDate` to `codemeta:embargoEndDate` (#314 by **@tmorrell**)
- Added `codemeta:hasSourceCode` and `codemeta:isSourceCodeOf` to describe links between `schema:SoftwareSourceCode` and `schema:SoftwareApplication`. (#300 by **@dgarijo** and **@progval**)

Context changes:

- Updated the context with the above names changes.
- Removed type restriction to `schema:releaseNote` (#280 by **@progval**)
- Added `schema:Role`, `schema:startDate`, `schema:endDate`, and `schema:roleName`, to allow easier expression of author and contributor roles. See http://blog.schema.org/2014/06/introducing-role.html for an introduction to the concept. (#241 by **@progval**)
- Added `schema:Review`, `schema:review`, `schema:reviewAspect`, and `schema:reviewBody`, to describe software reviews. (#311 by **@progval**)

Other changes:

- Added a crosswalk from codemeta v2 to codemeta v3 (#315 by **@progval**)
- Fixed some new crosswalks missing from crosswalk.csv (#316 and #317 by **@progval**)

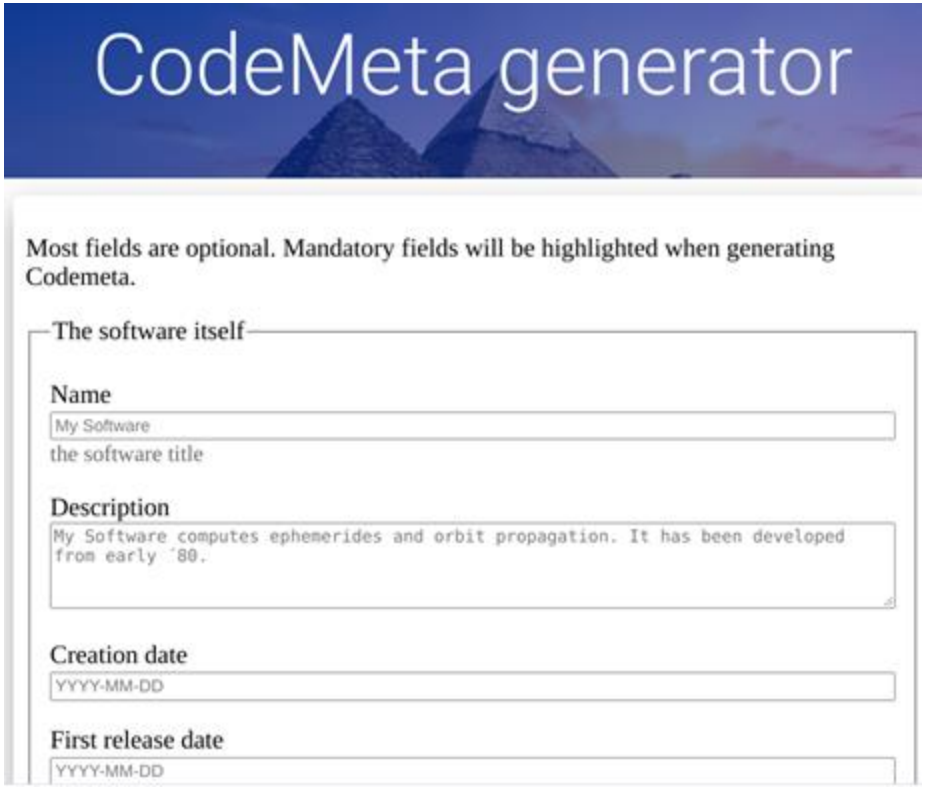
Matthew B. Jones, Carl Boettiger, Abby Cabunoc Mayes, Arfon Smith, Morane Gruenpeter, Valentin Lorentz, Thomas Morrell, Daniel Garijo, Peter Slaughter, Kyle Niemeyer, Yolanda Gil, Martin Fenner, Krzysztof Nowak, Mark Hahnel, Luke Coy, Alice Allen, Mercè Crosas, Ashley Sands, Neil Chue Hong, Patricia Cruse, Daniel S. Katz, Carole Goble, Bryce Mecum,. 2023. CodeMeta: an exchange schema for software metadata. Version 3.0.

The CodeMeta generator

- An open source tool to create codemeta.json files
  - Use it directly on the CodeMeta hosted version
  - Contributions are welcome on the code repository

Contributed to the community by

Software Heritage
THE GREAT LIBRARY OF SOURCE CODE



Updating tool with the v3.0:
https://github.com/codemeta/codemeta-generator/issues/23

CodeMeta v3.0 identification: pathway to accessibility

Ideally we should:

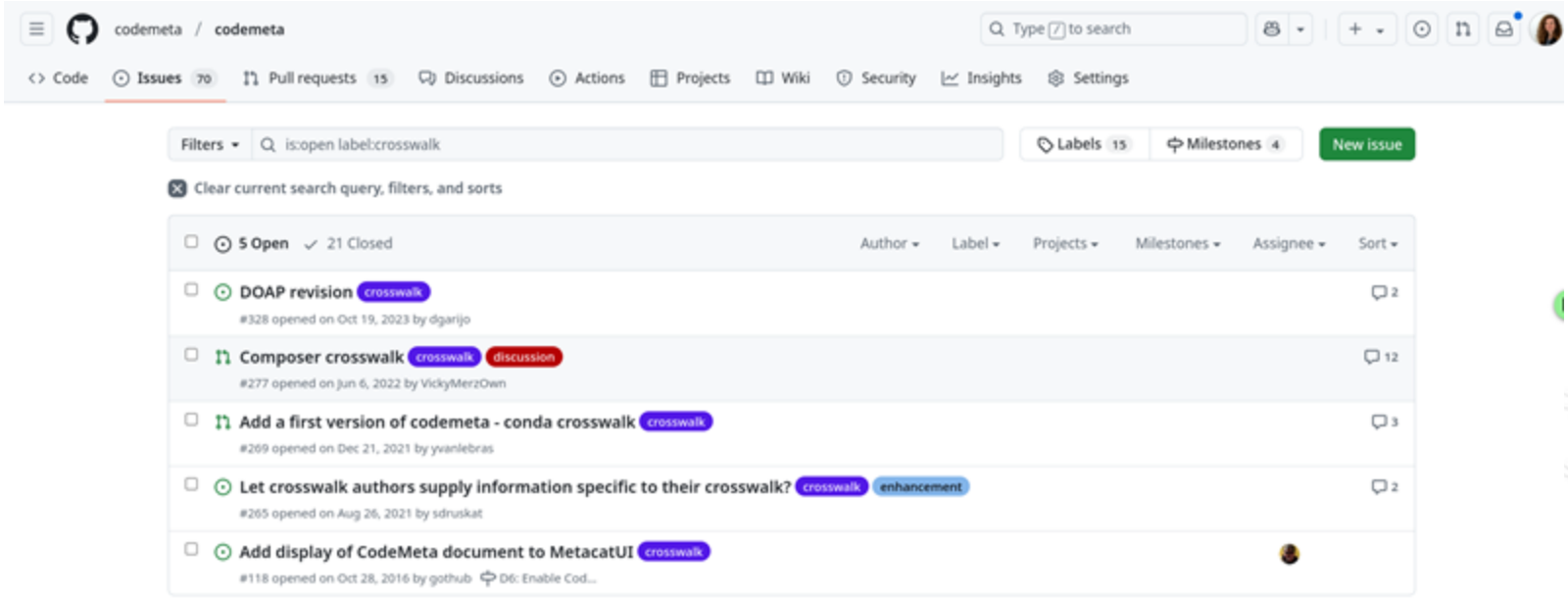
1. Get the context file directly, when requesting JSON-LD
2. Get the documentation page for the terms, when requesting HTML
3. Have individual term identifiers resolve to anchored term definitions when HTML is requested.

The accepted suggestion is using https://w3id.org/codemeta (Thanks @dgarijo !)

- curl -sH "Accept:application/ld+json" -L https://w3id.org/codemeta/ will get you the JSON.
- If you resolve https://w3id.org/codemeta/ in your browser, it should take you to the v3.0 of https://codemeta.github.io/terms/
- Version ids are supported: https://w3id.org/codemeta/{version}.
- For example https://w3id.org/codemeta/1.0. I redirected the HTML of the versions to https://codemeta.github.io/terms/
    a. Version should be supported in the html too
- W3ID is open: https://github.com/perma-id/w3id.org/tree/master/codemeta

How To crosswalk? CodeMeta mappings

First, know your target vocabulary = CodeMeta



The Research Software MetaData guidelines

The RSMD seven Aspects

1. General Metadata Requirements
2. Accessibility & preservation
3. Reference & identification
4. Description & classification
5. Attribution & credit
6. Reuse, licensing & legal aspects
7. Re-execute: Dependencies & execution environment

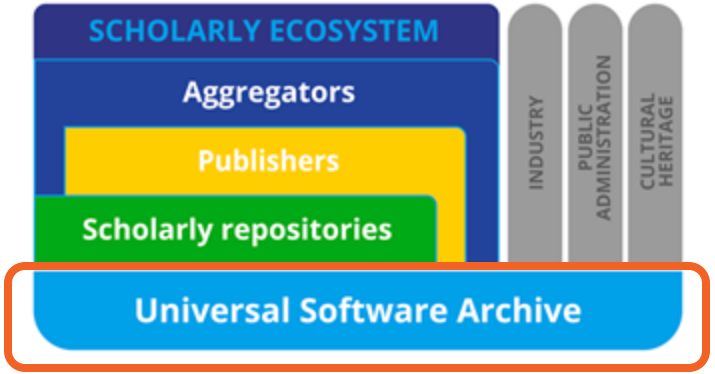
	SIRS report	FAIR4RS
1. General Metadata Requirements		
2. Accessibility & preservation	A = Archive	A = Accessible
3. Reference & identification	R = Reference	F = Findable
4. Description & classification	D = Describe	I = Interoperable
5. Attribution & credit	C = Cite	
6. Reuse, licensing & legal aspects		R = Reusable
7. Re-execute: Dependencies & execution environment		

👉 https://github.com/FAIR-IMPACT/RSMD-guidelines

RSAC=> Interoperability driven approach through MD

Research Software APIs and Connectors: implementing

- The RSAC components connecting Software Heritage with
  - **Scholarly repositories**: Zenodo (CERN), DANS Dataverse's instance,
  - **Publishers**: Dagstuhl, Episciences
  - **Aggregators**: SwMath, OpenAire & Datacite



Software Heritage

10.5281/zenodo.14509418

Read metadata curation report or come to the RS stand

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Core Components Supporting a FAIR EOSC

eosc | FAIR-IMPACT

Join the effort to describe software!

Thank you for your engagement.

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the European Union

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FAIR mappings recommendations and the MSCR service

Yann Le Franc, e-Science Factory & Joonas Kesäniemi, CSC

FAIRfest 20 February 2025
The Hague, The Netherlands (Madurodam)
Celebrating the advancements in FAIR solutions for EOSC

What do we mean by mappings?

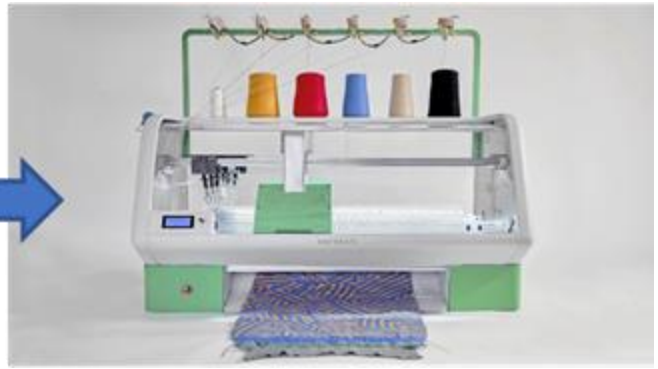
*"A **mapping** defines connections or relationships between different information elements by identifying similarities, correspondences, and alignments. Mappings include different types of connections, depending on the level of the elements that are being mapped."*

*"A **crosswalk** is a set of mappings connecting two information objects together"*

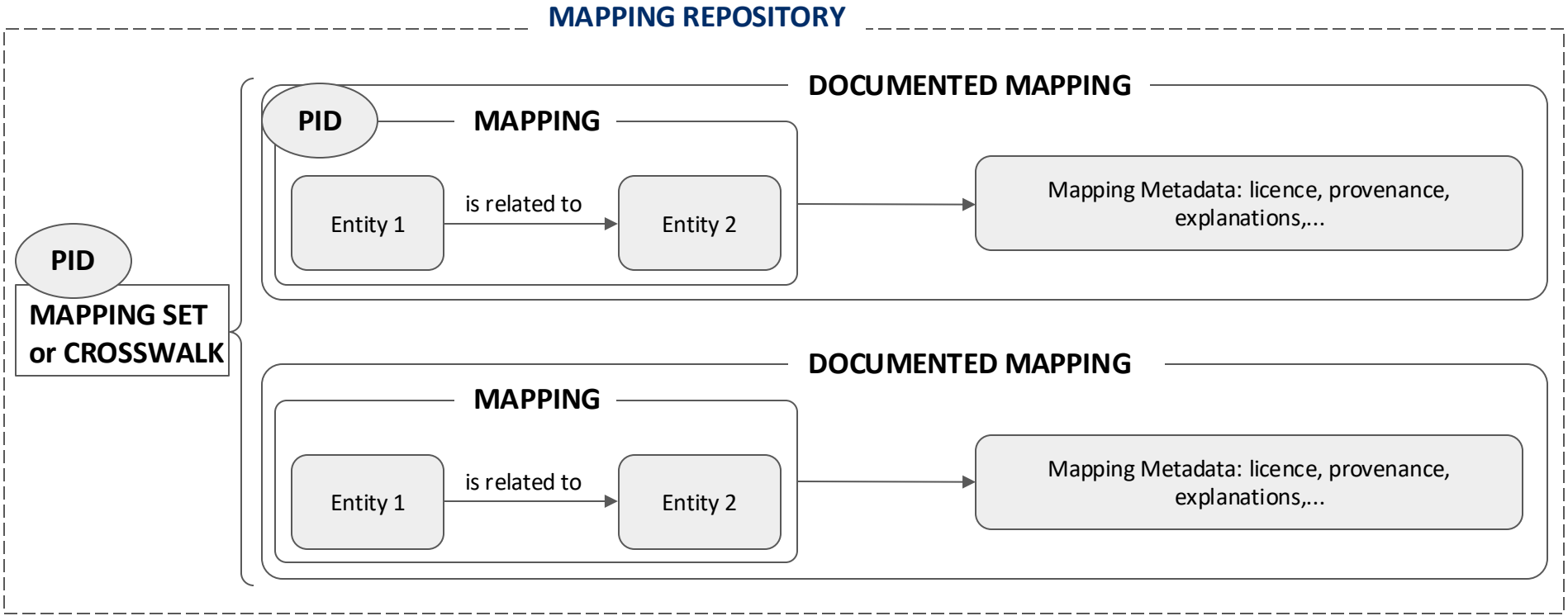
Moving towards FAIR mappings and crosswalks. Jana Martínková, Nick Juty, Alejandra Gonzalez Beltran, Carole Goble and Yann Le Franc
CEUR Workshop Proceeding - Vol-3882

Why making mappings FAIR?

FAIR Principles



What do we mean by FAIR mappings and crosswalks?



The two sides of the FAIR Mappings in FAIR-IMPACT

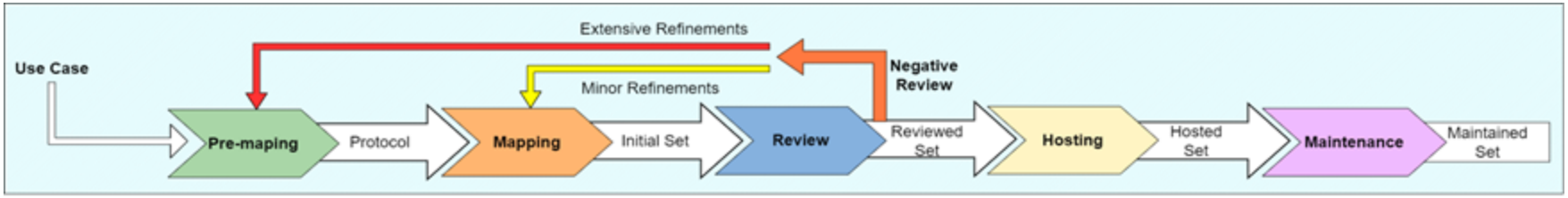
- Analysis of the requirements and technical recommendations for making mappings FAIR

- Practical aspects of mappings from creation to maintenance: understanding and documenting community practices

Open survey to collect information on mapping practices

Contribute to the survey here

Practical Mapping Framework



Use Case Owner	X		X		X
Semantic Domain Knowledge	X	X	X		
Developer/Architect	X	X		X	
Governance (Project Manager)	X			X	X

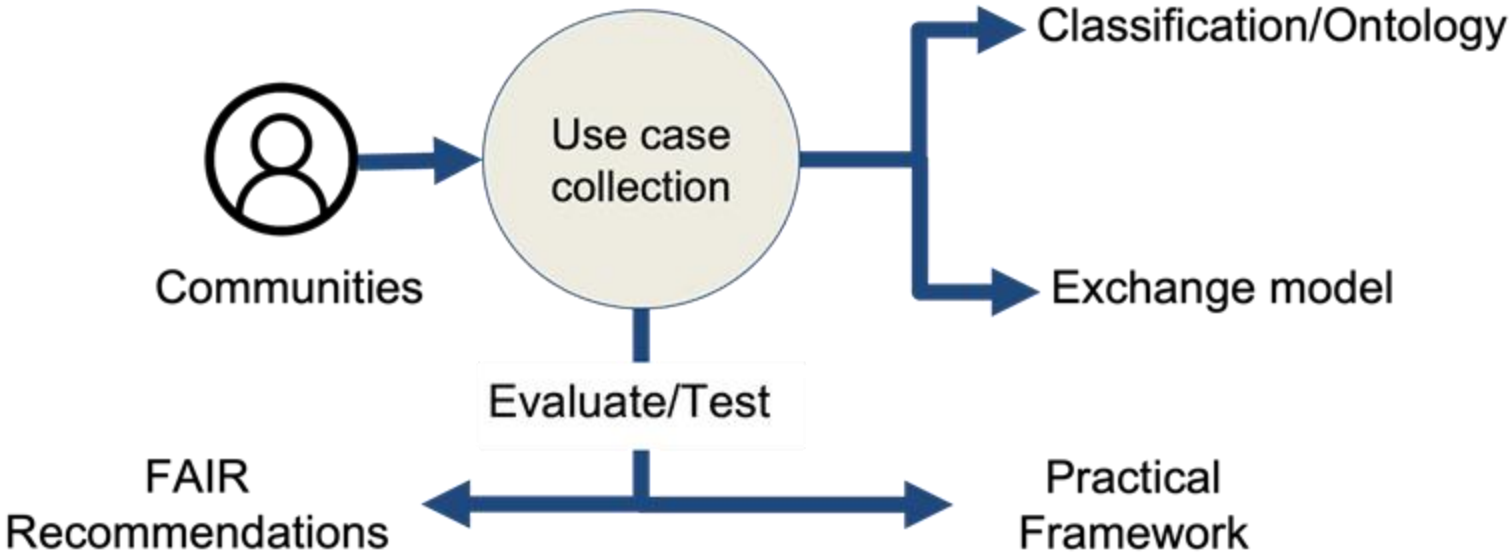
Juty, N., Le Franc, Y., Goble, C., & Martínková, J. (2024). FAIR-IMPACT Task 4.4 Workshop: Developing a Mapping Process Framework (1.0). Zenodo. https://doi.org/10.5281/zenodo.12521432

FAIR Mapping recommendations

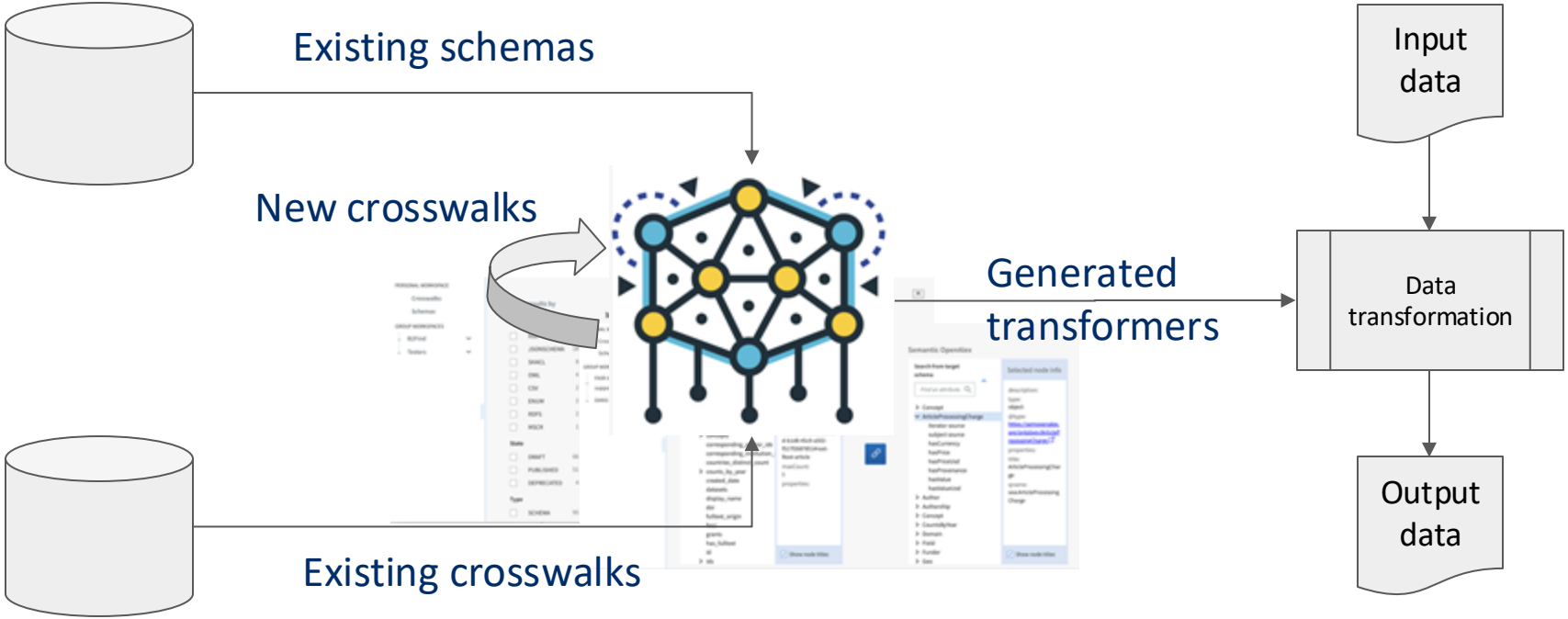
- Grouped the 15 individual FAIR principles into 4 categories:
  - **Model and Format:** Interoperability (I1, I2, I3) and Reusability (R1, R1.1, R1.2, R1.3)
  - **Metadata:** Findability (F2, F3) and Reusability (R1, R1.1, R1.2, R1.3)
  - **PID :** Findability (F1, F3)
  - **Service and API:** Accessibility (A1, A1.1, A1.2, A2) and Findability (F4)
- Established **14 Recommendations** covering the different categories
- FAIR Mapping recommendation document to be **released soon**

RDA FAIR Mapping WG: a path to sustainability

RDA FAIR Mapping WG: endorsed on 13/02/2025



Metadata Schema and Crosswalk Registry



Metadata Schema and Crosswalk Registry (MSCR)

- Semantic artefact repository - and more
- Goal is to implement the FAIR Mappings recommendations
- Two major development “tracks”
  - Registry/repository functionality
  - Crosswalk definition and operationalization
- Both contribute to the big A
  - Hosts metadata and content
  - Making crosswalks understandable for a wider audience (Visualization vs code/configuration)

Class A MSCR Features

- PIDs for all content
  - Crosswalk = set of mappings
- Versioning
  - Accessing a specific or latest version of the content
- Metadata and content always available
  - Published content is immutable
  - Tombstoning → Metadata remains

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Expanding FAIR solutions across EOSC

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Core Components Supporting a FAIR EOSC

FAIR Semantic Artefact and their Catalogues

Clement Jonquet, INRAE

FAIRfest 20 February 2025
The Hague, The Netherlands (Madurodam)
Celebrating the advancements in FAIR solutions for EOSC

FAIR Semantic Artefacts and their Catalogues

Clement Jonquet

clement.jonquet@inrae.fr

FAIRfest (FAIR-IMPACT & FAIRCORE4EOSC final project meeting)

The Hague, February 20th 2025

Funded by the European Union

A couple of definitions (not absolute, but adopted in EOSC)

Semantic artefacts: a broader term to include ontologies, terminologies, taxonomies, thesauri, vocabularies, metadata schemas and standards.

Legacy of FAIRsFAIR and adopted in the EOSC Interoperabibily Framework

Semantic artefact catalogues: encompass any existing ontology repositories, registries, vocabulary/terminology services and metadata schemas catalogues.

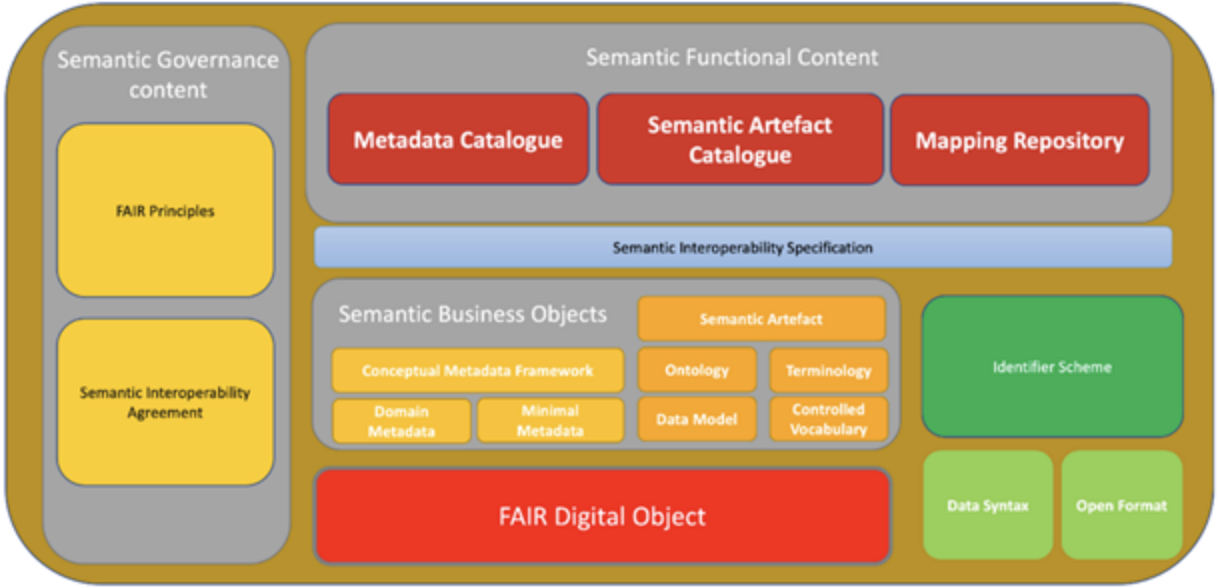
(Semantic) Crosswalks and mappings: formal links between the content of these semantic artefacts.

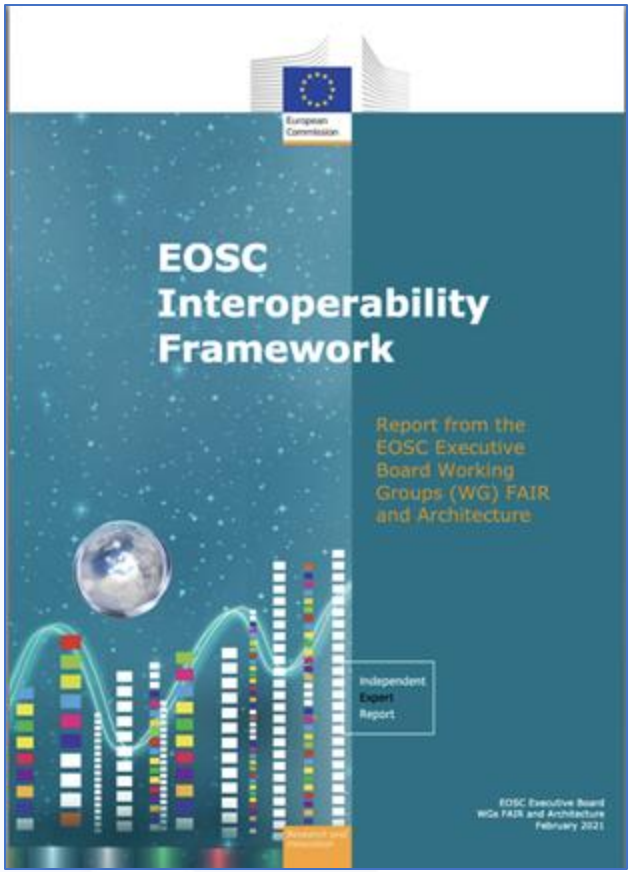
FAIRsFAIR D2.5 FAIR Semantics Recommendations

Figure 2: Semantic artefact spectrum. Derived from Leo Obrst, 2010

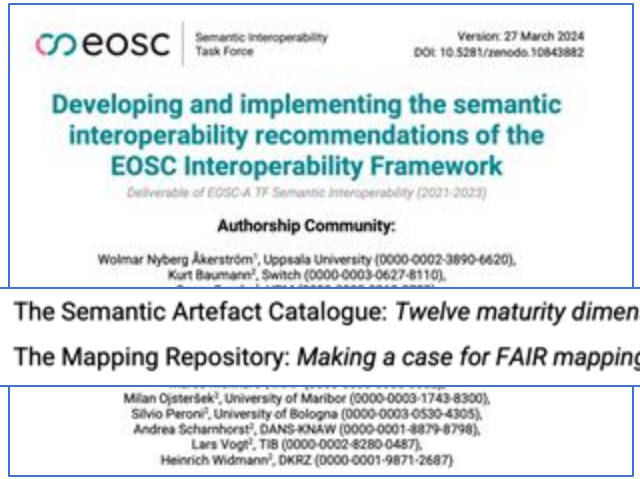
A semantic artefact is defined in this work as a machine-actionable and -readable formalisation of a conceptualisation, enabling sharing and reuse by humans and machines. These artefacts may have a broad range of formalisation, from loose sets of terms, taxonomies, thesauri to higher-order logics. Moreover, semantic artefacts are serialised using a variety of digital representation formats, e.g., RDF Turtle, and OWL, using XML (RDF) and JSON-LD.

Semantic Artefact Catalogue in the EOSC Interoperability Framework





A subject studied by the EOSC task forces



eosc | Semantic Interoperability Task Force

Version: 27 March 2024
DOI: 10.5281/zenodo.10843882

Developing and implementing the semantic interoperability recommendations of the EOSC Interoperability Framework

Deliverable of EOSC-A TF Semantic Interoperability (2021-2023)

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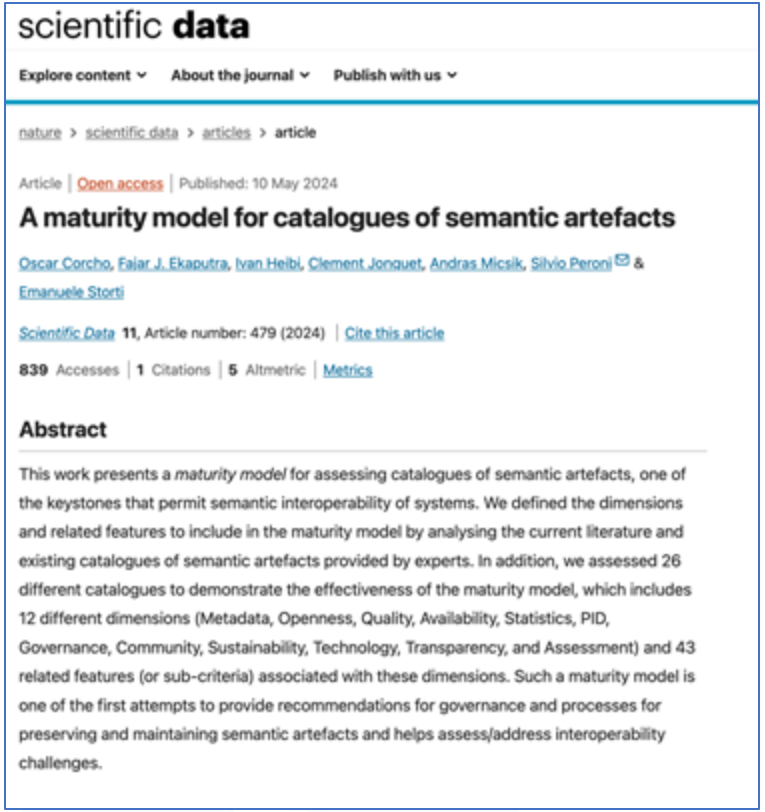

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Article | Open access | Published: 10 May 2024

A maturity model for catalogues of semantic artefacts

Oscar Corcho, Fajar J. Ekaputra, Ivan Heibi, Clement Jonquet, Andras Micsik, Silvio Peroni & Emanuele Storti

Scientific Data **11**, Article number: 479 (2024) | Cite this article

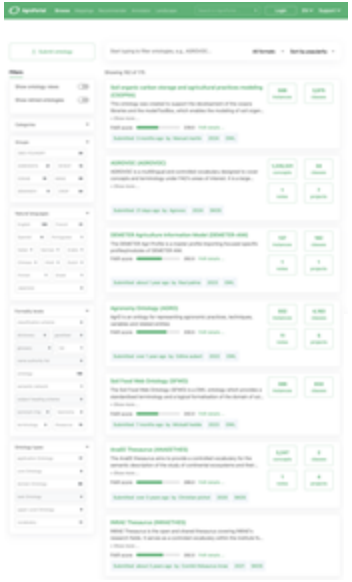
839 Accesses | **1** Citations | **5** Altmetric | Metrics

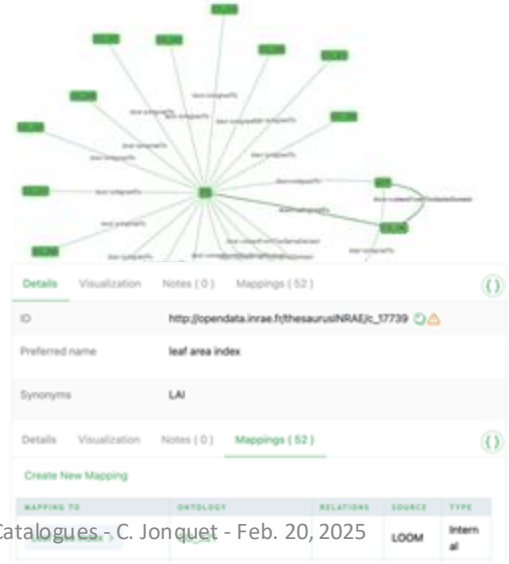
Abstract

This work presents a *maturity model* for assessing catalogues of semantic artefacts, one of the keystones that permit semantic interoperability of systems. We defined the dimensions and related features to include in the maturity model by analysing the current literature and existing catalogues of semantic artefacts provided by experts. In addition, we assessed 26 different catalogues to demonstrate the effectiveness of the maturity model, which includes 12 different dimensions (Metadata, Openness, Quality, Availability, Statistics, PID, Governance, Community, Sustainability, Technology, Transparency, and Assessment) and 43 related features (or sub-criteria) associated with these dimensions. Such a maturity model is one of the first attempts to provide recommendations for governance and processes for preserving and maintaining semantic artefacts and helps assess/address interoperability challenges.

Ontology repositories help to make ontologies FAIR

Findable **A**ccessible **I**nteroperable **R**e-usable





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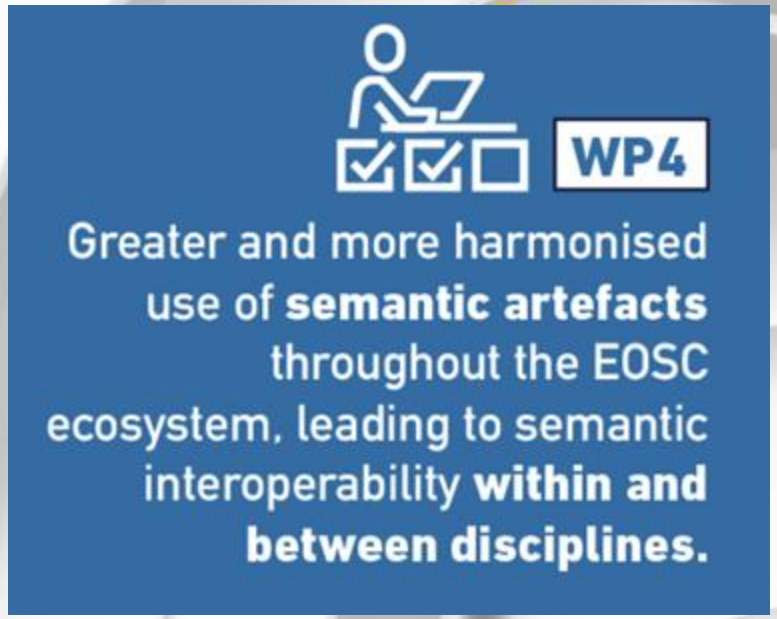


WP4 work on Semantic Artefact and their Catalogues

*WP4 will develop and foster the uptake of a semantic **framework** for the governance, creation, mapping, sharing, reuse, FAIRness assessment and interoperability of **semantic artefacts** for EOSC.*

Funded by the European Union

Main focus of WP4

…implementation of FAIR-enabling practices ***across communities and research outputs***

WP4's use cases include

- Agri-food (INRAE with AgroPortal, EMPHASIS, ANAEE)
- Ecology/biodiversity (LifeWatch with EcoPortal)
- Earth sciences (CNRS with DataTerra EarthPortal)
- Photons and neutrons (UKRI-STFC)
- Social sciences and humanities (DANS)
- Astronomy (Obs. Paris)

…projecting the FAIR principles to other ***types of research objects***

WP4's research objects

Our work on Semantic Artefacts and their Catalogues

Semantic Artefact Catalogues

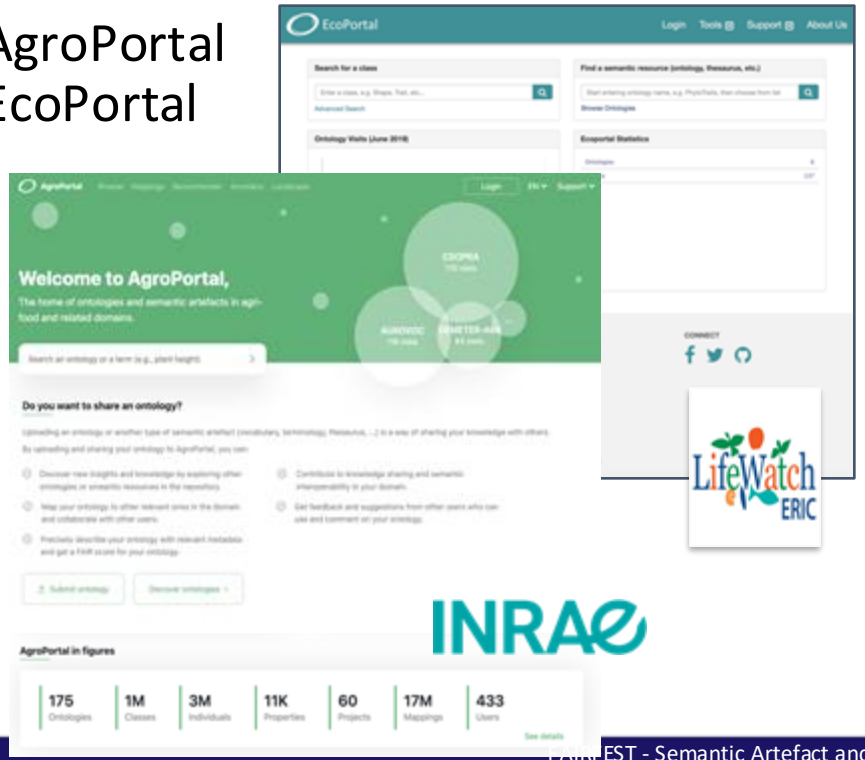
- Existing catalogues being consolidated in communities
- New catalogues being deployed in other communities/projects
- *Semantic Artefact « FAIR-by-design » methodology*
- FAIRenabling tools and methods being transferred
- Exhaustive review of current and retired catalogues and FAIR-enabling criteria
- *Catalogues being exploited in data repositories (9 use cases)*
- A metadata standard for semantic artefacts (MOD)
- A standard API for semantic artefact catalogues (MOD-API)
- Early work on federation of 4 catalogues
- *3 possible models for semantic artefact governance*
- *Toward specifications for FAIR mappings*

Semantic Artefact

Mappings

Existing catalogues being consolidated in communities

AgroPortal
EcoPortal



LifeWatch ERIC

INRAE

New catalogues being deployed in other communities/projects

Inside of FAIR-IMPACT

- EarthPortal (earth sciences)
- EscapePortal (astronomy)

…and outside (technological sciences, SSH, biodiversity)

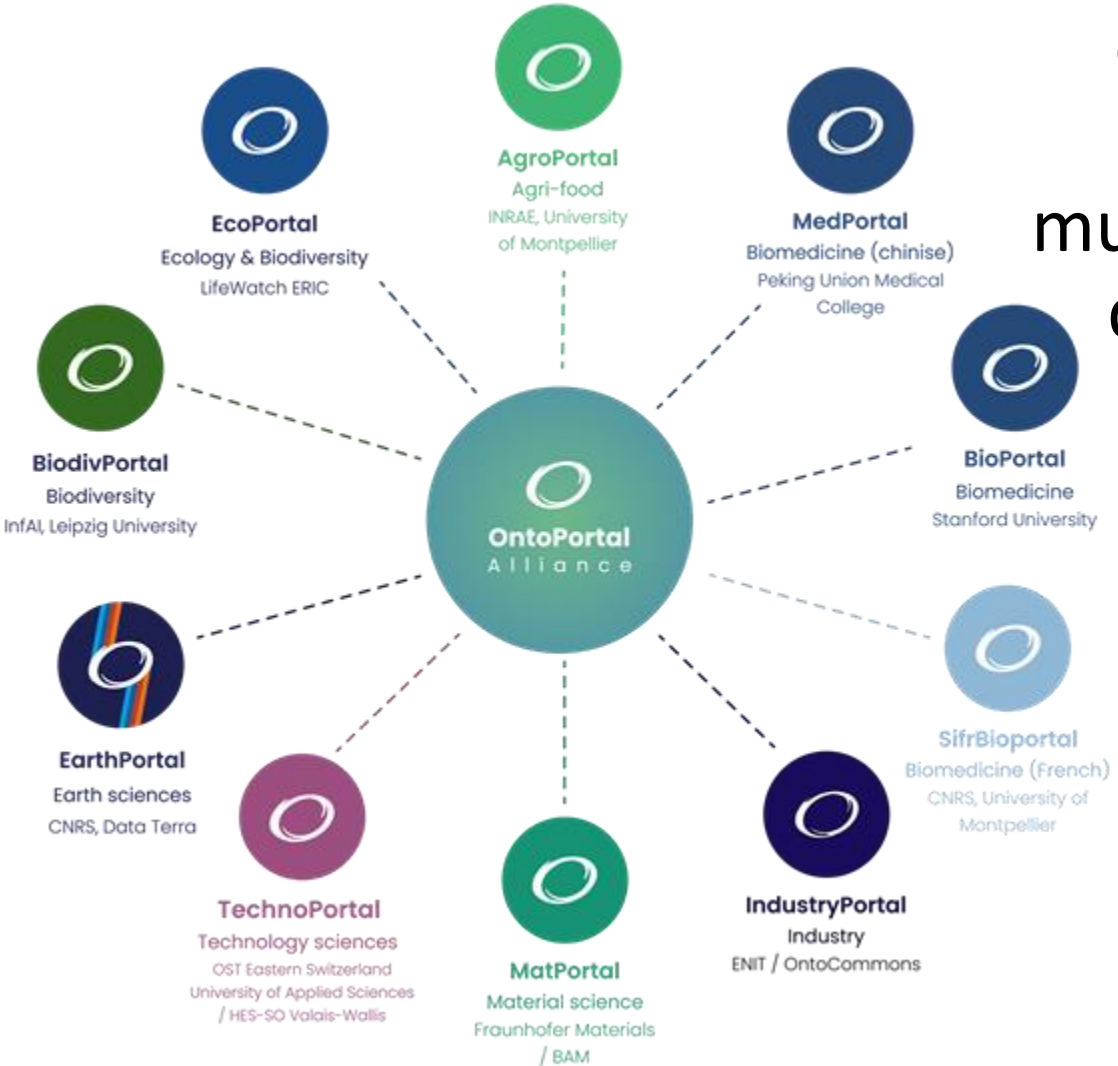
DATA TERRA

l'Observatoire de Paris

NFDI4 BIODIVERSITY

Working with other approaches too: Linked Open Vocabularies, CESSDA Vocabularies, etc.

OntoPortal Alliance: Synchronizing and mutualizing research and development efforts



Representing OntoPortal adopters and end users

- to maximize OntoPortal value (state-of-the-art service portfolio)
- to improve OntoPortal software while managing several parallel and different installations
- to increase semantic uptake in science communities and facilitate adoption of the FAIR principles
- to increase the ecosystem's long term operational and financial health

FAIRenabling tools and methods being transferred

- 4 new deployments of O'FAIRe (the Ontology FAIRness Evaluator)
- A methodology developed and implemented first in AgroPortal

E. Amdouni, S. Bouazzouni, C. Jonquet. **O'FAIRe: Ontology FAIRness Evaluator in the AgroPortal semantic resource repository**. *ESWC 2022 - 19th Extended Semantic Web Conference, Poster and demonstration*, May 2022, Hersonissos, Greece. (10.1007/978-3-031-11609-4_17)

O'FAIRe deployments:

AgroPortal

SIFR BioPortal

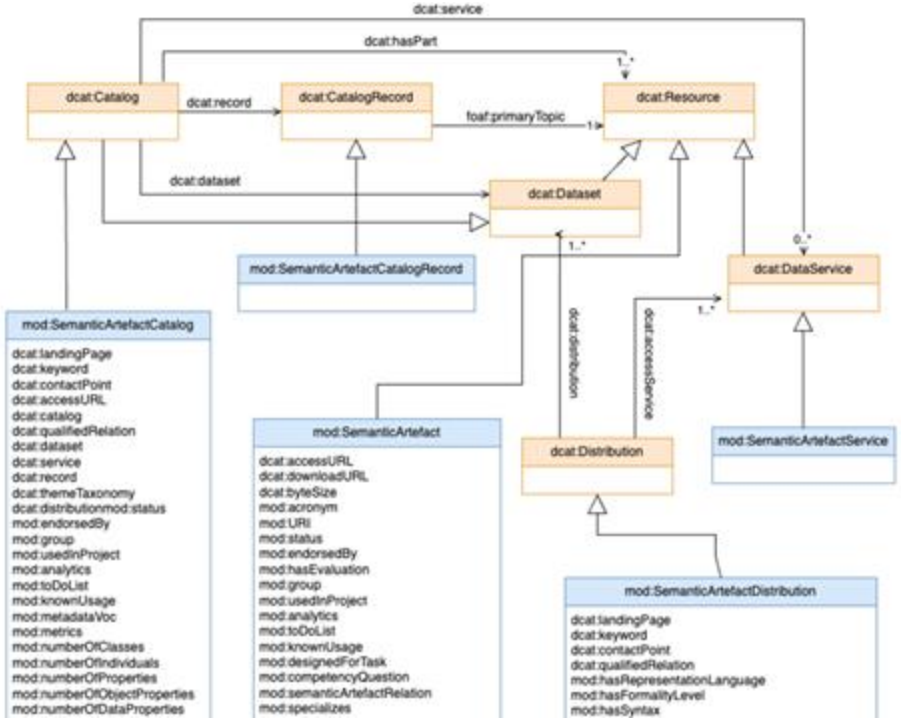
IndustryPortal

EcoPortal

EarthPortal

BiodivPortal

A metadata standard for semantic artefacts (MOD)



Based on DCAT

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Expanding FAIR solutions across EOSC

Project Title	Expanding FAIR solutions across EOSC
Project Acronym	FAIR-IMPACT
Grant Agreement No.	101057344
Start Date of Project	2022-06-01
Duration of Project	36 months
Project Website	https://fair-impact.eu/

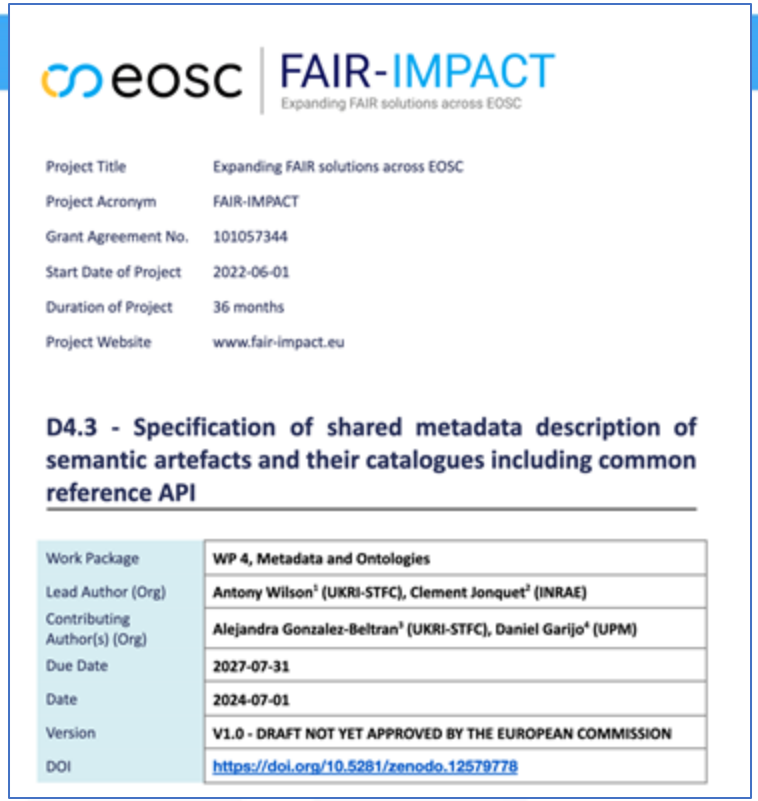
1 M4.3 - Specification of semantic artefact description

Work Package	WP 4, Metadata and Ontologies
Lead Author (Org)	Alejandra Gonzalez-Beltran[1] (UKRI-STFC), Antony Wilson[2] (UKRI-STFC)
Contributing Author(s) (Org)	Biswanath Dutta[3] (ISI), Daniel Garijo[4] (UPM), Clement Jonquet[5] (INRAE), Yann Le Franc[6] (eSDF), María Poveda-Villalón[7] (UPM)
Due Date	2024-02-29
Date	2024-02-29
Version	V1.0
DOI	10.5281/zenodo.10725304

https://github.com/FAIR-IMPACT/MOD

A standard API for semantic artefact catalogues (MOD-API)

FAIR-IMPACT's implementation action for MOD-API (after a dedicated open call) **gathers 16 SAC providers**



eosc | FAIR-IMPACT
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Project Acronym	FAIR-IMPACT
Grant Agreement No.	101057344
Start Date of Project	2022-06-01
Duration of Project	36 months
Project Website	www.fair-impact.eu

D4.3 - Specification of shared metadata description of semantic artefacts and their catalogues including common reference API

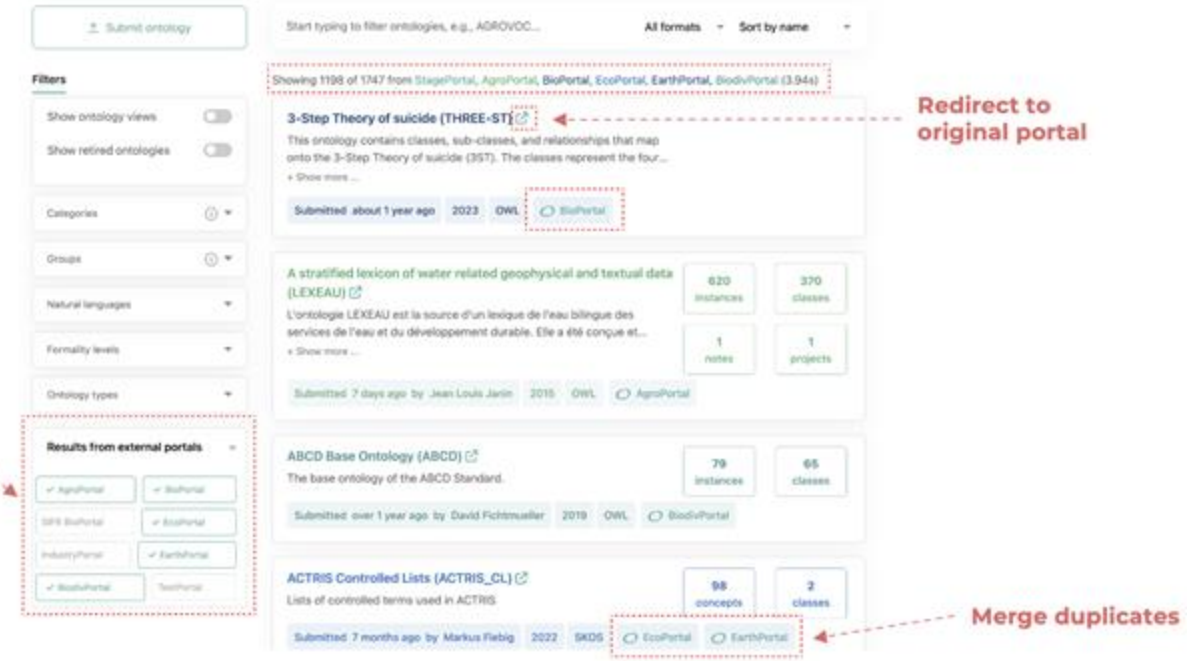
Work Package	**WP 4, Metadata and Ontologies**
Lead Author (Org)	**Antony Wilson[1] (UKRI-STFC), Clement Jonquet[2] (INRAE)**
Contributing Author(s) (Org)	**Alejandra Gonzalez-Beltran[3] (UKRI-STFC), Daniel Garijo[4] (UPM)**
Due Date	**2027-07-31**
Date	**2024-07-01**
Version	**V1.0 - DRAFT NOT YET APPROVED BY THE EUROPEAN COMMISSION**
DOI	https://doi.org/10.5281/zenodo.12579778

https://github.com/FAIR-IMPACT/MOD-API

OntoPortal Federation: SAC talking one-another!

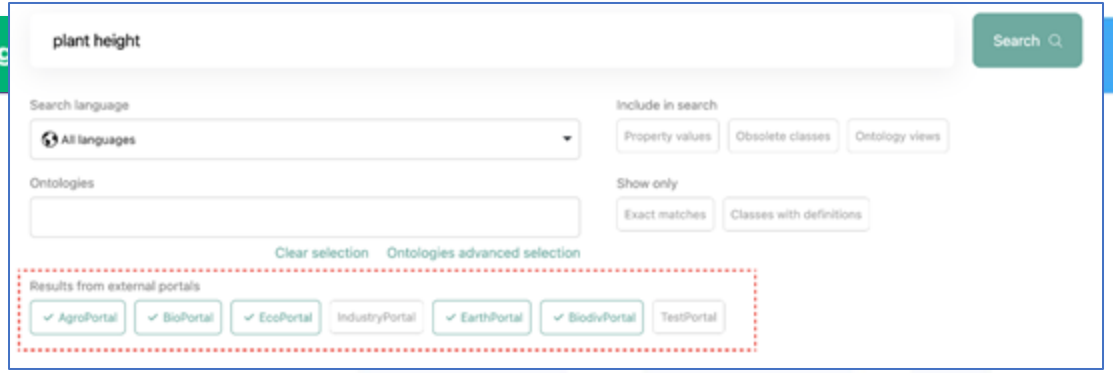
- Explore ontologies across the four portals, using:
  - **federated browsing**
  - **federated search**

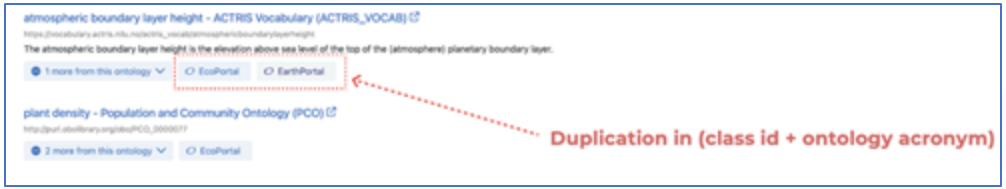
- But also federated:
  - APIs,
  - user interfaces,
  - documentation,
  - Categories
  - and more!



Federated Search

- A new dimension to SA exploration by enabling users to search concepts and classes not only within the local SAC but also across other federated OntoPortal instances
- Results are merged and sorted
- Move to the original portal if the result is from a federated portal





3 approaches to SAC interoperability

MOD-API

FA
Expandi

- *Each SAC implements a shared/standard API*
- - - API needs to be produced and maintained
- - - need SAC to commit to implement API □ Open call
- ++ more robust
- ++ no proxy or indirection
- ++ more sustainable
- ++ engage SACs towards interoperability

OntoPortal

OntoPortal Alliance

- *SACs are already interoperable at API/backend level and may federate their content (at UI level)*
- + + no need to implement another API
- + + federation is straightforward as APIs are the same
- - - works only for OntoPortal

API Gateway

TS4nfdi
Terminology Services for the German National Research Data Infrastructure

- *SACs do nothing, TS4NFDI implements the wrappers to consume SKOSMOS-based, OLS-based and OntoPortal-based SACs*
- + + very convenient for SACs
- - - need a proxy in the middle
- - - less sustainable
- - - does not engage SACs on the interoperable path

Deliverables (done & *upcoming*)

- D4.1 - Semantic artefact **governance models** and disciplinary approaches for inclusion within EOSC
- M4.2 - Processes & tools **to engineer FAIR semantic artefacts**
- D4.3 - Specification of shared **metadata description** of semantic artefacts and their catalogues including common reference API
- D4.4 - Guidelines for recommended **metadata standard for research software** within EOSC
- D4.2 - FAIR **semantic artefact lifecycle** from engineering, to sharing
- *D4.5 - Guidelines and methodology to create, document and share* ***mappings and crosswalks***
- *D4.6 - Use case driven validation of semantic artefact exploitation* ***within data repositories***

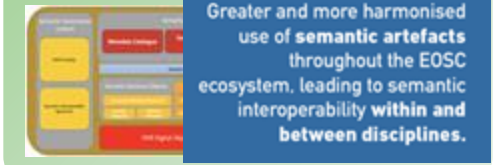
Say Hi! to Semanta

Other Milestones documents

- M4.1 - Semantic artefact governance models: example of community practices
- M5.3 - Semantic artefact FAIRness assessment methodology ready
- M4.4 - Review of semantic artefact catalogues and guidelines for serving FAIR semantic artefacts in EOSC
- *M4.5 - Internal and external use case evaluation & demonstrators*

Conclusion

- Semantic Artefact Catalogues are a key component of the EOSC Interoperability Framework
- In FAIR-IMPACT, we strongly relied on OntoPortal and made this SAC technology stronger to support FAIR SAs
- Every new community, every new use cases brings new ideas. Participate. Join. FAIR-IMPACT was a catalyser.
- There are even more dimensions to semantic artefacts (governance, mappings, etc.). Check out our deliverables.



Summary

Questions ?

eosc | FAIR-IMPACT
Expanding FAIR solutions across EOSC

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Core Components Supporting a FAIR EOSC

DTR on the roadmap of implementing FDOs

Hans Lienhop, GDWG

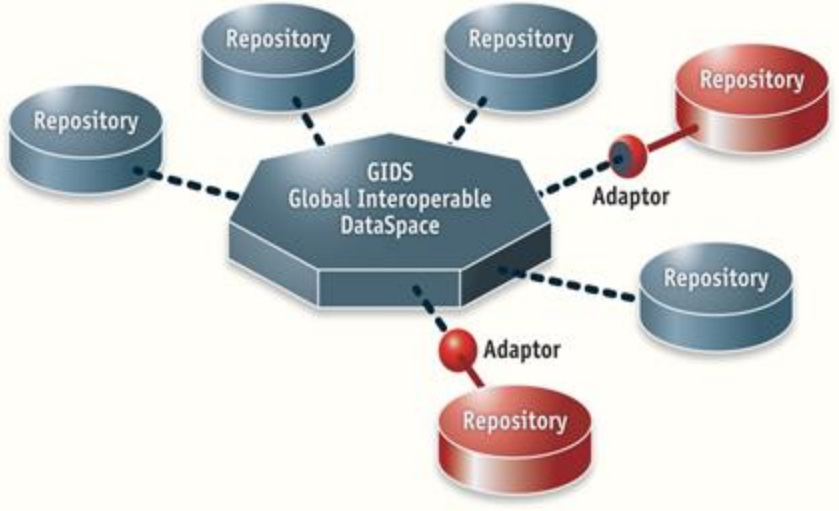
FAIRfest 20 February 2025
The Hague, The Netherlands (Madurodam)
Celebrating the advancements in FAIR solutions for EOSC

Concerning Fair Digital Objects

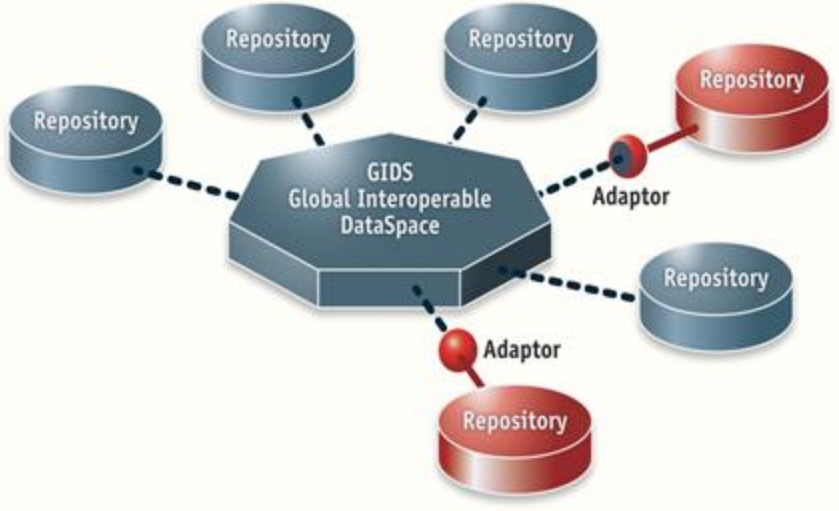
"FAIR Digital Objects combine dataspaces as the Internet combined computer networks"

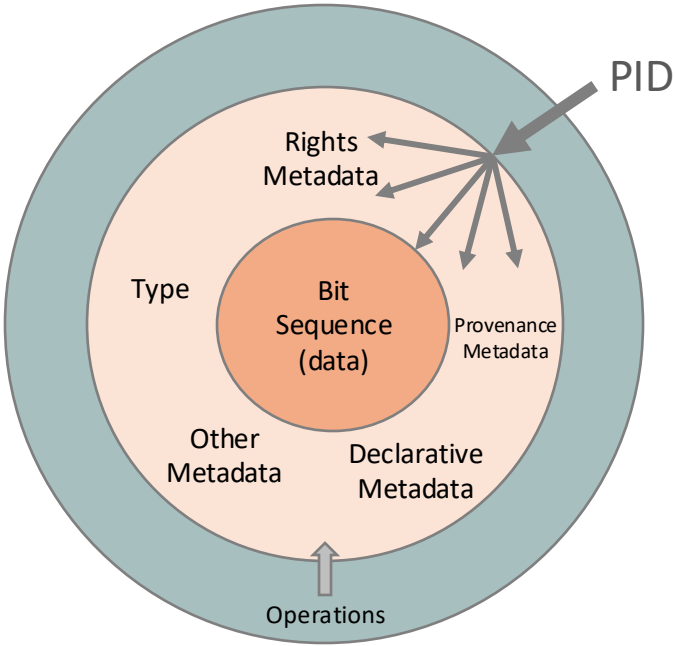
"The Web was designed to enable humans to access media data, the GIDS with FDOs is designed to enable access to all data by humans and machines."

Concerning Fair Digital Objects

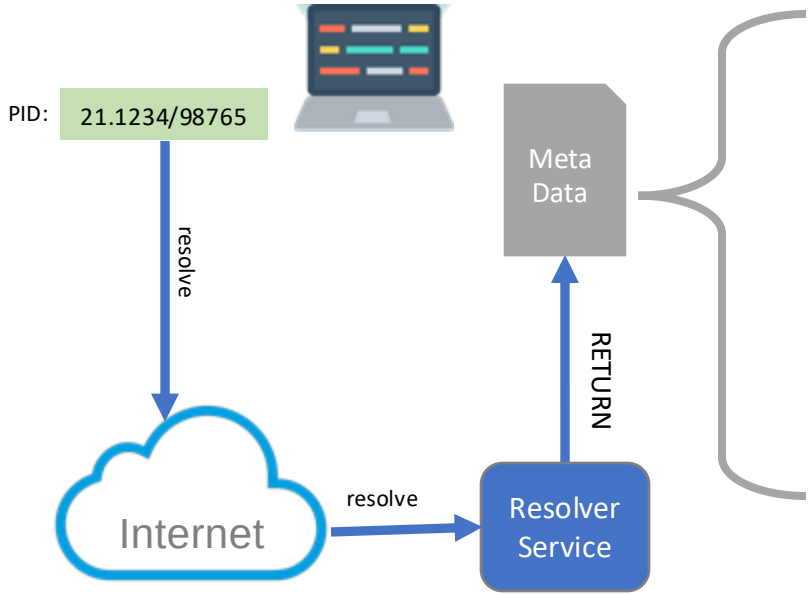


Concerning Fair Digital Objects





Resolving an FDO PID

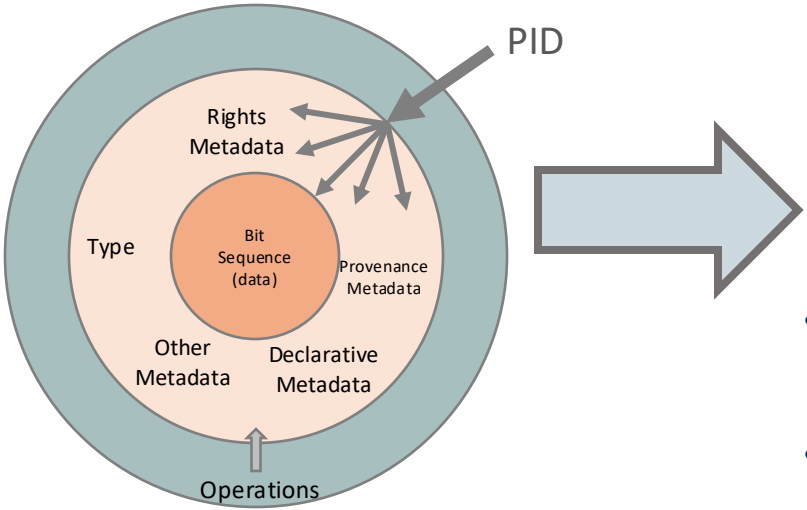


- Who created
- What is it about
- What can be done with it
- How is it related to other objects
- ....

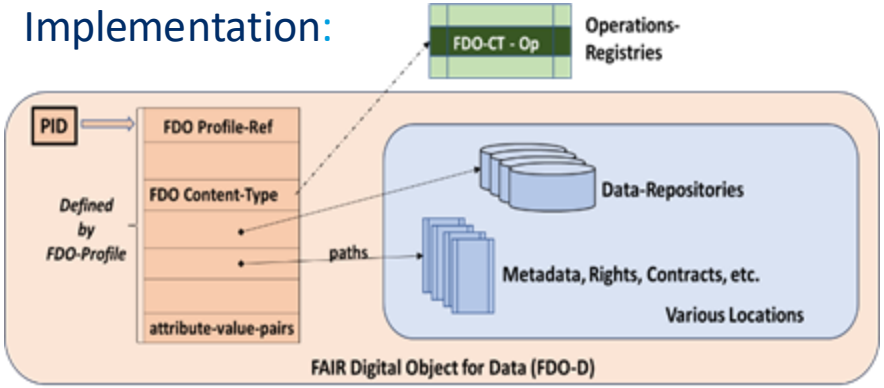
- What is the license
- Who is the owner
- ...
- and other more **technical** meta data

From Theory to Practice

Concept:

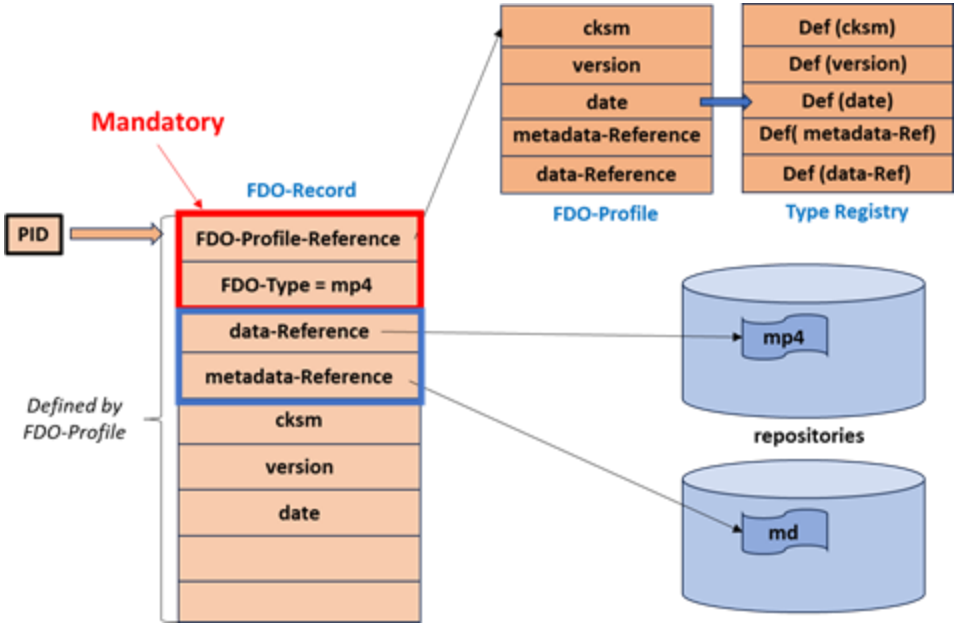


Implementation:

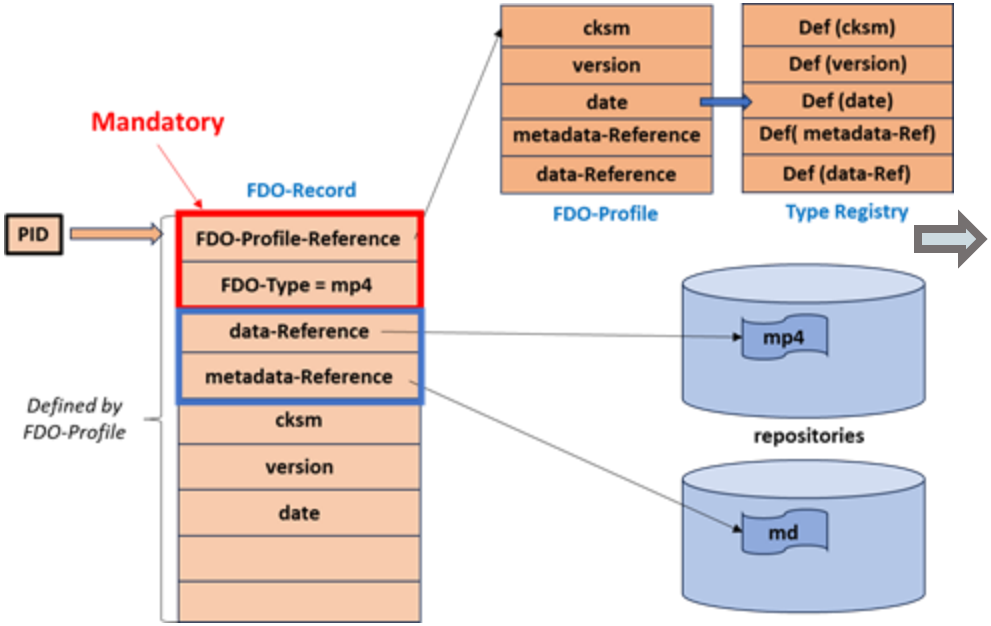


- A PID resolves to an FDO Record which is a protected set of attributes
- A Profile defines the set of attributes in the record
- Only a very minimal set of attributes is mandatory

From Theory to Practice



From Theory to Practice



Handle Values for: 21.T11967/7cac06ea60e01a96ee02

Index	Type	Timestamp	Data
100	HS_ADMIN	2024-12-01 10:44:44Z	handle=0.NA/21.T11967; index=300; [cre… admin,del admin,add admin,list]
1	10320/loc	2024-12-01 10:44:44Z	<locations> <location href="https://cordra.testbed.pid.… <location href="https://cordra.testbed.pid.… </locations>
2	id	2024-12-01 10:44:44Z	21.T11967/7cac06ea60e01a96ee02
3	name	2024-12-01 13:51:11Z	sensor_data_bme2080_26083_20241130
4	FDO_MD_Refs	2024-12-01 10:44:44Z	[21.T11967/5c17b5b735a90c555725]
5	FDO_Data_Refs	2024-12-01 10:44:44Z	[21.T11967/d174f6c0b2a4abda913b]
6	FDO_Profile_Ref	2024-12-01 10:44:44Z	21.T11969/141bf451b18a79d0fe66
7	FDO_Type_Ref	2024-12-01 10:44:44Z	21.1/sensordata
8	creationDate	2024-12-01 13:51:11Z	2024-12-01T10:44:44.863Z
9	modificationDate	2024-12-01 13:51:11Z	2024-12-01T13:51:11.612Z
10	createdBy	2024-12-01 13:51:11Z	admin
11	modifiedBy	2024-12-01 13:51:11Z	admin
12	FDO_Status	2024-12-01 13:51:11Z	created
13	FDO_Rights_Ref	2024-12-01 13:51:11Z	21.1/CC0
14	FDO_Genre_Ref	2024-12-01 13:51:11Z	21.1/thisIsAnFdoGenre
15	0.TYPE/ DOIPService	2024-12-01 13:51:11Z	21.T11967/service

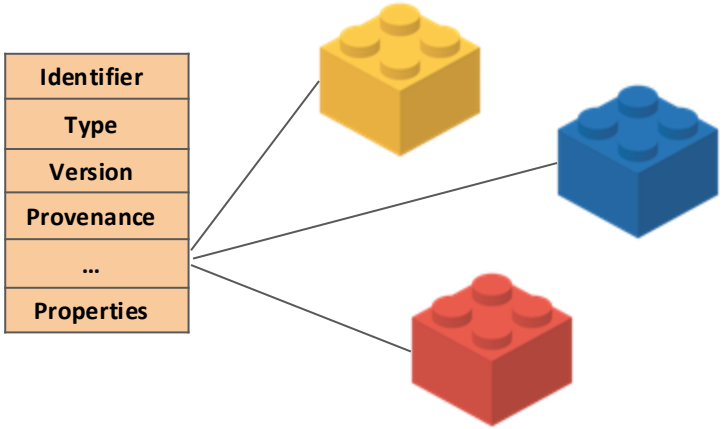
The Data Type Registry

DTR
EOSC Data
Type Registry

- Data Type: A grouping of Data Values based on a **set of possible values**
- Using Persistent Identifiers to ensure **Accessibility** and **Interoperability**
- Promotes the **reuse** of existing assets and the compliance with data **standards**
- Increase the **machine actionability** of Data Types and Metadata
- Validate conformity of data with data types

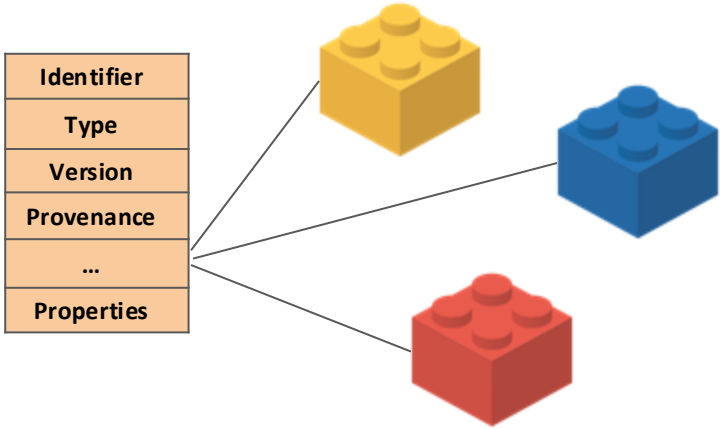
The Data Type Registry

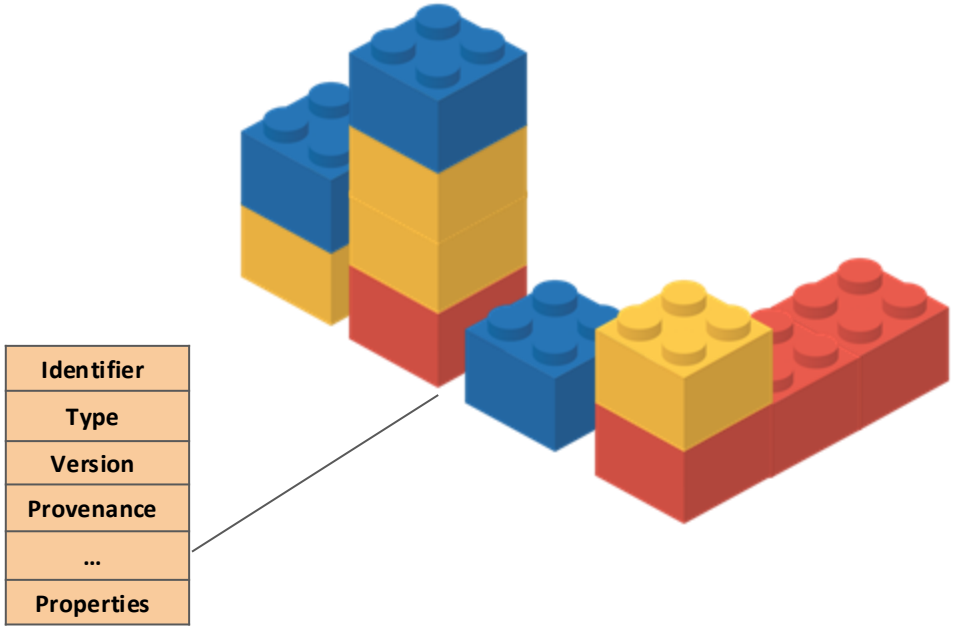
DTR
EOSC Data Type Registry



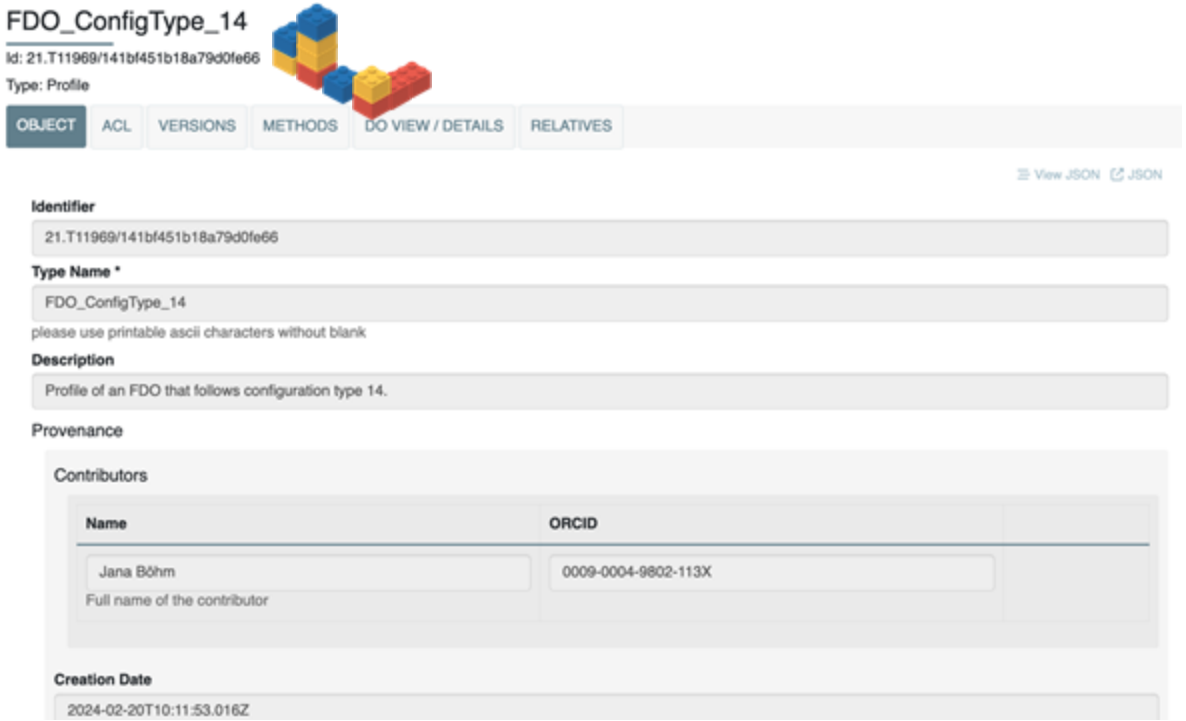
The Data Type Registry

DTR
EOSC Data Type Registry

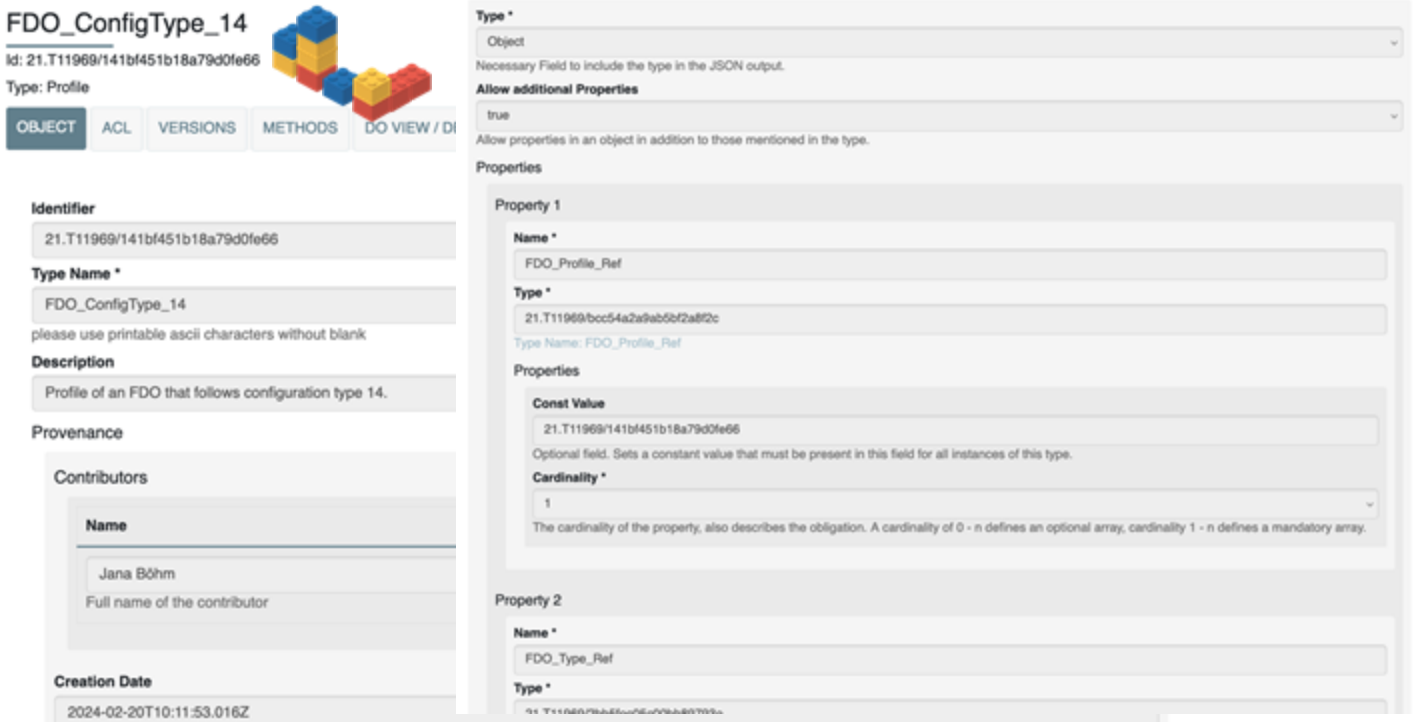




The DTR on the FDO Roadmap



The DTR on the FDO Roadmap



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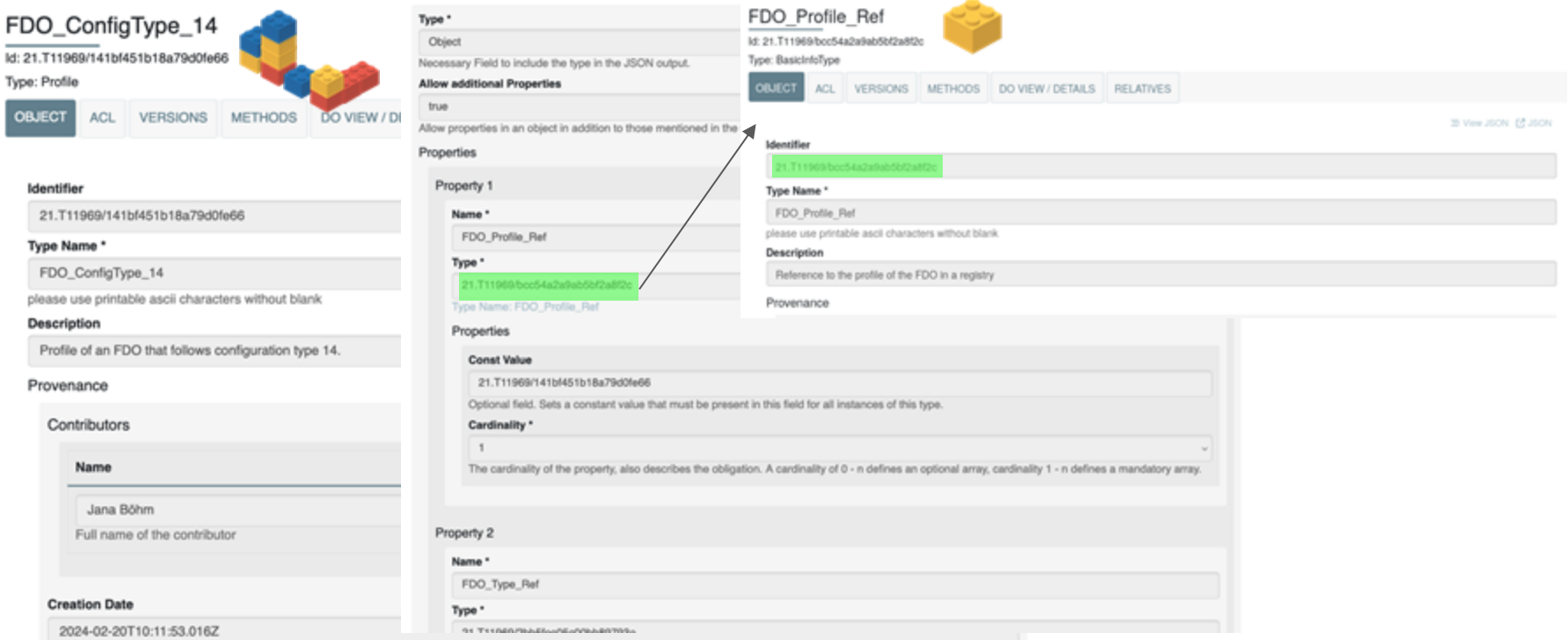
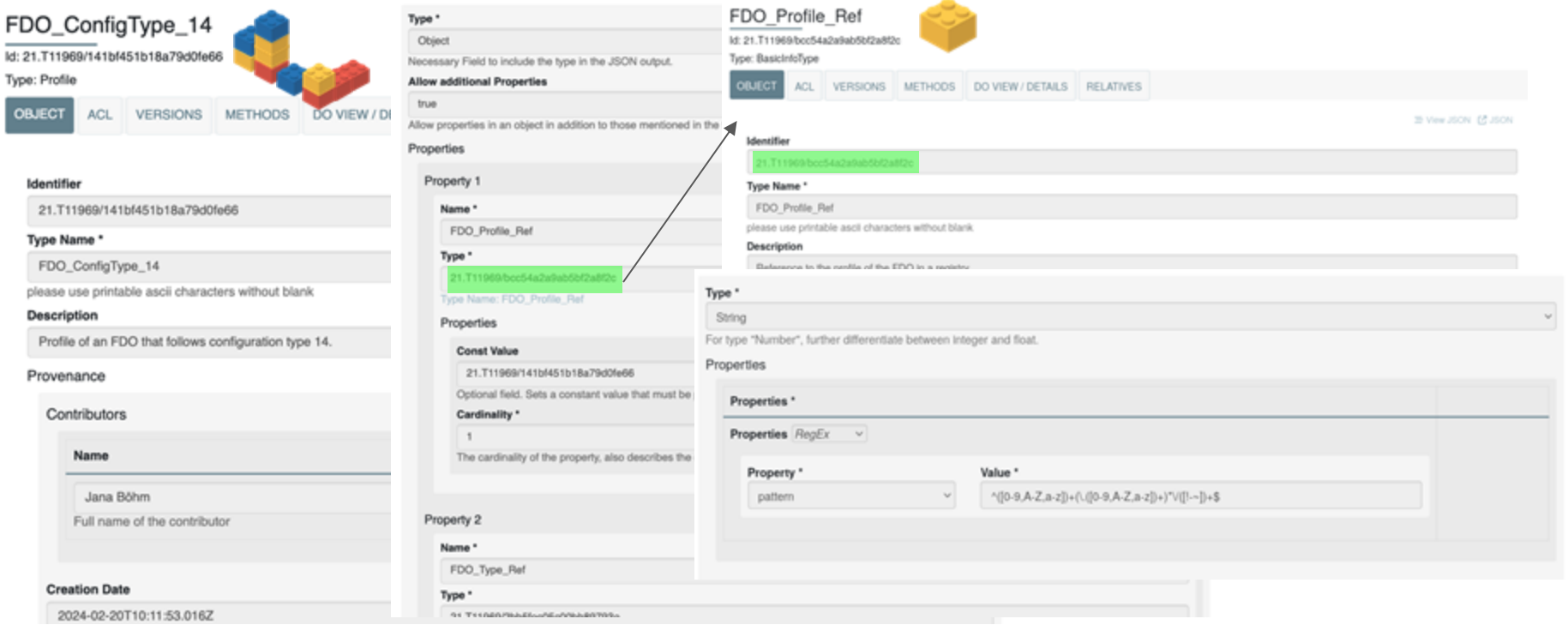


The DTR on the FDO Roadmap



The DTR on the FDO Roadmap

Handle Values for: 21.T11967/7cac06ea60e01a96ee02

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3	name	2024-12-01 13:51:11Z	sensor_data_bme2080_26083_20241130
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12	FDO_Status	2024-12-01 13:51:11Z	created
13	FDO_Rights_Ref	2024-12-01 13:51:11Z	21.1/CC0
14	FDO_Genre_Ref	2024-12-01 13:51:11Z	21.1/thisIsAnFdoGenre
15	0.TYPE/ DOIPService	2024-12-01 13:51:11Z	21.T11967/service


```
▼ Object
    @id: "21.T11969/141bf451b18a79d0fe66"
    type: "object"
    additionalProperties: true
  ▶ required: Array[3]
  ▼ properties: Object
      ▶ FDO_Profile_Ref: Object
      ▶ FDO_Type_Ref: Object
      ▶ FDO_Data_Refs: Object
      ▶ FDO_MD_Refs: Object
      ▶ FDO_Rights_Ref: Object
      ▶ FDO_Genre_Ref: Object
      ▶ FDO_Status: Object
    description: "Profile of an FDO that follows configuration type 14."
    title: "FDO_ConfigType_14"
    $schema: "http://json-schema.org/draft-04/schema#"
```

The DTR on the FDO Roadmap

Handle Values for: 21.T11967/7cac06ea60e01a96ee02

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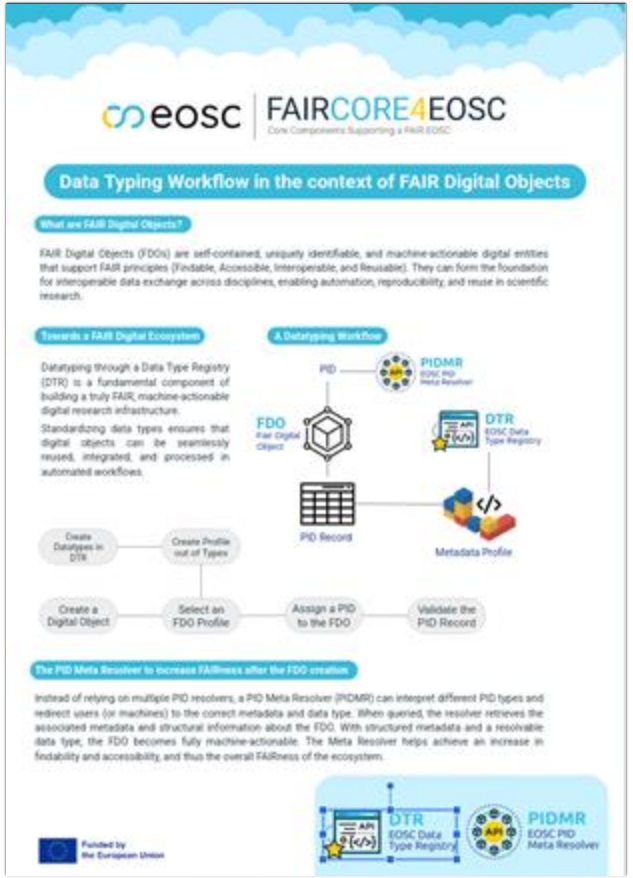
Visit the Marketplace!



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Panel Discussion

FAIRfest 20 February 2025
The Hague, The Netherlands (Madurodam)
Celebrating the advancements in FAIR solutions for EOSC

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