



FAIR-IMPACT

Expanding FAIR solutions across EOSC

FAIR Mappings and Crosswalks and more

Yann Le Franc, PhD

A short personal introduction

- CEO and Scientific Director of e-Science Data Factory (France)
- Head of the EUDAT CDI Secretariat
- Trained as Neuroscientist - 10+ years academic experience
- Specialised on Semantic Web and Linked Data, Ontology design - 15 years experience

A short personal introduction

- Contributing to H2020 and HEurope Research projects
 - EUDAT 2020(2015-2018) – Task lead
 - EOSC-Hub (2018-2020) - Participant
 - FAIRsFAIR (2019-2021) – Task lead
 - OntoCommons (2020-2023) – Task lead
 - EOSC-Pillar (2019-2022) – Technical Coordinator as CINES employee
 - FAIR IMPACT (2022-2025) - Task lead
- Leading and contributing to international expert groups on Semantics and FAIR
 - Co-chair of the RDA Interest Group on Vocabulary and Semantic Services since 2017
 - Co-chair of the RDA FAIR Mapping WG
 - Member of the EOSC Semantic interoperability Task Force
 - Member of the GOFAIR Implementation Network on Cross disciplinary Semantic interoperability
 - Co chair of the FAIR Digital Object Semantic Working Group

Expanding FAIR Solutions across Europe



**Call
HORIZON-INFRA-2021-
EOSC-01-05**
*Enabling discovery and
interoperability of federated
research objects across scientific
communities*

**Expanding FAIR
solutions in Europe**

**Partly following up on
FAIRsFAIR**



EU funded project

**Coordination and
Support Action**

10 million euro

**36 months, starting
1 June 2022**



**28 partners and
affiliate entities**

**From 10 EU
member states:
NL, FI, FR, DK, IT,
DE, ES, NO, BE,
RO**

and the UK

Semantic artefacts* are a key elements to achieving FAIR and these artefacts and their catalogues have to be FAIR too

*ontologies, terminologies, taxonomies, thesauri, vocabularies, metadata schemas and standards...

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.



WP4

Greater and more harmonised use of **semantic artefacts** throughout the EOSC ecosystem, leading to semantic interoperability **within and between disciplines.**

WP4's tasks



T4.1 (governance)

Nicola Fiore



T4.2 (lifecycle and catalogues)

Daniel Garijo +
Clement Jonquet
+ Alejandra
Gonzalez-Beltran



T4.3 (for research software)

Morane
Gruenpeter



T4.4 (crosswalks and mappings)

Yann Le Franc

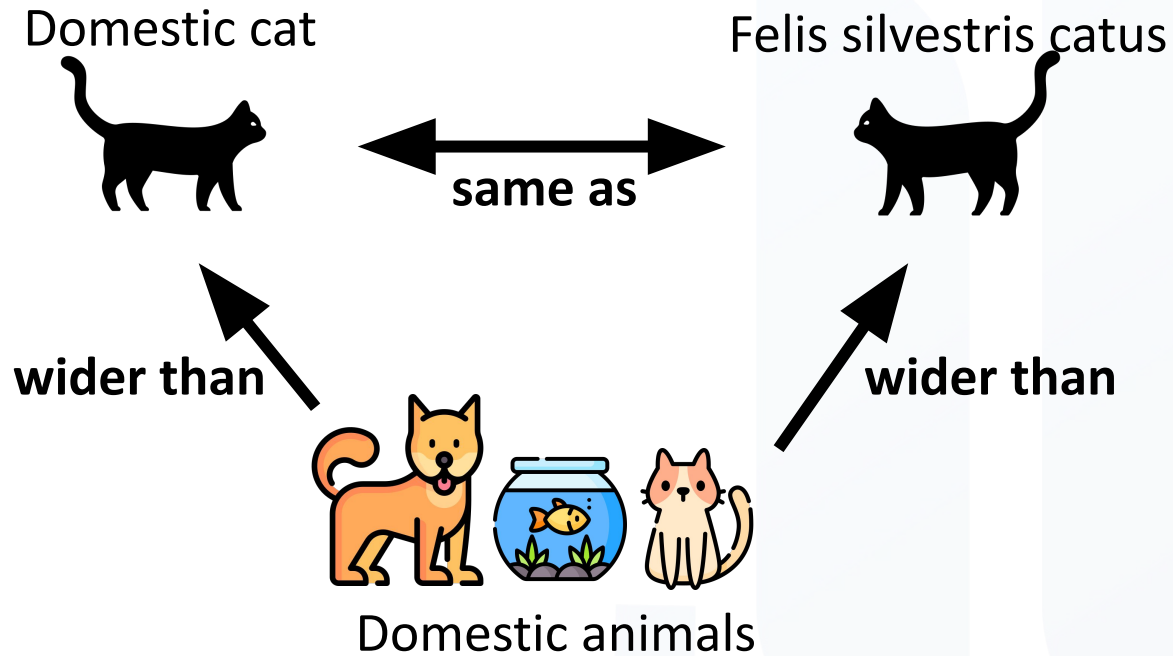


T4.5 (in-use in data repos)

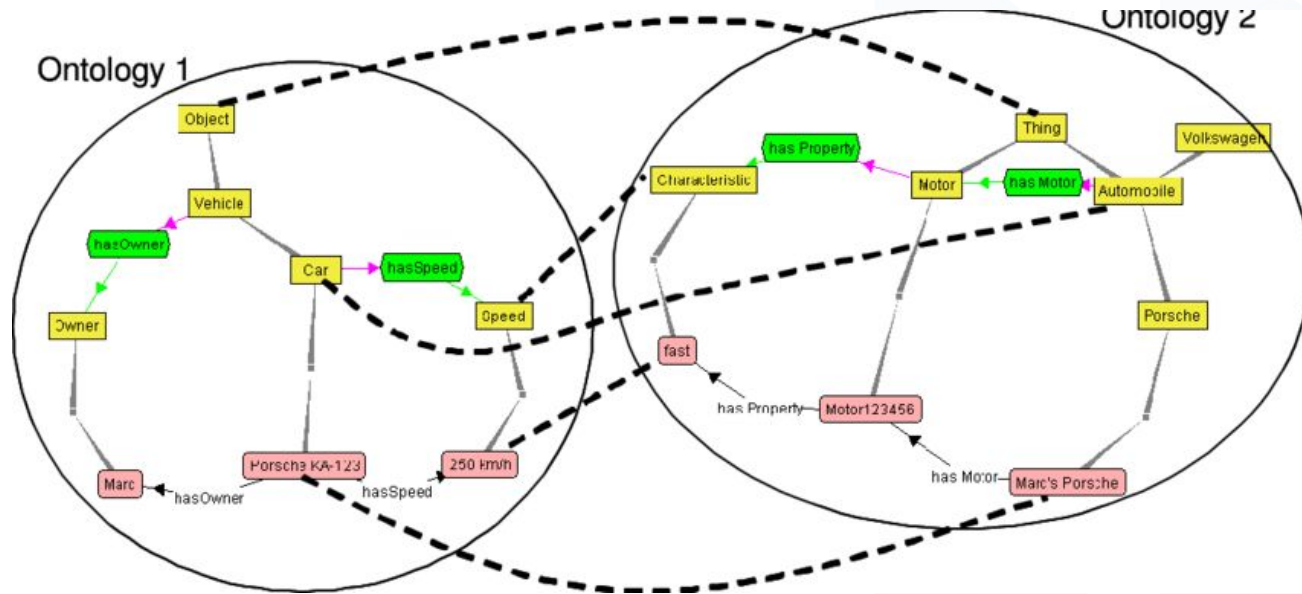
Sophie Aubin



What are mappings and crosswalks?

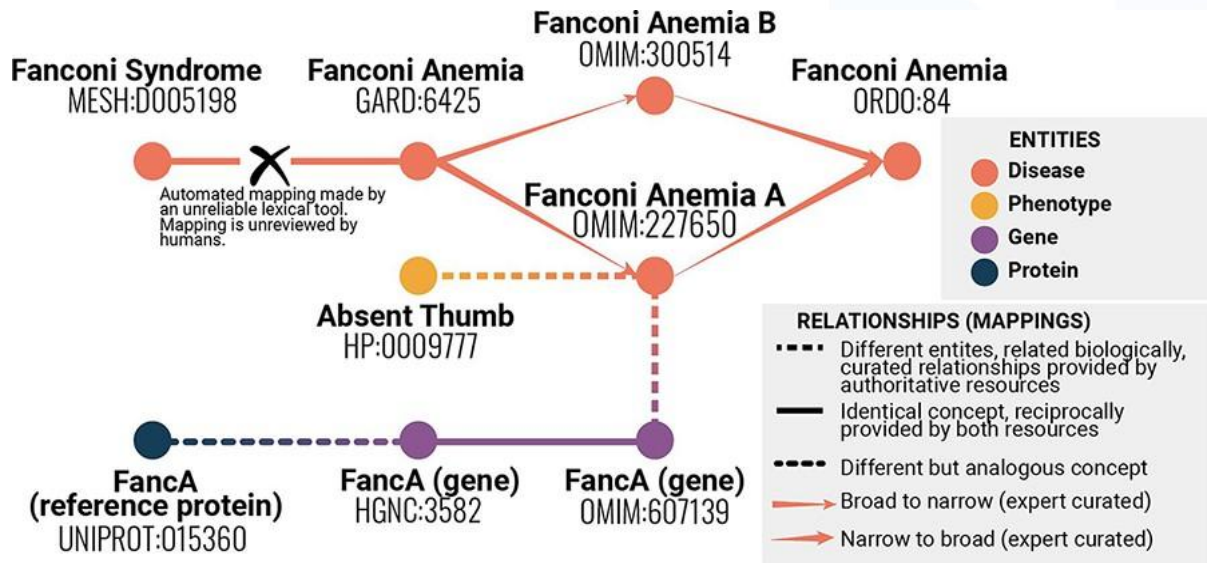


Mapping examples



From Ehrig, Marc & Staab, Steffen. (2004). QOM – Quick ontology mapping. 3298. 356-361. 10.1007/978-3-540-30475-3_47.

Mapping examples



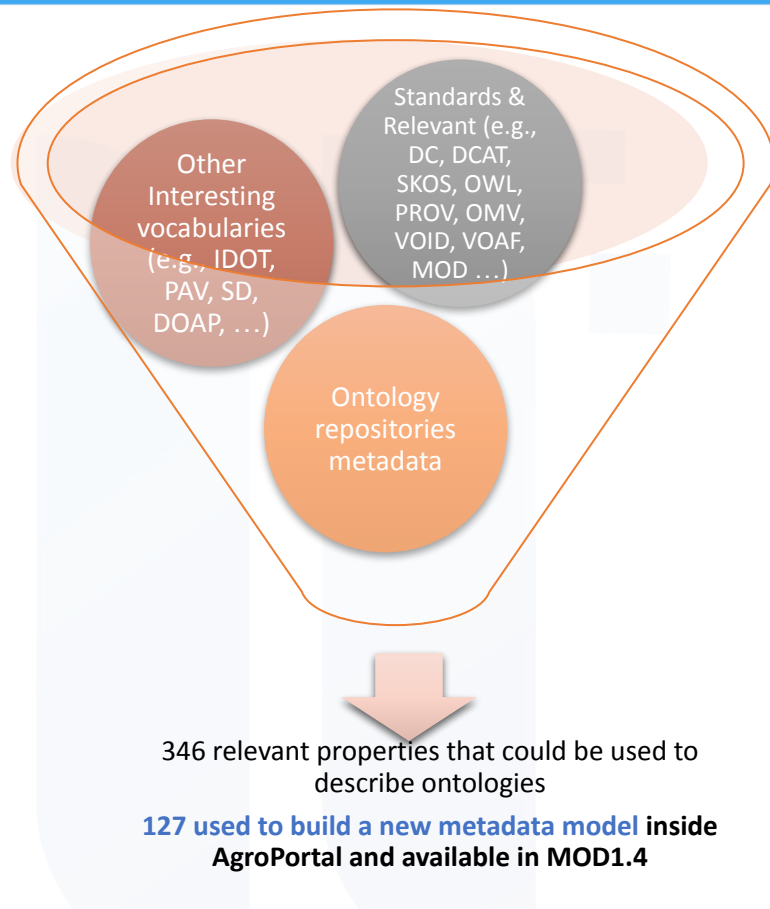
From N. Matentzoglou et al., "A Simple Standard for Sharing Ontological Mappings (SSSOM)", *Database*, Volume 2022, 2022, baac035, <https://doi.org/10.1093/database/baac035>

When do we need mappings?

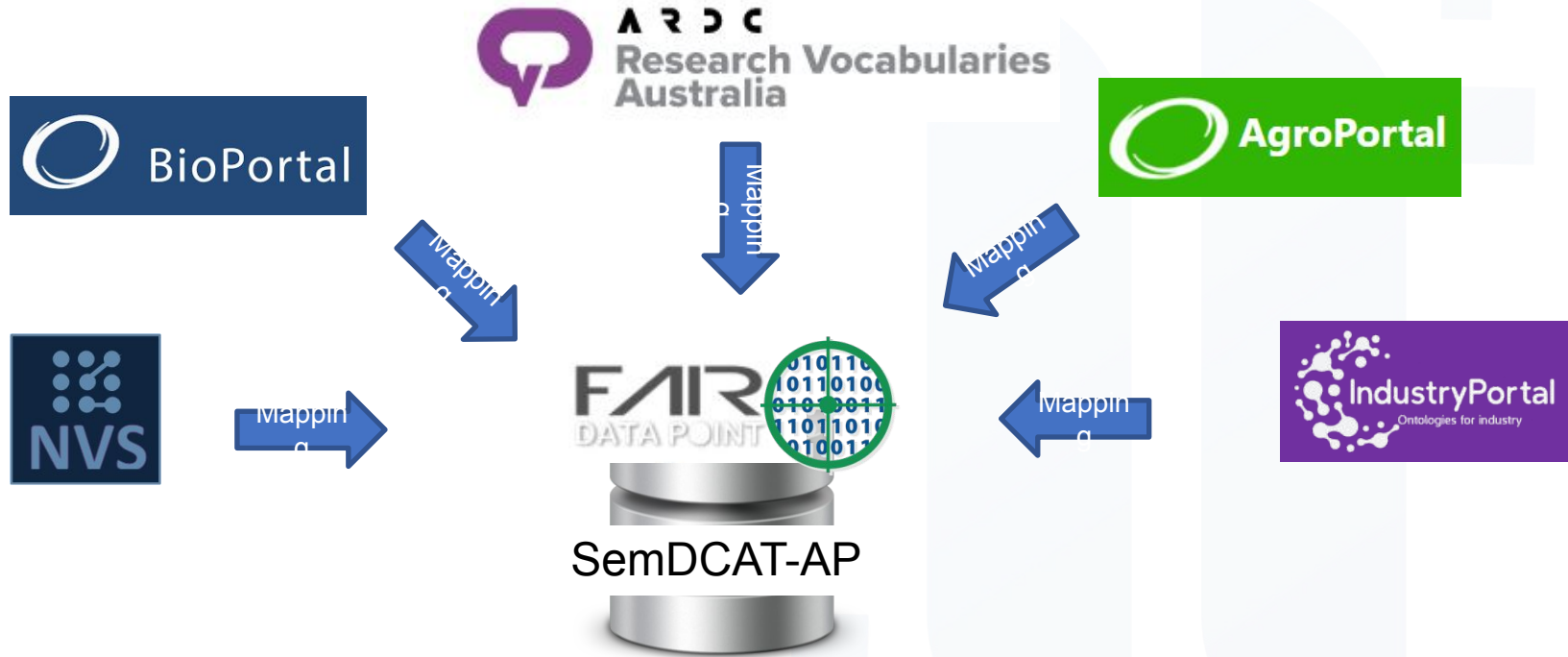
- Needed to integrate different information sources either as one information system or for enabling federated search
- Part of the ontology development process: reducing ambiguities in information systems

Review of ontology metadata practices to produce MOD

- Analysis of the **use of metadata vocabularies** in describing ontologies (by ontology developers)
 - 805 ontologies analyzed
- Analysis of the existing **metadata vocabularies**
 - 23 metadata vocabularies
- Analysis of the **uses of metadata vocabularies in various ontology libraries and repositories** (e.g., BioPortal, MMI, LOV, OBO Foundry)
 - 13 libraries



Mapping ontology repositories to SemDCAT-AP



A harmonised Semantic Artefact Metadata Catalog

FDP for Semantic Artefacts

RP

Catalogs

5

Datasets

1532

Themes & Keywords

58

Description

This FAIR Data Point implements the SemanticDCAT DCAT profile. It contains sample catalogs harvested from notable semantic artefacts repositories. Each collection contains all the metadata about semantic artefacts that was possible to collect using their public API.

Search...



Themes & Keywords

Titles

Descriptions

Recent additions



Today



Last Week



Last Month

<https://bit.ly/FDP-SemDCAT>

Clement Jonquet, Biswanath Dutta, Luiz O. Bonino da Silva Santos, Robert Pergl, Yann Le Franc. Common Minimum Metadata for FAIR Semantic Artefacts. Onto4FAIR 2023 - 2nd Workshop on Ontologies for FAIR and FAIR Ontologies, C. Trojahn; L. O. Bonino da Silva Santos; G. Guizzardi; C. Jonquet, Jul 2023, Sherbrooke, Canada. ⟨hal-04106533v2⟩

SEMANTICS
@ROCHE

CodeMeta Project: metadata for research software

The CodeMeta Project

HOME CROSSWALK CREATE TERMS



 [Crosswalk for WikiData Properties](#)

 [Crosswalk for DataCite metadata](#)

 [Crosswalk for Debian packages](#)

 [Crosswalk for DOAP Ontology](#)

 [Crosswalk for GitHub API](#)

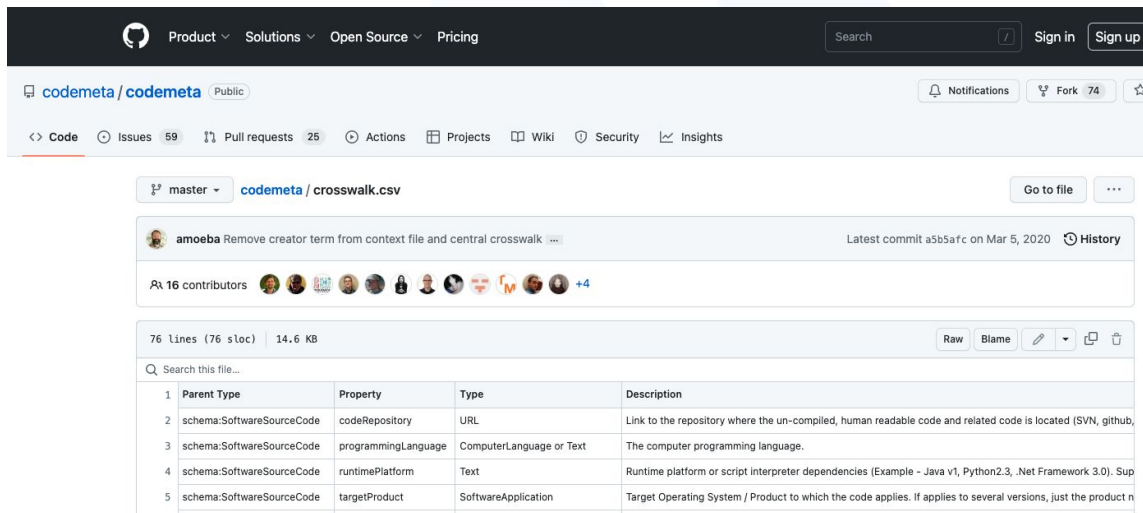
 [Crosswalk for Java's Maven metadata](#)

 [Crosswalk for NodeJS package.json](#)

 [Crosswalk for Python distutils](#)

 [Crosswalk for R Packages](#)

 [Crosswalk for Ruby gems](#)



Product Solutions Open Source Pricing Search Sign in Sign up

codemeta / codemeta Public Notifications Fork 74

Code Issues 59 Pull requests 25 Actions Projects Wiki Security Insights

master codemeta / crosswalk.csv Go to file

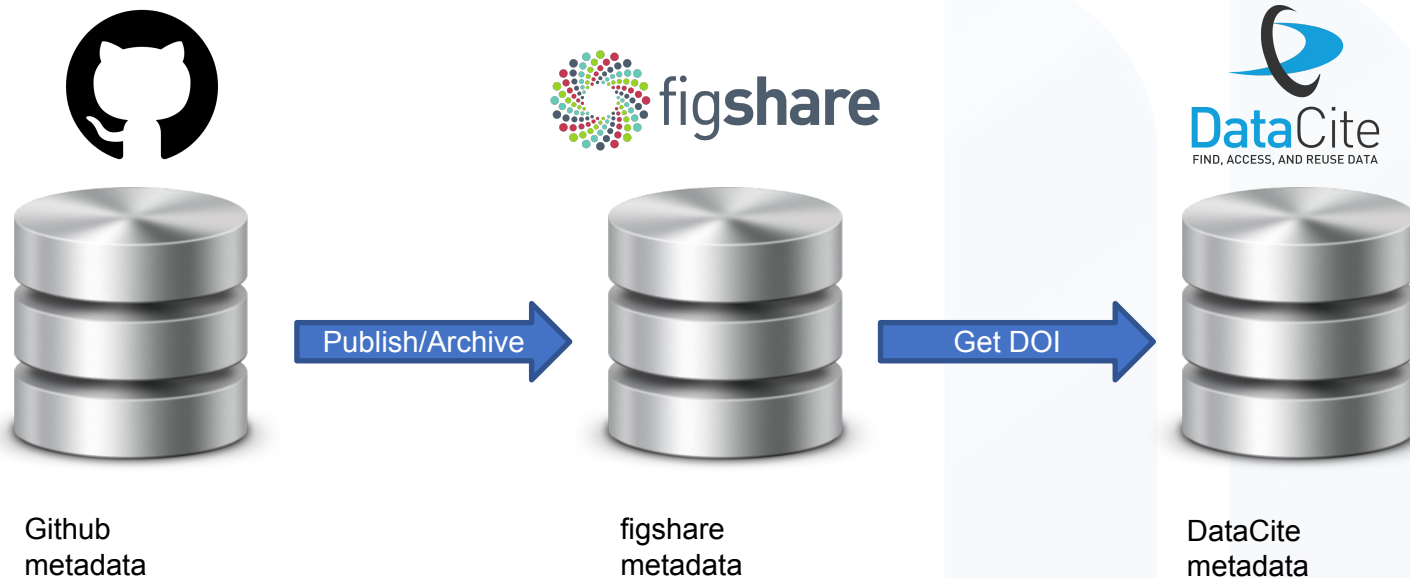
amoeba Remove creator term from context file and central crosswalk ... Latest commit a5b5afc on Mar 5, 2020 History

16 contributors

76 Lines (76 sloc) 14.6 KB Raw Blame

1	Parent Type	Property	Type	Description
2	schema:SoftwareSourceCode	codeRepository	URL	Link to the repository where the un-compiled, human readable code and related code is located (SVN, github, ...)
3	schema:SoftwareSourceCode	programmingLanguage	ComputerLanguage or Text	The computer programming language.
4	schema:SoftwareSourceCode	runtimePlatform	Text	Runtime platform or script interpreter dependencies (Example - Java v1, Python2.3, .Net Framework 3.0). Sup
5	schema:SoftwareSourceCode	targetProduct	SoftwareApplication	Target Operating System / Product to which the code applies. If applies to several versions, just the product n

Reducing information loss across services



A predefined metadata model for software

Terms from Schema.org

Recognized properties for CodeMeta [Code](https://schema.org) includes the following terms from <https://schema.org>. These terms are part of the CodeMeta specification and can be used without any prefix.

Property	Type	Description
codeRepository	URL	Link to the repository where the un-compiled, human readable code and related code is located (SVN, GitHub, CodePlex, institutional GitLab instance, etc.).
programmingLanguage	ComputerLanguage or Text	The computer programming language.
runtimePlatform	Text	Runtime platform or script interpreter dependencies (Example - Java v1, Python2.3, .Net Framework 3.0). Supersedes runtime.
targetProduct	SoftwareApplication	Target Operating System / Product to which the code applies. If applies to several versions, just the product name can be used.
applicationCategory	Text or URL	Type of software application, e.g. 'Game, Multimedia'.
applicationSubCategory	Text or URL	Subcategory of the application, e.g. 'Arcade Game'.
downloadUrl	URL	If the file can be downloaded, URL to download the binary.
fileSize	Text	Size of the application / package (e.g. 18MB). In the absence of a unit (MB, KB etc.), KB will be assumed.
installUrl	URL	URL at which the app may be installed, if different from the URL of the item.
memoryRequirements	Text or URL	Minimum memory requirements.
operatingSystem	Text	Operating systems supported (Windows 7, OSX 10.6, Android 1.6).
permissions	Text	Permission(s) required to run the app (for example, a mobile app may require full internet access or may run only on wifi).

Codemeta terms

The CodeMeta project also introduces the following additional properties, which lack clear equivalents in <https://schema.org> but can play an important role in software metadata records covered by the CodeMeta crosswalk.

Property	Type	Description
softwareSuggestions	SoftwareSourceCode	Optional dependencies, e.g. for optional features, code development, etc.
maintainer	Person	Individual responsible for maintaining the software (usually includes an email contact address)
contIntegration	URL	link to continuous integration service
buildInstructions	URL	link to installation instructions/documentation
developmentStatus	Text	Description of development status, e.g. Active, inactive, suspended. See repostatus.org
embargoDate	Date	Software may be embargoed from public access until a specified date (e.g. pending publication, 1 year from publication)
funding	Text	Funding source (e.g. specific grant)
issueTracker	URL	link to software bug reporting or issue tracking system
referencePublication	ScholarlyArticle	An academic publication related to the software.
readme	URL	link to software Readme file

Please suggest additional terms or adjustments to this representation in the [codemeta issues](https://github.com/codemeta/codemeta/issues)

Tabular mappings between Codemeta model and DataCite

Property	DataCite
programmingLanguage	Format
author	creators
dateCreated	date
dateModified	date
datePublished	publicationYear
fileFormat	Format
license	rights
publisher	publisher
version	version
description	description



Metadata mappings problems

- String to string mapping
- String to object mapping
- Object to object mapping
- Field to field mapping (usage of different vocabularies)

String to object mapping problem

- Different character strings mean the same thing

Example:

Milan Ojsteršek, Ojsteršek Milan, Ojstersek Milan, Ojstersek M., M. Ojstersek....

Solution:

Author normalization with authoritative database (for example ORCID, DBLP, VIAF...). We need a normalization service.

Transformation from string (for example dc.creator) to object in other metadata schema (for example datacite.creator)

dct:creator

creatorName
nameType
givenName
familyName
nameIdentifier (R)
nameIdentifierScheme
schemeURI

Field to field mapping problem

- Different vocabularies is used in semantically similar field in different metadata schemas

Example:

resourceTypeGeneral in Datacite schema 4.3
Audiovisual
Collection
DataPaper
Dataset
Event
Image
InteractiveResource
Model
PhysicalObject
Service
Software
Sound
Text
Workflow
Other

to

COAR Resource types 3.1
vocabulary

dataset

- aggregated data
- clinical trial data
- compiled data
- encoded data
- experimental data
- genomic data
- geospatial data
- laboratory notebook
- measurement and test data
- observational data
- recorded data
- simulation data
- survey data

DataCite metadata schema mapping

DataCite Schema Schema 4.4 Older Versions Contribute Support ↗

Documentation

DataCite Metadata Working Group. (2021). DataCite Metadata Schema Documentation for the Publication and Citation of Research Data and Other Research Outputs. Version 4.4. DataCite e.V. <https://doi.org/10.14454/3w3z-sa82>

[Download PDF](#)

On the occasion of the release of v4.4 of the DataCite Metadata Schema its Metadata Working Group has updated the mapping to Dublin Core. This replaces the mapping in the Appendix of the DataCite-MetadadataKernel v2.1.

[Download PDF](#)

Schema

DataCite Metadata Working Group. (2021). DataCite Metadata Schema for the Publication and Citation of Research Data and Other Research Outputs. Version 4.4. DataCite e.V. <https://doi.org/10.14454/fxws-0523>

[View XSD](#)

Changes

Addition of the new subproperty "classificationCode" in the Subject property.

ID	DataCite-Property	Dublin Core
1	Identifier	dcterms:identifier
1.a	identifierType	Not present in Dublin Core
2	Creator	dcterms:creator
2.1	creatorName	dcterms:creator
2.1.a	nameType	Not present in Dublin Core
2.2	givenName	Not present in Dublin Core
2.3	familyName	Not present in Dublin Core
2.4	nameIdentifier	dcterms:identifier
2.4.a	nameIdentifierScheme	Not present in Dublin Core
2.4.b	schemeURI	Not present in Dublin Core
2.5	Affiliation	dcterms:contributor
2.5.a	affiliationIdentifier	dcterms:identifier
2.5.b	affiliationIdentifierScheme	Not present in Dublin Core
2.5.c	SchemeURI	Not present in Dublin Core

DataCite metadata schema mapping

DataCite Schema

Schema 4.4 Older Versions Contribute Support ↗

Documentation

DataCite Metadata Working Group. (2021). DataCite Metadata Schema Documentation for the Publication and Citation of Research Data and Other Research Outputs. Version 4.4. DataCite e.V. <https://doi.org/10.14454/3w3z-sa82>

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2.2	givenName	Not present in Dublin Core
2.3	familyName	Not present in Dublin Core
2.4	nameIdentifier	dcterms:identifier
2.4.a	nameIdentifierScheme	Not present in Dublin Core
2.4.b	schemeURI	Not present in Dublin Core
2.5	Affiliation	dcterms:contributor
2.5.a	affiliationIdentifier	dcterms:identifier
2.5.b	affiliationIdentifierScheme	Not present in Dublin Core
2.5.c	SchemeURI	Not present in Dublin Core

DataCite metadata schema mapping

DataCite Schema

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View XSD

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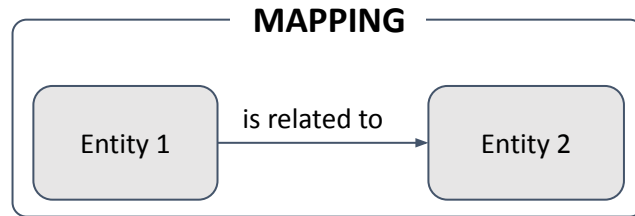
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2.2	givenName	Not present in Dublin Core
2.3	familyName	Not present in Dublin Core
2.4	nameIdentifier	dcterms:identifier
2.4.a	nameIdentifierScheme	Not present in Dublin Core
2.4.b	schemeURI	Not present in Dublin Core
2.5	Affiliation	dcterms:contributor
2.5.a	affiliationIdentifier	dcterms:identifier
2.5.b	affiliationIdentifierScheme	Not present in Dublin Core
2.5.c	SchemeURI	Not present in Dublin Core

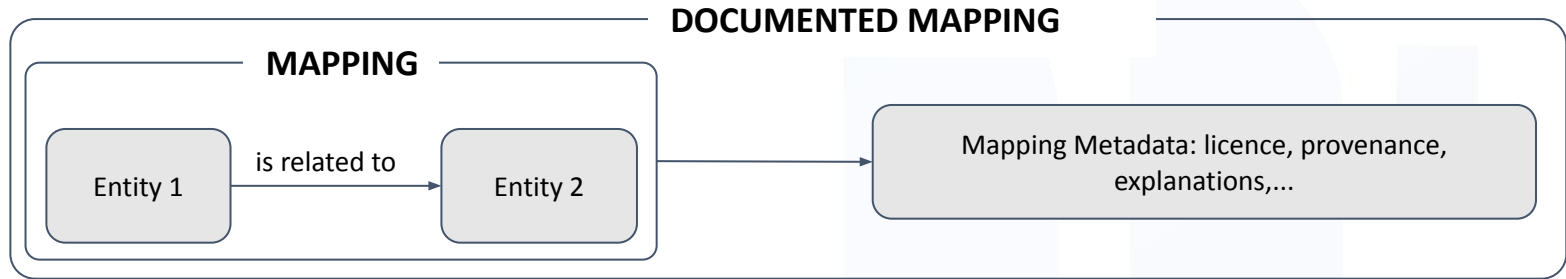
There are more types of mappings

- Unit Conversion
- Mapping Nanomaterials shapes
- Knowledge graphs mappings
- Data Mappings
- API mappings

What do we mean by mappings?

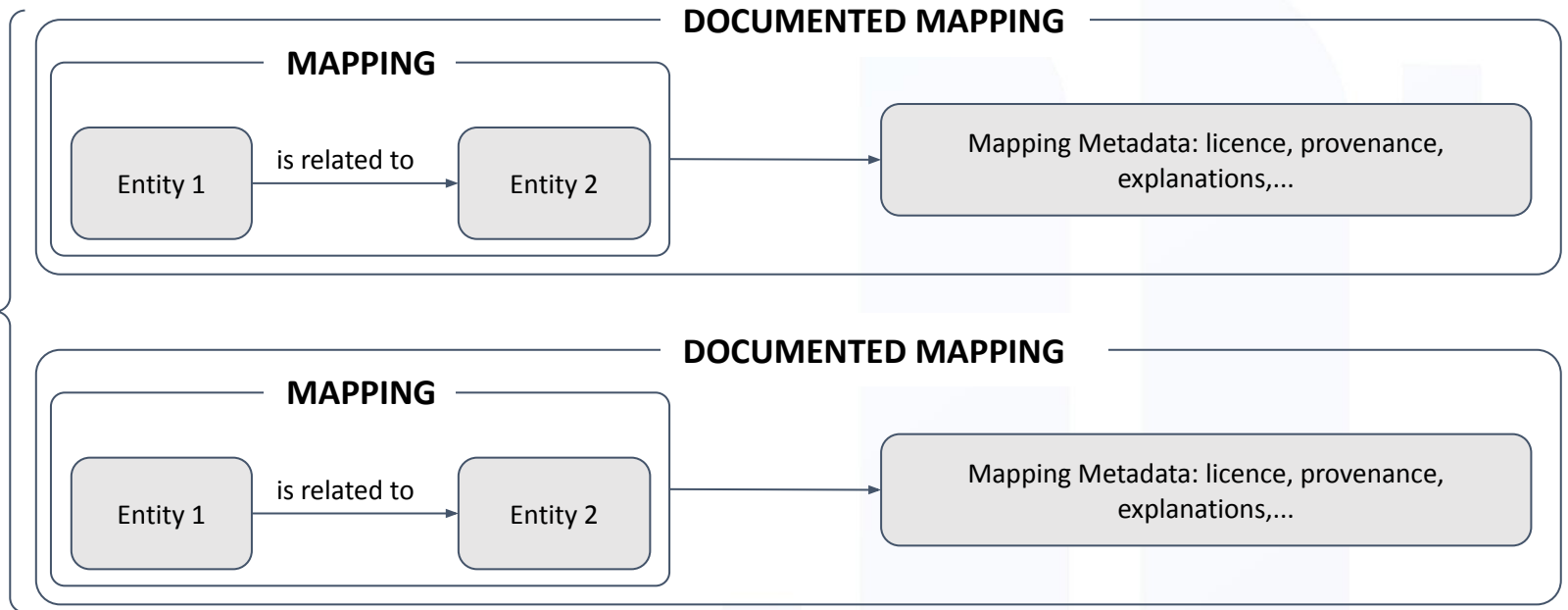


What do we mean by mappings?



What do we mean by mappings?

MAPPING SET
or CROSSWALK



How are mapping stored?

- Within the ontology or as machine readable format
- In tabular format for simple correspondances shared on github.
- In research papers

Can I reuse mappings made by others?

- In few exemption, yes (e.g. Biomedical,...)
- Most of the time, no
 - Hard to find (need to know a guy who knows a guy who knows where to find them)
 - In some cases, not published
 - Not interoperable: relation is often not explicit and format varies.
 - Not reusable
 - No context explaining the reason for the mapping
 - No information about who created the mapping
 - Based on community standard practice and format requiring additional mappings (mappings of mappings)

Cost/Benefits of FAIR Mappings

Mapping now



Cost/Benefits of FAIR Mappings

Mapping now



FAIR
Principles



With FAIR Mapping?



Mappings in FAIR Impact

Our objectives

- Establish **guidelines** on how to make mappings FAIR
- Propose a **machine-actionable common exchange model** for sharing the diversity of FAIR mappings
- Engage with communities to **co-create, test and adopt** the model for FAIR mappings and to **identify methodologies and practices** around mappings
- Establish a **governance framework** for mapping in collaboration with T4.1

Our ongoing work

Two sides of the same coins:

- Analysis of the requirements and technical recommendations for making mappings FAIR
- Practical aspects of mappings from creation to maintenance: understanding and documenting community practices

How do we work? Workshops and community engagement

Why Mappings Matter and how to make them FAIR?

Funded by the European Union

14.00 - 18.00 CEST
13 April 2023 *Online*

Organised jointly by



Documenting mapping community practices

10.00 - 13.00 CET
24 November 2023 *Online*



FAIR-IMPACT.eu

Developing a mapping process framework

15.00 - 18.00 CEST
30 April 2024 *Online*



FAIR-IMPACT.eu



Contribute to the survey on mappings and practices

https://bit.ly/fairmapping_survey

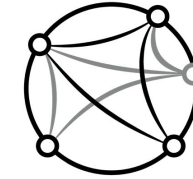


What about the FAIR Recommendations?

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)

Model and format: 1st Recommendation



SSSOM
SIMPLE STANDARD FOR SHARING
ONTOLOGY MAPPINGS

```
#license: "https://creativecommons.org/publicdomain/zero/1.0/"
#mapping_tool: "https://github.com/cmungall/rdf_matcher"
#mapping_date: "2021-04-20"

#curie_map:
# CHEBI: "http://purl.obolibrary.org/obo/CHEBI_"
# BFO: "http://purl.obolibrary.org/obo/BFO_"
# ECTO: "http://purl.obolibrary.org/obo/ECTO_"
# ...
# owl: "http://www.w3.org/2002/07/owl#"

```

Header (metadata)

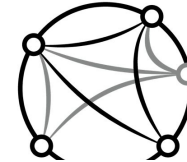
Source of mappings

CURIEs (registered prefixes) and their PURLs

Mappings

subject_id	subject_label	predicate_id	object_id	object_label	match_type	subject	object	mapping_tool	confidence	subject_match_f
CHEBI:33282		owl:equivalentClass	XCO:0000483	antibacterial agent	Lexical	CHEBI	XCO	rdf_matcher	0.500024776	dc:identifier
ECTO:9001190	exposure to nitromethane	owl:equivalentClass	NCIT:C44412	Nitromethane	Lexical	ECTO	NCIT	rdf_matcher	0.500097687	oio:hasExactSynor
XCO:0000408	metformin	owl:equivalentClass	ECTO:9000391	exposure to metformin	Lexical Stemming	XCO	ECTO	rdf_matcher	0.500090361	rdfs:label
XCO:0000408	metformin	owl:equivalentClass	GO:1901558	response to metformin	Lexical	XCO	GO	rdf_matcher	0.500042380	rdfs:label
NCIT:C44462	UV Radiation Exposure	owl:equivalentClass	XCO:0000042	ultraviolet ray exposure	Lexical	NCIT	XCO	rdf_matcher	0.500075951	oio:hasExactSynor
ECTO:9000308	exposure to fatty acid	owl:equivalentClass	GO:0070542	response to fatty acid	Lexical Stemming	ECTO	GO	rdf_matcher	0.500050796	oio:hasExactSynor

Model and format: 1st Recommendation



SSSOM
SIMPLE STANDARD FOR SHARING
ONTOLOGY MAPPINGS

```
#licen
#mappi
#mappi
#curie
# CHE
# BFC
# ECT
# ...
# owl
```

- Use SSSOM as model to represent mappings and crosswalks
- Use SSSOM metadata schema
- SSSOM as common exchange model will require extensions to cover the different types of mappings.

subject_id	subject_label	subject_class	subject_id	subject_label	subject_class	object_id	object_label	object_class	matcher	score	label
XCO:0000408	metformin	owl:equivalentClass	ECTO:9000391	exposure to metformin	Lexical Stemming	XCO	ECTO	rdf_matcher	0.500090361	rdfs:label	
XCO:0000408	metformin	owl:equivalentClass	GO:1901558	response to metformin	Lexical	XCO	GO	rdf_matcher	0.500042380	rdfs:label	
NCIT:C44462	UV Radiation Exposure	owl:equivalentClass	XCO:0000042	ultraviolet ray exposure	Lexical	NCIT	XCO	rdf_matcher	0.500075951	oio:hasExactSynon	
ECTO:9000308	exposure to fatty acid	owl:equivalentClass	GO:0070542	response to fatty acid	Lexical Stemming	ECTO	GO	rdf_matcher	0.500050796	oio:hasExactSynon	

Service and API

Services such as mapping repository/registry support the implementation of the FAIR principles

Recommendations provide additional requirements for these services.



MSCR

EOSC Metadata Schema & Crosswalk Registry

 **FAIRCORE4EOSC**

Enabling a FAIR EOSC ecosystem

Expected impact of the **Metadata Schema and Crosswalk Registry (MSCR)**:



Better metadata interoperability

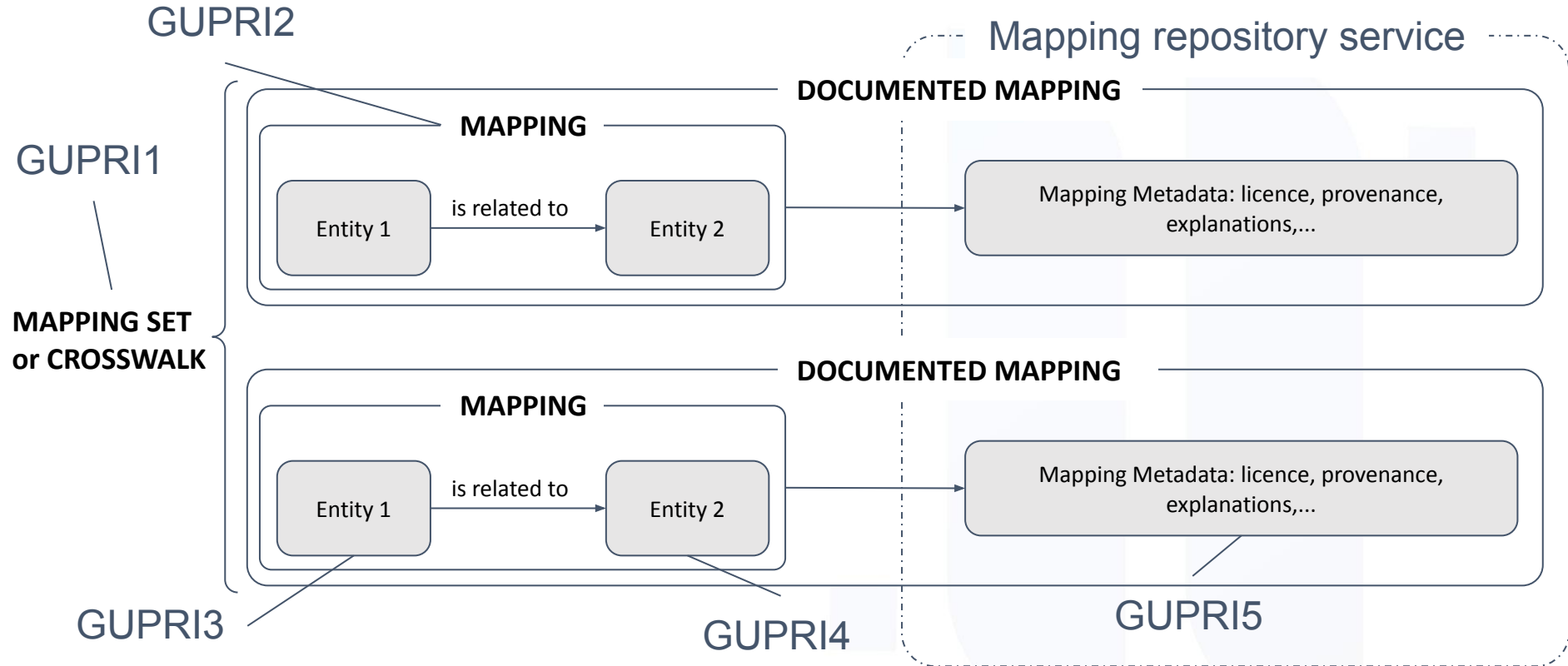


Easy to use GUI for creating crosswalks

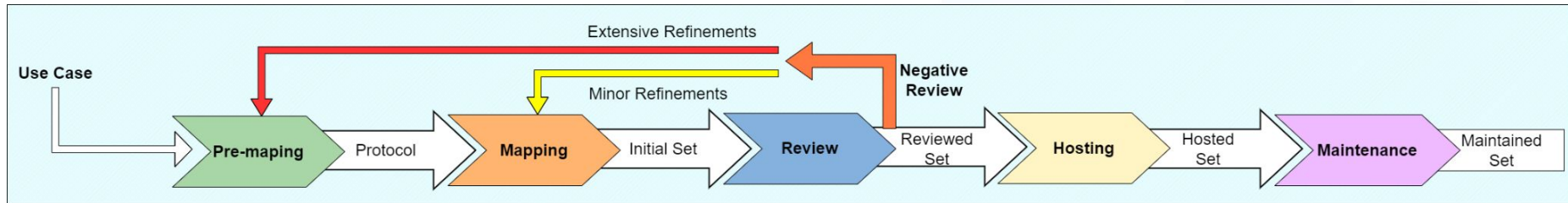


Incentivised FAIRification

PID: Use GUPRIs to identify individual mappings



Mapping Framework: Summary



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

Framework: template

- Template
 - Top sheet
 - + Sheet per phase
- Reusing categories
- Indicate inputs/outputs
 - E.g. protocol
- ‘Guided’

1	Context	Are there existing mappings for this use case or similar?	<input type="text"/>	link (optional)	use case link
5	Context	If so, why are they unsuitable?	text		documented use case link
3	Nature	Is it a one-off solution or will it be maintained?	<input type="text"/>		Protocol
7	Nature	If applicable, where will the solution be maintained	<input type="text"/>	hosting resource link	Protocol
3	Nature	Have you decided on a license?	<input type="text"/>	link	Protocol
3	Nature	How will you share the protocol	<input type="text"/>	link	Protocol
0	Sustainability	If applicable, how will you incorporate feedback, refine & update	text or n/a		Protocol
1	Nature	Does the mapping involve any standard or established vocabulary as source?	<input type="text"/>	vocabulary link	Protocol
2	Nature	Does the mapping involve any standard or established vocabulary as target?	<input type="text"/>	vocabulary link	Protocol
3	Scope	What will the solution look like?	<input type="text"/>		Protocol
4	Scope	What are the relationships between source and target terms? (semantic terms to be used)	<input type="text"/>	terms link	Protocol
5	Scope	Will the mapping be manual or automated?	<input type="text"/>		Protocol
6	Scope	identified source	URI		Protocol
7	Scope	Source - identify the concepts to be mapped	text or link(s)		Protocol
8	Scope	identified target	URI		Protocol
9	Scope	Target - identify the concepts to be mapped	text or link(s)		Protocol
n					

RDA Working Group on FAIR Mappings

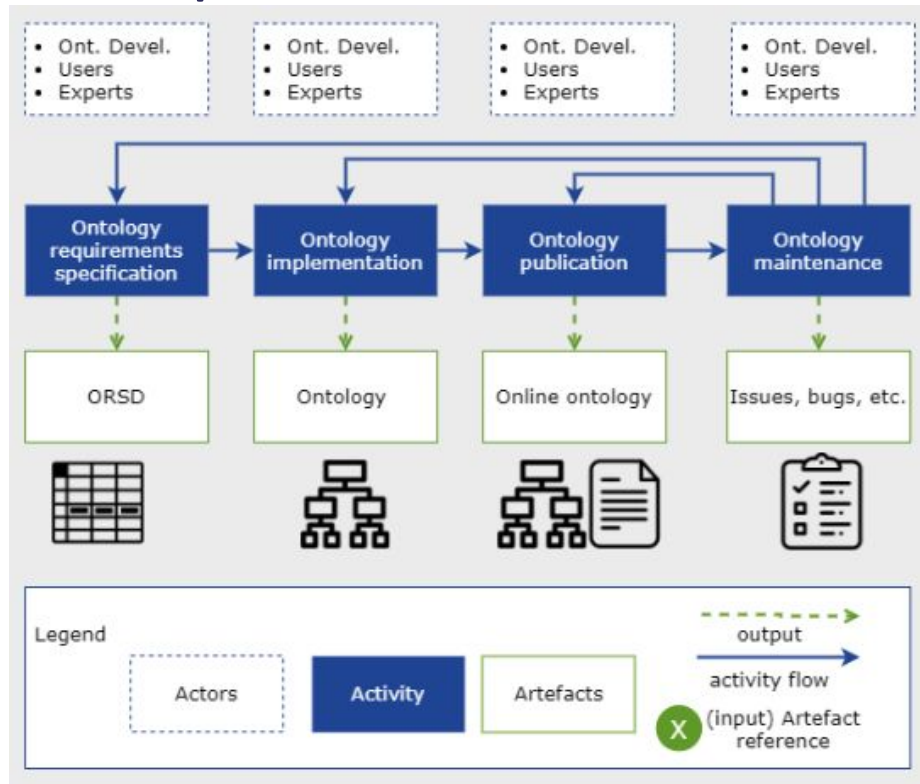
- Co-created with FAIRCORE4EOSC
- Current charter version: https://bit.ly/fair_mapping_wg_charter
- Planned submission for Community Review by the end of July
- Initial activities
 - Bird of a Feather session during RDA P22
 - Bird of a Feather session submitted for RDA P23

Planned WG outputs

- Technical recommendations to make FAIR Mappings and FAIRness evaluation grid
- Practical mapping framework and guidelines
- Harmonized mapping use case collection
- Mapping classification/ontology
- Generic exchange model and the associated metadata
- FAIR Mapping Knowledge Base

Some useful resources to consider
for putting together a research data
management vocabulary

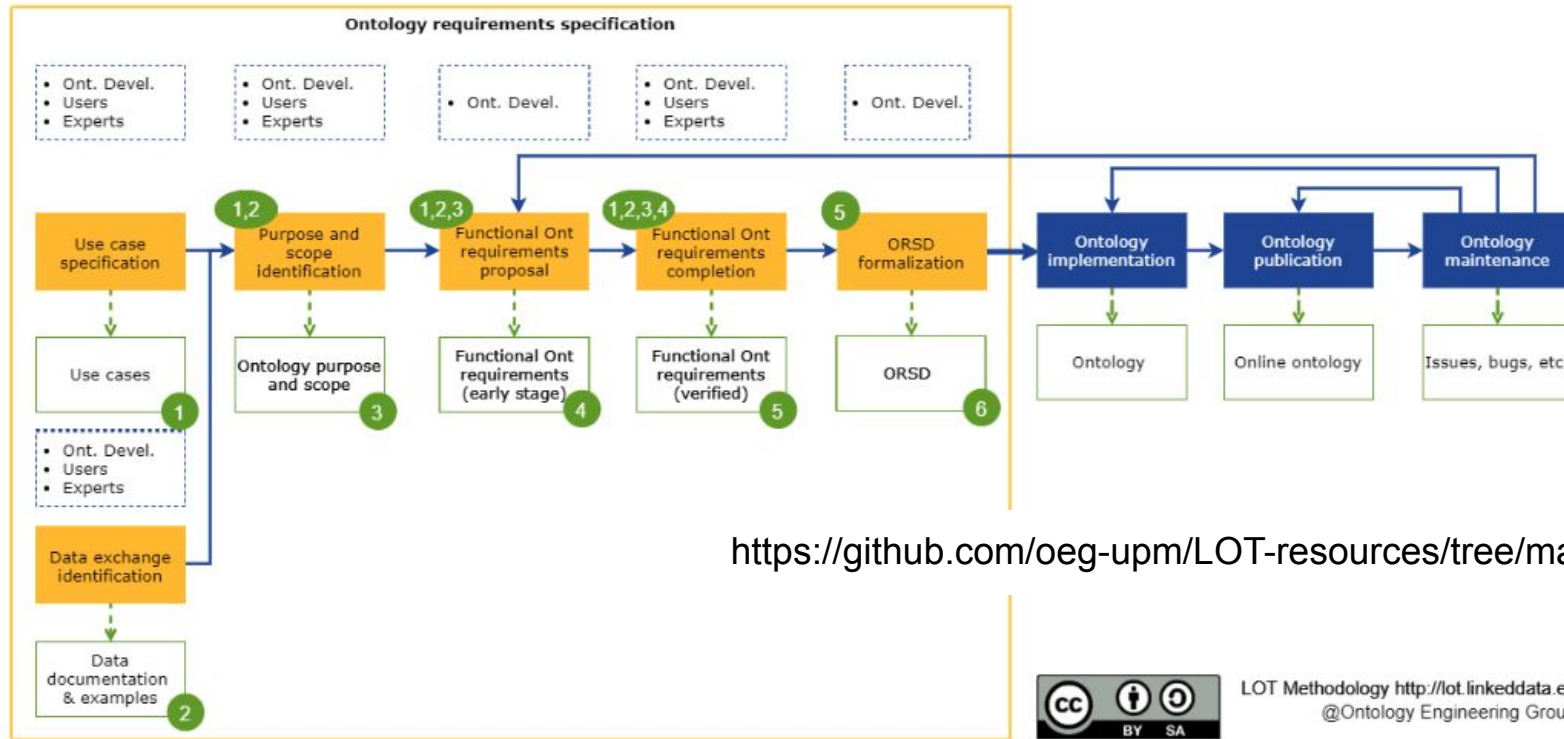
Linked Open Terms: methodology



<https://lot.linkeddata.es/>

María Poveda-Villalón, Alba Fernández-Izquierdo, Mariano Fernández-López, Raúl García-Castro, LOT: An industrial oriented ontology engineering framework, Engineering Applications of Artificial Intelligence, Volume 111,2022, 104755, <https://doi.org/10.1016/j.engappai.2022.104755>.

Requirement specification



<https://github.com/oeg-upm/LOT-resources/tree/master>



LOT Methodology <http://lot.linkedata.es>
@Ontology Engineering Group

Other resources from FAIR IMPACT

- Processes & tools to engineer FAIR semantic artefacts
 - <https://zenodo.org/records/10551054>
- Semantic artefact governance models and disciplinary approaches for inclusion within EOSC
 - <https://zenodo.org/records/13142842>

Other resources for RDM Ontology

- Terms4FAIRSkills
 - <https://zenodo.org/records/4772741>
 - <https://github.com/terms4fairskills/FAIRterminology>
 - CASRAI/RDM-Glossary (Codata):
<https://codata.org/new-machine-actionable-rdm-terminology-launched/>
- DAMA-DM Book
 - <https://www.dama.org/cpages/body-of-knowledge>
- DCSO Ontology:
 - Cardoso, J., Castro, L.J., Ekaputra, F.J. et al. DCSO: towards an ontology for machine-actionable data management plans. J Biomed Semant 13, 21 (2022). <https://doi.org/10.1186/s13326-022-00274-4>