Ontology metadata recommendations by TIB

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0. Executive summary

The number of ontology registries, archives and catalogues has increased over time. There are multiple services that list and also index ontologies. The registry entries of such services usually require the metadata of the ontologies they index, in order to make the ontologies findable and to provide users with general introductory information about the ontologies and their reuse. Registries currently face several problems, though:

- It is not yet standard procedure to provide rich ontology metadata despite efforts towards increasing the FAIRness of semantic resources [1], [2], in particular legacy ontologies may not be updated with rich metadata.
- Metadata may be provided in unstructured form outside of the ontology source which makes their collection difficult.
- Different registries may provide structured, open metadata documents for the same ontology which may at some point become incongruous with the source data.
- Currently, no standard metadata schema for ontologies exists.

In order to avoid these problems, metadata management should be part of the ontology engineering process: The metadata of an ontology should be part of the ontology's code base or the ontology itself. This would make the ontology resp. its code base the single source of truth for its own metadata.

It is therefore mandatory that an ontology provides its own metadata with machine-understandable semantics and established terms from metadata ontologies and controlled vocabularies. The metadata need to be as or even more persistent than the ontology itself. Principle R1 of the FAIR principles [1] furthermore recommends to not just provide metadata that allow the discovery of an ontology (e.g. title, ontology prefix, authors), but to add metadata that richly describe the contents of the ontology and the conditions of its creation and use (cf. 1.2 Why ontology metadata?).

With this document, *TIB - Leibniz Information Centre for Science and Technology University Library* provides a practical guide for metadata management of ontologies. It gives recommendations on required, recommended and optional metadata for ontologies. As there are currently several recommendations available (cf. [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23]), this guide will provide recommendations on ontology metadata that particularly adress the publishing of ontologies on the TIB Terminology Service.

In addition, we provide shapes for SHACL validators based on these recommendations (cf. 2.2 Metadata recommendations and SHACL).

1 Ontology metadata

1.1 How to provide ontology metadata?

Ontology metadata must be provided in a machine-understandable format. We therefore recommend to provide them as a part of the ontology itself: The metadata should be statements about the ontology that use dedicated annotation, object or data properties, to guarantee a good level of granularity and distinguishability of the metadata.

If you provide metadata that are here considered as *recommended* or *optional* in a single file, you may add a statement using rdfs:seeAlso to point to that document. Ideally, this document should then be etrievable with a persistent identifier (PID) - e.g. a DOI or a PURL. However, we do not recommend this, especially if that document is not machine-understandable.

1.2 Why ontology metadata?

Providing rich, machine-understandable metadata for an ontology has many advantages for their users (cf. [1], [2]), e.g.:

- They give a rich description about the ontology including its provenance, scope and purpose.
- They allow automatic extraction and indexing of the ontology by different services and reduce the effort of manual curation.
- They enable others to reuse the ontology or its terms and apply them for their own purposes.
- They indicate the current status of an ontology, distinguishing whether an ontology is still maintained by an active community or whether it is dormant.
- They allow referencing other Web resources with persistent identifiers (e.g. resources with identifiers like DOI, ROR, ORCiD, RAiD, etc.).
- They allow detailed requests about ontologies on the web.
- They enable comparability and automated comparisons of ontologies.
- They can be retrieved via APIs and used in many different services.

2 How to read this document

2.1 Chapter structure and wording

This guide tries to use clear wording to distinguish absolute requirements (*must*, *required*, *mandatory*) from either recommendations (*should*, *recommended*) or optional metadata (*may*, *can*, *could*, *optional*). The sub-sections will each give

- a short introduction to the metadatum
- recommend a property
- recommend controlled vocabularies where appropriate
- provide examples in text/turtle serialization
- list alternative properties that may also be used to provide the metadatum
- specify SHACL validation rules (cf. section 2.2 Metadata recommendations and SHACL)

Subproperties to any properties mentioned will not be implied, but explicitly listed in the "alternative properties" part of each section.

2.2 Metadata recommendations and SHACL

This guide is a human-readable specification. In addition, we also provide SHACL specifications of these recommendations that can be/are used for three different purposes.

1. Data validation
   A shape for data validation can be retrieved from https://www.purl.org/ontologymetadata/shape and can be used with SHACL validators to test ontologies for any violations of required metadata by TIB Terminology Service and to get suggestions for recommended metadata. We recommend the online SHACL validators SHACL Playground, SHACL Playground by Zazuko or SHACL Play! for performing evaluations. Turtle or json-ld are common input format. SHACL Play! also allows to use IRIs for shapes and ontologies.
   The shape can also be used to evaluate metadata of instances of skos:ConceptScheme. The instances of skos:ConceptScheme need to be declared as instances of owl:Ontology to trigger the shapes (cf. also section 4.6.2. SKOS Concept Schemes and OWL Ontologies of the SKOS Reference document). A video demonstration of how to use this is given at our GitHub repository: https://github.com/user-attachments/assets/c5d6be07-3bfb-44ab-ae65-e3f75b8e883a.

2. Data validation at TIB Terminology Service
   The shape at https://www.purl.org/ontologymetadata/shape4ts is applied in the Ontology Suggestion Feature at TIB Terminology Service. The messages are adapted to the context of use and the particular use case: The person suggesting an ontology is not necessarily involved in its development. On TIB Terminology Service, they will be asked to provide metadata of the ontology if these are not present in the ontology, and if known to the user. These users are not required to provide the meatdata as code. A video demonstration on how this is applied is given at our GitHub repository: https://github.com/user-attachments/assets/847cfd39-0823-4a83-9c8a-0cf3d23d38a7

3. Data generation
   A shape for form generators and code generation can be retrieved from https://www.purl.org/ontologymetadata/shape4forms. It can for example be used with the form generator tool by ULB Darmstadt which has a live demo instance. This shape is not as granular as the one for validation: All constraints are bundled in one shape in order to generate a form, that users can use to enter values. The user input is validated immediately for all criteria and the metadata code is generated. Only the recommended properties will be used to do so: This version of the recommendation does not make use of `sh:alternativePath` constructs, in order to generate valid RDF code with named properties, not anonymous/ blank nodes. A video demonstration on how to apply this is given at our GitHub repository: https://github.com/user-attachments/assets/55cdf44f-5289-4989-9014-5e670fd73418.

2.3 Prefixes used in this document

Code examples will usually provide full IRIs of statement subjects and objects. Properties will be presented in prefixed notation. The table provides the prefix definitions:

prefix	namespace
adms	http://www.w3.org/ns/adms#
bibo	http://purl.org/ontology/bibo/
dcat	http://www.w3.org/ns/dcat#
dcterms	http://purl.org/dc/terms/
doap	http://usefulinc.com/ns/doap#
foaf	http://xmlns.com/foaf/0.1/
idot	http://identifiers.org/idot/
mod	https://w3id.org/mod#

prefix	namespace
obo	http://purl.obolibrary.org/obo/
omv	http://omv.ontoware.org/2005/05/ontology#
owl	http://www.w3.org/2002/07/owl#
pav	http://purl.org/pav/
premis	http://www.loc.gov/premis/rdf/v3/
rdf	http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs	http://www.w3.org/2000/01/rdf-schema#
schema	https://schema.org/
sh	http://www.w3.org/ns/shacl#
vann	http://purl.org/vocab/vann/
void	http://rdfs.org/ns/void#
xsd	http://www.w3.org/2001/XMLSchema#

2.4 Acronyms

Acronym	Full form
DOI	Digital Object Identifier
IRI	International Resource Identifier
PID	Persistent Identifer
ROR	Research Organization Identifier

3 Mandatory metadata

Metadata in this section are mandatory for publishing an ontology at TIB Terminology Service. Ontologies missing these metadata will not be accepted.

3.1 Ontology title

Ontologies must state their own title. The title will be displayed on TIB Terminology Service, e.g. on each ontology's landing page, in search results or in ontology lists. The ontology must have at most one title per language. Ontology titles should be tagged for language.

Recommended property: http://purl.org/dc/terms/title

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:title "Some Ontology"@en .
```

Alternative properties:

- http://purl.org/dc/elements/1.1/title
- https://schema.org/name
- https://schema.org/headline

SHACL validation rules:

- sh:datatype rdf:langString
- sh:minCount 1
- sh:uniqueLang true

3.2 Preferred ontology prefix/ acronym

The ontology must declare its preferred, unique prefix or a short acronym. The prefix/ acronym will be used on TIB Terminology Service's ontology list as a short name for the ontology. It must not contain hyphens or other special characters and should be written in lowercase.

You can check whether an ontology prefix is already in use on services like prefix.cc or Bioregistries.

Recommended property: http://purl.org/vocab/vann/preferredNamespacePrefix

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    vann:preferredNamespacePrefix "so"^^xsd:string .
```

Alternative properties:

- http://identifiers.org/idot/preferredPrefix
- https://w3id.org/mod#acronym

SHACL validation rules:

- sh:datatype xsd:string

3.3 Ontology license

Ontologies must declare their license, referring to their license document via PID. The license text helps others to evaluate how they may reuse the ontology. Only ontologies with an open license will be published on TIB Terminology Service. Consider, for example, the list of licenses that are conformant with the Open Definition.

Recommended property: http://purl.org/dc/terms/license

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:license <http://creativecommons.org/licenses/by/4.0/> .
```

Alternative properties:

- https://schema.org/license
- http://creativecommons.org/ns#license
- http://dbpedia.org/ontology/license
- http://purl.org/dc/terms/licence (is a mis-spelled variant of http://purl.org/dc/terms/license)

SHACL validation rules:

- value must be from defined list of accepted licenses
- value must not be from defined list of unaccepted licences
- `sh:maxCount 1`
- `sh:minCount 1`

3.4 Ontology creator(s)

The ontology must list its creators, i.e. the people or institutions who were responsible for its development. It is recommended to refer to a creator with a PID (e.g. ORCiD, Wikidata-ID, or ROR-ID). Plain name strings can be provided in addition for readability. If an ontology is developed by a larger group, it is recommended to give the organization or project identifier as the creator and list individual persons as contributors. If no project or organisation PID is available, the respective name (rdf:langString) will also be accepted.

Recommended property: http://purl.org/dc/terms/creator

Example 1 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:creator <https://orcid.org/0000-0000-0000-0000> .
```

Example 2 (text/turtle):

```
<https://www.purl.org/SomeOntology> <http://purl.org/dc/terms/creator> <https://orcid.org/0000-0000-0000-0000>.

<https://orcid.org/0000-0000-0000-0000> rdf:type foaf:Person ;
    <http://xmlns.com/foaf/0.1/firstName> "Max" ;
    <http://xmlns.com/foaf/0.1/lastName> "Muster" .
```

Alternative properties:

- http://purl.org/dc/elements/1.1/creator
- https://schema.org/creator
- http://purl.org/pav/createdBy
- http://www.w3.org/ns/prov#wasAttributedTo
- https://schema.org/accountablePerson
- https://schema.org/author

SHACL validation rules:

- `sh:minCount 1`
- `sh:nodeKind sh:IRI`

3.5 Ontology version IRI

Since the PURL of an ontology usually only points to the latest version of an ontology, each ontology must state its version IRI. A version IRI is a persistent identifier for a version of an ontology and is used to reliably retrieve this earlier version of the ontology. We recommended to use semantic versioning or OBO style date-based versioning [3].

Recommended property: http://www.w3.org/2002/07/owl#versionIRI

Example 1 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    owl:versionIRI <https://www.purl.org/SomeOntology/1.0.0> .
```

Example 2 (text/turtle)

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    <http://www.w3.org/2002/07/owl#versionIRI> <https://www.purl.org/SomeOntology/2019-12-31> .
```

Example 3 (text/turtle):

```
<http://purl.obolibrary.org/obo/pco.owl> rdf:type owl:Ontology ;
    owl:versionIRI <http://purl.obolibrary.org/obo/pco/releases/2021-05-03/pco.owl> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:maxCount 1`
- `sh:minCount 1`
- `sh:nodeKind sh:IRI`

3.6 Ontology creation date

The ontology must state the date of its first creation.

Recommended property: http://purl.org/dc/terms/created

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:created "2020-11-19T00:00:00"^^xsd:dateTime.
```

Alternative properties:

- http://purl.org/pav/createdOn
- https://schema.org/dateCreated
- http://www.w3.org/ns/prov#generatedAtTime

SHACL validation rules:

- `sh:datatype xsd:dateTime`
- `sh:maxCount 1`
- `sh:minCount 1`

3.7 Ontology abstract

The ontology must describe its own contents and scope with a few words or sentences in order to inform human users what the ontology tries to accomplish. The abstract is displayed in the TIB Terminology Service ontology list and on the landing page of each ontology - we therefore recommend to keep it short. You can also provide abstracts in several languages (as an rdf:langString). You may provide only one abstract per language. Each abstract may be up to 500 characters long including spaces. We do not recommend to use markups (html, markdown) in the abstract since these are not supported by TIB Terminology Service. If you want to include a longer text about the ontology, you should include a description 5.1 Ontology description. For an extensive discussion about further aspects of the ontology (e.g. ontology creation, ontology use, ontology structure, etc.) we recommend the publication of a detailed documentation (cf. 3.9 Ontology documentation) or traditional academic article (cf. 4.13 Related resources).

Recommended property: http://purl.org/dc/terms/abstract

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:abstract "SomeOntology defines a range of classes and properties which can be applied to do stuff in a
particular domain."@en , "SomeOntology definiert eine Reihe von Klassen und Properties, die in einer bestimmten
Domäne verwendet werden können, um etwas damit zu tun."@de .
```

Alternative properties:

- https://schema.org/abstract

SHACL validation rules:

- sh:datatype rdf:langString
- sh:maxLength 500
- sh:minCount 1
- sh:uniqueLang true

3.8 Ontology issue tracker

The ontology must point to the issue tracker of its own development environment so that others may report bugs or suggestions to the developers. Ideally, the development process of an ontology is open and takes place on platforms like GitLab.com that allow for version management with version control software like git.

Recommended property: http://usefulinc.com/ns/doap#bug-database

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    doap:bug-database <https://github.com/SomeOrganisation/SomeOntology/issues> .
```

Alternative properties: n/a

SHACL validation rules:

- sh:maxCount 1
- sh:minCount 1
- sh:nodeKind sh:IRI

3.9 Ontology documentation

To familiarize interested others with the concepts and scope of your ontology, some kind of documentation must be provided. This is usually an external online document that should be referenced by the ontology via an IRI or more persistently with a PID. A relatively easy way to do this is to use the tool Widoco [4], [5]. It generates the documentation from the ontology and a resulting html-document can be published, for example with GitLab Pages. This auto-generated document can contain customized passages that provide users with a deeper understanding of the ontology. There are, however, other forms of ontology documentations: scientific articles, well-curated README files in repositories, Wikis etc. Here, we recommend to choose the form which is most easily attainable by your working group or project. Here are some examples for ontology documentation:

- PROV Ontology: https://www.w3.org/TR/2013/REC-prov-o-20130430/
- GND Ontology: https://d-nb.info/standards/elementset/gnd
- Gene Ontology - Relations: https://geneontology.org/docs/ontology-relations/
- CHEBI User Manual: https://docs.google.com/document/d/1_w-DwBdCCOh1gMeeP6yqGzcnkpbHYOa3AGSODe5epcg/
- CHEBI Developer Manual: https://docs.google.com/document/d/11G6SmTtQRQYFT7l9h5K0faUHiAaekcLeOweMOOTIpME/

The documentation of an ontology offers a lot of room to describe the ontology and provide detailed information about it to its readers. In fact, you may wonder whether it would be sufficient to provide a well-structured and well-readable text document - containing all the metadata suggested in this guide. Here, our answer is a clear no: Providing the metadata of your ontology in a machine-readable format, makes them much more re-usable (cf. sections 0. Executive summary and 1.2 Why ontology metadata).

Recommended property: http://www.loc.gov/premis/rdf/v3/documentation

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    premis:documentation <https://www.purl.org/SomeOntology/Documentation> .
```

Alternative properties: n/a

SHACL validation rules:

- sh:maxCount 1
- sh:minCount 1
- sh:nodeKind sh:IRI

4 Recommended Metadata

In addition to mandatory metadata, we recommend providing a number of further helpful metadata.

4.1 Ontology contributor(s)

If you had help in developing the ontology, you should indicate this by listing contributors so that all participants receive proper credit for their efforts. If an ontology is developed by a larger group, it is recommended to give the organization or project identifier as the creator and list individual persons as contributors. Persons and organisations shpuld be listed via PID, e.g. ORCiD or ROR.

Recommended property: http://purl.org/dc/terms/contributor

Example 1 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:contributor <https://orcid.org/0000-0000-0000-0000> .
```

Example 2 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:contributor <https://orcid.org/0000-0000-0000-0000>.

<https://orcid.org/0000-0000-0000-0000> rdf:type foaf:Person ;
    foaf:firstName "Max" ;
    foaf:lastName "Muster" .
```

Alternative properties:

- http://purl.org/dc/elements/1.1/contributor
- https://schema.org/contributor
- http://purl.org/pav/contributedBy

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.2 Ontology funder

The development of an ontology may rely on external funding and take place in a third-party funding project. Since funding institutions usually want to be credited, we highly recommend mentioning them in your ontology. The best way to do so is by referring to their ROR ID.

Recommended property: https://schema.org/funder

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    schema:funder <https://ror.org/018mejw64> .
```

Alternative properties:

- http://rdf-vocabulary.ddialliance.org/discovery#fundedBy
- http://xmlns.com/foaf/0.1/fundedBy

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.3 Ontology funding

In addition to referencing the funding institution, you may be required to point to the specifc grant that enables the work on the ontology. We recommend to provide this information as an IRI, ideally a PID. We are aware, though, that PIDs for grants are not common, yet. We therefore also accept this information in the form of acknowledgement statements (rdf:langString) containing the grant number provided by the funding institution.

Recommended property: https://schema.org/funding

Example 1 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    schema:funding <https://doi.org/00.00000/000000000> .
```

Example 2 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    schema:funding "The authors (Some Ontology Workgroup) would like to thank the Government of Some Country or
Some Other Funding Institution for their funding and support within Some Funding Program (project number
123456789)."@en .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.4 Ontology audience description

Defining the target group of your ontology might be useful information for others when evaluating if and how they could reuse your ontology. You should describe the intended audience of the ontology. The audience description should be a short, language-tagged text.

Recommended property: http://usefulinc.com/ns/doap#audience

Examples (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    doap:audience "This ontology is intended for researchers in derivational morphology, a branch of linguistics.
[...]"@en .
```

See also audience description of NMRC at TIB Terminology Service or the audience description of CROPUSAGE at AgroPortal.

Alternative properties:

- https://schema.org/audience
- http://purl.org/dc/terms/audience

SHACL validation rules:

- `sh:datatype rdf:langString`
- `sh:maxCount 1`

4.5 Ontology subject(s)

We recommend tagging the ontology with a subject from a controlled vocabulary to indicate which domain it belongs to or which subject it deals with. This information is helpful for terminology service and ontology registry providers: Subject tags from controlled vocabularies can be mapped to other controlled vocabularies that are the basis of filters and browsing functionalities of such services. Subject tags can help to make your ontology better findable and available for a wider audience.

Recommended property: http://purl.org/dc/terms/subject

Recommended controlled vocabularies:

- https://purl.org/linsearch
- https://terminology.tib.eu/ts/ontologies/bk
- https://terminology.tib.eu/ts/ontologies/dfgfo
- https://explore.gnd.network/ (remember: the identifiers need to start with http://d-nb.info/gnd/!)

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:subject <https://d-nb.info/gnd/4067537-3>, <https://d-nb.info/gnd/4070177-3>,
<http://uri.gbv.de/terminology/bk/42.15>, <https://github.com/tibonto/dfgfo/201-03>.
```

The [TIB Terminology Service](#) applies [LinSearch](#) labels for subject values, e.g.:

```
<https://www.purl.org/SomeOntology> dcterms:subject "Chemistry"^^xsd:string .
```

Alternative properties:

- http://purl.obolibrary.org/obo/IAO_0000136
- https://schema.org/about
- https://schema.org/keywords
- http://www.w3.org/ns/dcat#keyword
- http://purl.org/dc/terms/coverage

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.6 Ontology annotation language(s)

If your ontology does not only provide formal semantics but also multi-lingual annotations for entities, you should provide information about the ontology annotation languages (e.g. for term labels, term definitions, etc.) in its metadata. At least one language should be provided, since at least one set of annotations is expected in a well-documented ontology. You should only claim that the ontology uses an annotation language, if all ontology elements or an extensive part of the ontology is annotaed in that languge.

Recommended property: http://purl.org/dc/terms/language

Recommended controlled vocabulary: http://id.loc.gov/vocabulary/iso639-2

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:language <http://id.loc.gov/vocabulary/iso639-2/eng>, <http://id.loc.gov/vocabulary/iso639-2/tgl> .
```

Alternative properties:

- https://schema.org/inLanguage

SHACL validation rules:

- `sh:nodeKind sh:IRI`
- `sh:pattern "(^http://id.loc.gov/vocabulary/iso639-2/[a-z]{3}$|^https://id.loc.gov/vocabulary/iso639-2/[a-z]{3}$)"`

4.7 Applied logical framework

You should state which logical framework the ontology applies. The information can be given as a text, referring to the Semantic Web Standard (e.g. 'OWL 2') and possibly the OWL profile (e.g. 'OWL 2 EL profile').

Recommended property: https://w3id.org/mod#hasFormalityLevel

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    mod:hasFormalityLevel "OWL version 2, EL profile"@en .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:datatype rdf:langString`
- `sh:maxCount 1`

4.8 Ontology serialization/ file format

You should state the ontology's serialization/ file format. The value should be provided as an IRI from the Media Types list of the Internet Assigned Number Authority (IANA) [6] or from the W3C resource Unique URIs for File Formats [7].

Recommended property: https://w3id.org/mod#hasSyntax

Recommended controlled vocabularies:

- https://www.w3.org/ns/formats
- https://www.iana.org/assignments/media-types/media-types

In order to publish your ontology on the the TIB Terminology Service you must providde the ontology as one of the following media types:

- https://www.iana.org/assignments/media-types/application/rdf+xml resp. http://www.w3.org/ns/formats/RDF_XML
- https://www.iana.org/assignments/media-types/text/turtle resp. http://www.w3.org/ns/formats/Turtle
- OBO format (cf. http://purl.obolibrary.org/obo/oboformat/spec.html)

Currently, there is no registered media type for obo format.

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    <https://w3id.org/mod#hasSyntax> <http://www.w3.org/ns/formats/Turtle> .
```

Alternative properties:

- http://purl.org/dc/terms/format
- http://purl.org/dc/elements/1.1/format
- https://schema.org/encodingFormat
- http://omv.ontoware.org/2005/05/ontology#hasOntologySyntax

SHACL validation rules:

- value must be from a defined list
- sh:maxCount 1
- sh:nodeKind sh:IRI

4.9 Ontology status

You should declare the current maintenance status of the ontology. You could use an English label to do so. We recommend using one of the values suggested by the OBO Foundry [8]. Ontologies are prone to link rot and sometimes left abandoned. If you cannot keep up the work on an ontology, this needs to be documented: Is your ontology retired? Is it still a draft? Or is it maintained by an active community?

Recommended property: http://purl.org/ontology/bibo/status

Recommended controlled vocabulary: https://obofoundry.org/docs/OntologyStatus.html

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    bibo:status "inactive"@en .
```

Alternative properties:

- https://schema.org/creativeWorkStatus

SHACL validation rules:

- sh:datatype rdf:langString
- sh:maxCount 1

4.10 Ontology code repository

A code repository (e.g. on GitLab.com or GitHub.com) should be the development environment of your ontology. It should contain the source code of your ontology but may also be used to host your documentation, your issue tracker and may contain related resources like different distributions of your ontology, versions of your ontology, application examples, competency questions, discussions and decisions - in short: the entire history of your ontology should be located in a code repository.

Recommended property: http://usefulinc.com/ns/doap#repository

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    doap:repository <https://github.com/SomeOrganisation/SomeOntology> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:maxCount 1`
- `sh:nodeKind sh:IRI`

4.11 Ontology distributions/ products

There are different serializations available for ontologies but not all are parsable by any system: For example an ontology tool may be well prepared for rdf/xml but not so much for json-ld. It may help users of your ontology, if you provided IRIs to available alternative serializations or distributions of your ontology.

Recommended property: http://www.w3.org/ns/dcat#distribution

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology;
    dcat:distribution <https://www.purl.org/SomeOntology.owl>, <https://www.purl.org/SomeOntology.json>,
<https://www.purl.org/SomeOntology.ttl> .
```

Alternative properties:

- https://schema.org/distribution
- http://purl.org/dc/terms/hasFormat
- http://purl.org/dc/terms/isFormatOf
- https://schema.org/associatedMedia
- https://schema.org/encoding

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.12 Application example

How to use an ontology is often helpfully demonstrated by application examples and visualizations that give a glimpse about how the ontology can be used to structure actual data. If you have such application examples, these might be better found, if you link to them from the ontology. These application examples could be part of the ontology documentation, formal serializations applying the ontology or even technical applications that make use of the ontology.

Recommended property: http://purl.org/vocab/vann/example

Example (text/turtle):

```
<http://www.w3.org/ns/dcat> rdf:type owl:Ontology ;
    vann:example <https://www.w3.org/TR/vocab-dcat-2/#collection-of-examples> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.13 Related resource(s)

Resources related to the ontology could be publications discussing the ontology, applications of the ontology or mapping files (see also section 5.17 Alignments/ mappings). If any such resources exist, you should mention them in the ontology. You may also point to other related resources, for example resources that are cited or were otherwise used to inform the ontology. We recommend using a permanent identifier, such as a DOI, of the referenced resource.

Recommended property: http://purl.org/dc/terms/references

Example:

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:references <http://doi.org/10.00000/some0.ontolo> .
```

Alternative properties:

- https://schema.org/citation

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.14 Citation suggestion

You could give information on how you would like others to cite your ontologies. You may even provide structured metadata ready for import into citation management tools like Bibtex etc. Currently, there is no citation standard considering the citation of ontologies. We therefore recommend to provide at least the creators, the year of publication, the ontology title and to give the versionIRI as the access URL. In addition, you could also provide references to citable publications (cf. section 4.13 Related resources).

Recommended property: http://purl.org/dc/terms/bibliographicCitation

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:bibliographicCitation "Last name, first name; last name, first name et al. (YYYY): Ontology title.
URL: https://w3id.org/SomeOntology/1.1.6 (last accessed: DD.MM.YYYY)"^^@en .
```

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology;
    dcterms:bibliographicCitation "@misc{SomeOntology, title = \"Some Ontology\", author = \"Last name, first name
and Last name, first name\", url = \"https://w3id.org/SomeOntology/1.1.6\",year = \"YYYY\",}"^^xsd:string .
```

Alternative properties: n/a

SHACL validation rules: n/a

4.15 Ontology sources (derived from)

You should specify whether and from which other ontologies your ontology has been derived. The reference should be made by an owl:versionIRI of the ontology from which the current ontology has been derived.

Recommended property: http://purl.org/pav/derivedFrom

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology;
    pav:derivedFrom <https://www.purl.org/SomeOtherOntology> .
```

Alternative properties:

- http://www.w3.org/ns/prov#wasDerivedFrom
- https://schema.org/isBasedOn

SHACL validation rules:

- `sh:nodeKind sh:IRI`

4.16 Ontology root classes

You should explicitly declare the ontology's preferred root classes. Display tools like the TIB Terminology Service and other OLS-based services [9], [10] can pick specific, user-defined classes for rendering the ontology class hierarchy. This is especially helpful, when an ontology imports a lot of classes from other ontologies. The respective classes need to be provided via their identifier.

Recommended property: http://purl.obolibrary.org/obo/IAO_0000700

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    obo:IAO_0000700 <https://www.purl.org/SomeOntology/class12345654544545> .
```

Alternative properties:

- http://rdfs.org/ns/void#rootResource

SHACL validation rules:

- `sh:nodeKind sh:IRI`

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    obo:IAO_0000700 <https://www.purl.org/SomeOntology/class12345654544545> .
```

5 Optional metadata

The metadata of an ontology can contain much more information than what has been suggested in sections 3 Mandatory metadata and 4 Recommended metadata so far. Perhaps, you will also find the following categories useful or informative enough to include them into your metadata.

At TIB Terminology Service all additional metadata will be displayed on the ontology landing page if available.

5.1 Ontology description

If you want to provide more information about the ontology than the few characters that fit into the ontology abstract, you may also provide a longer descriptive text. In a longer description you may, for example, provide more information about how and why the ontology was created, where it is used, how it will be updated and the like. For extensive discussions about further aspects of the ontology (e.g. ontology creation, ontology use, ontology structure, etc.) we recommend the publication of a detailed documentation (cf. 3.9 Ontology documentation) or traditional academic article (cf. 4.13 Related resources), instead of an ontology description.

Recommended property: https://schema.org/description

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology;
    schema:description "Free text describing the ontology and how it came to be. Basically everything you might
want to add and which does not fit into the abstract."@en .
```

Alternative properties:

- http://purl.org/dc/terms/description
- http://purl.org/dc/elements/1.1/description

SHACL validation rules:

- `sh:datatype rdf:langString`
- `sh:nodeKind sh:Literal`
- `sh:uniqueLang true`

5.2 Alternative ontology title

An alternative title for the ontology may provided, for example a former working title the ontology has been known by.

Recommended property: http://purl.org/dc/terms/alternative

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:alternative "My Ontology"@en .
```

Alternative properties:

- https://schema.org/alternateName
- https://schema.org/alternativeHeadline

SHACL validation rules:

- `sh:datatype rdf:langString`

5.3 Alternative ontology prefix/ acronym

An alternative prefix for the ontology.

Recommended property: http://identifiers.org/idot/alternatePrefix

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:Type owl:Ontology ;
    idot:alternatePrefix "mo"^^xsd:string .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:datatype xsd:string`

5.4 Related version/ version history

When ontologies are developed on collaborative development platforms with version management software like GitLab.com or GitHub.com, it is relatively easy to maintain and keep all development and release versions of an ontology. Ontologies may therefore have multiple resolvable version IRIs. The different versions can relate to each other in different ways as discussed in the following sections.

5.4.1 Prior ontology version

An ontology may point back to one or more versions that were valid before the current version.

Recommended property: http://www.w3.org/2002/07/owl#priorVersion

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    owl:priorVersion <https://www.purl.org/SomeOntology/1.1.6> .
```

Alternative properties:

- http://www.w3.org/ns/adms#prev
- http://purl.org/pav/previousVersion
- http://www.w3.org/ns/prov#wasRevisionOf
- http://purl.org/dc/terms/replaces

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.4.2 Related ontology version

A related resource of which the described resource is a version, edition, or adaptation. The contents of related versions of an ontology are not identical.

Recommended property: http://purl.org/dc/terms/hasVersion

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:hasVersion <https://www.purl.org/SomeOntology/1.1.6> .
```

Alternative properties:

- http://purl.org/pav/hasCurrentVersion
- https://schema.org/version

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.4.3 Compatible ontology version

For application developers and other users, it may be useful to know whether a new version of your ontology is backward compatible with an older version of your ontology.

Recommended property: http://www.w3.org/2002/07/owl#backwardCompatibleWith

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    owl:versionIRI <https://www.purl.org/SomeOntology/1.1.7> ;
    owl:backwardCompatibleWith <https://www.purl.org/SomeOntology/1.1.6> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.4.4 Incompatible ontology version

For application developers and other users, it may be useful to know whether a new version of your ontology is incompatible with an older version of your ontology.

Recommended property: http://www.w3.org/2002/07/owl#incompatibleWith

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    owl:versionIRI <https://www.purl.org/SomeOntology/1.1.7> ;
    owl:incompatibleWith <https://www.purl.org/SomeOntology/1.1.6> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.5 Social media

If you toot about or otherwise promote your ontology on social media, it might be interesting for users to see on which platforms you are having accounts to follow your updates.

Recommended property: http://xmlns.com/foaf/0.1/holdsAccount

Example (text/turtle):

```
<https://www.purl.org/SomeOntology/1.1.7> rdf:type owl:Ontology ;
    foaf:holdsAccount "myOnto@ontology.social"^^xsd:string .
```

Alternative properties: n/a

SHACL validation rules: n/a

5.6 KOS type

You may want to additionally classify your ontology with a controlled value from the NKOS type vocabulary [11].

Recommended property: http://purl.org/dc/terms/type

Recommended controlled vocabulary: https://nkos.dublincore.org/nkostype/nkostype.rdf

Example (text/turtle):

```
<https://www.purl.org/SomeOntology/1.1.7> rdf:type owl:Ontology ;
    dcterms:type <http://w3id.org/nkos/nkostype#ontology> .
```

Alternative properties: n/a

SHACL validation rules:

- value must be from a defined list
- `sh:maxCount 1`
- `sh:nodeKind sh:IRI`

5.7 Example ontology identifier

Give an example for identifiers used in your ontology.

Recommended property: http://identifiers.org/idot/exampleIdentifier

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    idot:exampleIdentifier <https://www.purl.org/SomeOntology/1234-XY> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.8 Ontology identifier pattern

Identifiers for ontology classes, properties and individuals usually follow one specific pattern that can be summarized with a regular expression. In registries like Bioregistry this is usually provided as part of the ontology metadata.

Recommended property: http://identifiers.org/idot/identifierPattern

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    idot:identifierPattern "^\\d{4}-[A-Z]{2}$"^^xsd:string .
```

Alternative properties:

- https://bioregistry.io/schema/#0000008

SHACL validation rules:

- `sh:datatype xsd:string`
- `sh:maxCount 1`

5.9 Ontology homepage

The official homepage of your ontology. This is not necessarily the documentation website, but could be a general info page, which may also include documentation about the ontology.

Recommended property: http://xmlns.com/foaf/0.1/homepage

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology;
    foaf:homepage <https://www.example.com/SomeOntologyInfo> .
```

Alternative properties:

- http://xmlns.com/foaf/0.1/page

SHACL validation rules:

- `sh:maxCount 1`
- `sh:nodeKind sh:IRI`

5.10 Ontology publisher

The official publisher of the ontology. This might be the institution you are affiliated to. We recommend to refer to the institution via PIDs (e.g. ROR, ISNI, GND ID).

Recommended property: http://purl.org/dc/terms/publisher

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:publisher <https://isni.org/isni/0000000121746694> .
```

Alternative properties:

- http://purl.org/dc/elements/1.1/publisher
- https://schema.org/publisher

SHACL validation rules:

- `sh:nodeKind sh:IRI`
- `sh:pattern "https://d-nb.info/gnd/(|(1[012]?[0-9]{7}[0-9X]|[47][0-9]{6}-[0-9]|[1-9][0-9]{0,7}-[0-9X]|3[0-9]{7}[0-9X]))$"`
- `sh:pattern "https://isni.org/isni/[0]{4}[0-9]{4}[0-9]{4}[0-9]{3}[0-9X]"`
- `sh:pattern "https://ror.org/([a-z0-9]{9})"`

5.11 Ontology comments

Any comments you would like to make about your ontology.

Recommended property: http://www.w3.org/2000/01/rdf-schema#comment

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    rdfs:comment "SomeOntology does not actually exist."@en .
```

Alternative properties:

- https://schema.org/comment

SHACL validation rules:

- `sh:datatype rdf:langString`

5.12 Example ontology class

You could provide an example class that is representative for the entities described in the ontology, for example demonstrating typical term annotations, editorial notes or axiomatic statements, deprecation notes etc.

Recommended property: http://rdfs.org/ns/void#exampleResource

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    void:exampleResource <https://www.purl.org/SomeClass> .
```

Alternative properties:

- http://www.w3.org/2004/02/skos/core#example

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.13 Ontology mailing list

Communication about the ontology may take place over a mailing list, e.g. regarding updates. If this is your way to communicate, the info should be part of your ontology.

Recommended property: http://usefulinc.com/ns/doap#mailing-list

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    doap:mailing-list <someontology@list.de> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:maxCount 1`

5.14 Ontology logo/ depiction/ related visualizations

Links to official ontology logo or other visualizations/ diagrams of ontology elements online, e.g. WebVOWL visualizations and other graph views.

Recommended property: http://xmlns.com/foaf/0.1/logo

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    foaf:logo <https://www.example.com/MyOntoLogo.jpg>
```

Alternative properties:

- https://schema.org/logo
- http://xmlns.com/foaf/0.1/depiction
- https://w3id.org/mod#depiction
- https://schema.org/image

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.15 Alternative identifiers of the ontology

If your ontology has been published at an archive, you may want to declare these related identifiers in the ontology metadata. You should list here alternative URIs that may be used to identify your ontology. The identifier used as the base URI of the ontology should be provided with http://purl.org/vocab/vann/preferredNamespaceUri instead (cf. 5.20 Preferred ontology namespace).

Recommended property: http://purl.org/dc/terms/identifier

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:identifier <https://doi.org/10.5281/zenodo.0000000> .
```

Alternative properties:

- http://purl.org/ontology/bibo/doi
- https://schema.org/identifier
- http://purl.org/dc/elements/1.1/identifier>

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.16 Development environment

The software that was used to create the ontology.

Recommended property: http://purl.org/pav/createdWith

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    pav:createdWith "Protégé 4.8.8"^^xsd:string .
```

Alternative properties:

- https://w3id.org/mod#createdWith

SHACL validation rules: n/a

5.17 Alignments/ mappings

5.17.1 Aligned resources

The ontology may indicate to which other resource(s) it has been aligned or contains equivalences to.

Recommended property: https://w3id.org/mod#hasEquivalencesWith

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    mod:hasEquivalencesWith <https://www.purl.org/SomeOtherOntology> .
```

Alternative properties:

- http://w3id.org/nkos#alignedWith

SHACL validation rules:

- `sh:nodeKind sh:IRI`

5.17.2 Alignment files/ Mapping files

Alignments and mappings may not be included in the ontology document itself, but in a related resource (e.g. when following the SSSOM paradigm [12]). Accordingly, we recommend to treat mapping sets like related resources. The mapping set should be referenced via a PID or a version IRI.

Recommended property: http://purl.org/dc/terms/references

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:references <https://www.purl.org/SomeOntology/MappingSet1>.
```

Alternative properties: n/a

SHACL validation rules:

- `sh:nodeKInd sh:IRI`

5.18 Competency Questions

Which competency questions does the ontology address? For which use case was it developed?

Recommended property: https://w3id.org/mod#competencyQuestion

Example 1 (text/turtle)

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    mod:competencyQuestion "Who developed an ontology?"@en .
```

Example 2 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    mod:competencyQuestion <https://www.example.com/SomeOntologyInfo/Questions#Q1>
```

Alternative properties: n/a

SHACL validation rules:

- `sh:xone ([sh:nodeKind sh:IRI ;] [sh:datatype rdf:langString ;])`

5.19 Applied methodology

A name or description of the steps taken to develop the ontology. This should describe the overall organisation of the ontology development process.

Recommended property: http://omv.ontoware.org/2005/05/ontology#usedOntologyEngineeringMethodology

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    omv:usedOntologyEngineeringMethodology "Methontology" .
```

Alternative properties: n/a

SHACL validation rules: n/a

5.20 Preferred ontology namespace

The preferred namespace URI of an ontology is the URI which is to be used when referencing its terms.

Recommended property: http://purl.org/vocab/vann/preferredNamespaceUri

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    vann:preferredNamespaceUri <https://w3id/Example/SomeOntology> .
```

Alternative properties: n/a

SHACL validation rules:

- `sh:maxCount 1`
- `sh:nodeKind sh:IRI`

5.21 Ontology issue date

The date the ontology was officially published.

Recommended property: http://purl.org/dc/terms/issued

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:issued "2023-11-21"^^xsd:dateTime .
```

Alternative properties:

- https://schema.org/dateIssued
- https://schema.org/datePublished

SHACL validation rules:

- `sh:datatype xsd:dateTime`
- `sh:maxCount 1`

5.22 Modification date

Since ontologies are updated over time, it would be helpful to provide the date when the ontology has been last modified.

Recommended property: http://purl.org/dc/terms/modified

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    dcterms:modified "2020-11-19T00:00:00"^^xsd:dateTime .
```

Alternative properties:

- https://schema.org/dateModified
- http://purl.org/pav/curatedOn

- http://purl.org/pav/lastUpdateOn

SHACL validation rules:

- `sh:datatype xsd:dateTime`
- `sh:maxCount 1`

5.23 Textual version information

Some ontologies make use of semantic versioning and employ strings like 1.0.0 as a tag to distinguish one version of their ontology from a successor. Others employ the modification date, e.g. 2022-12-21. If you use such textual version information but do not use/have a Version URI, then we strongly recommend to also mint a version URI in which you use the textual version information as variable.

If you need to add a larger comment in natural language, you should provide the info as an rdf:langString, i.e. with a language tag. We do not encourage this, since such statements can most likely be expressed in more granular fashion with formal statements. Alternatively, you could add the info to the version notes (cf. 5.24 Version notes).

Recommended property: http://www.w3.org/2002/07/owl#versionInfo

Example 1 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    owl:versionInfo "2023-01-01"^^xsd:string .
```

Example 2 (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    owl:versionInfo "1.0.0"^^xsd:string .
```

Example 3 (text/turtle) :

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    owl:versionInfo "Ontology version 1.0.0 of the subject classification in tabular format from Nov 2024."@en .
```

Alternative properties:

- http://purl.org/pav/version

SHACL validation rules:

- `sh:xone ([sh:datatype xsd:string ;] [sh:datatype rdf:langString ;])`
- `sh:maxCount 1`

5.24 Version notes

Version information may also be accompanied by a description about changes between one version of the ontology and its predecessor.

There are several ways for an automatic generation of change notes. When using GitHub and properly atomic PRs for the implementation of each change, you could copy the notes that are created when preparing a release based on tags, which will list all the PRs that have been merged since the last tag. Another approach could be to use the output of the ROBOT diff command.

Recommended property: http://www.w3.org/ns/adms#versionNotes

Example (text/turtle):

```
<https://www.purl.org/SomeOntology> rdf:type owl:Ontology ;
    adms:versionNotes "Changes from 2000-01-12: add annotation properties: familyName [...] "@en .
```

Alternative properties:

- http://purl.org/vocab/vann/changes

SHACL validation rules:

- `sh:datatype rdf:langString`
- `sh:nodeKind sh:Literal`

- `sh:datatype rdf:langString`
- `sh:nodeKind sh:Literal`

6 Tabular overview

section	metadatum	Preferred property	Mandatory	Recommended	Optional	Cardinality
3.1	Title	http://purl.org/dc/terms/title	x			1...*
3.2	Preferred ontology prefix/ acronym	http://purl.org/vocab/vann/preferredNamespacePrefix	x			1
3.3	License	http://purl.org/dc/terms/license	x			1
3.4	Creator	http://purl.org/dc/terms/creator	x			1...*
3.5	Version IRI	http://www.w3.org/2002/07/owl#versionIRI	x			1
3.6	Creation date	http://purl.org/dc/terms/created	x			1
3.7	Abstract	http://purl.org/dc/terms/abstract	x			1...*
3.8	Issue tracker	http://usefulinc.com/ns/doap#bug-database	x			1
3.9	Documentation	http://www.loc.gov/premis/rdf/v3/documentation	x			1
4.1	Contributor(s)	http://purl.org/dc/terms/contributor		x		0...*
4.2	Funder	https://schema.org/funder		x		0...*
4.3	Funding (grant)	https://schema.org/funding		x		0...*
4.4	Audience description	http://usefulinc.com/ns/doap#audience		x		0...1
4.5	Subject(s)	http://purl.org/dc/terms/subject		x		0...*
4.6	Annotation language(s)	http://purl.org/dc/terms/language		x		0...*
4.7	Applied logical framework	https://w3id.org/mod#hasFormalityLevel		x		0...1
4.8	Serialization/ file format	https://w3id.org/mod#hasSyntax		x		0...1
4.9	Status	http://purl.org/ontology/bibo/status		x		0...1
4.10	Code repository	http://usefulinc.com/ns/doap#repository		x		0...1
4.11	Distributions/ products	http://www.w3.org/ns/dcat#distribution		x		0...*
4.12	Application example	http://purl.org/vocab/vann/example		x		0...*
4.13	Related resource(s)	http://purl.org/dc/terms/references		x		0...*
4.14	Citation suggestion	http://purl.org/dc/terms/bibliographicCitation		x		0...*
4.15	Ontology sources (derived from)	http://purl.org/pav/derivedFrom		x		0...*
4.16	Root classes	http://purl.obolibrary.org/obo/IAO_0000700		x		0...*
5.1	Description	https://schema.org/description			x	0...*
5.2	Alternative ontology title	http://purl.org/dc/terms/alternative			x	0...*

section	metadatum	Preferred property	Mandatory	Recommended	Optional	Cardinality
5.3	Alternative ontology prefix/ acronym	http://identifiers.org/idot/alternatePrefix			x	0...*
5.4.1	Prior ontology version	http://www.w3.org/2002/07/owl#priorVersion			x	0...*
5.4.2	Related ontology version	http://purl.org/dc/terms/hasVersion			x	0...*
5.4.3	Compatible ontology version	http://www.w3.org/2002/07/owl#backwardCompatibleWith			x	0...*
5.4.4	Incompatible ontology version	http://www.w3.org/2002/07/owl#incompatibleWith			x	0...*
5.5	Social media	http://xmlns.com/foaf/0.1/holdsAccount			x	0...*
5.6	KOS type	http://purl.org/dc/terms/type			x	0...1
5.7	Example ontology identifier	http://identifiers.org/idot/exampleIdentifier			x	0...*
5.8	Ontology identifier pattern	http://identifiers.org/idot/identifierPattern			x	0...1
5.9	Ontology homepage	http://xmlns.com/foaf/0.1/homepage			x	0...1
5.10	Publisher	http://purl.org/dc/terms/publisher			x	0...*
5.11	Ontology comments	http://www.w3.org/2000/01/rdf-schema#comment			x	0...*
5.12	Example ontology class	http://rdfs.org/ns/void#exampleResource			x	0...*
5.13	Ontology mailing list	http://usefulinc.com/ns/doap#mailing-list			x	0...1
5.14	Ontology logo/ depiction/ related visualizations	http://xmlns.com/foaf/0.1/logo			x	0...*
5.15	Related identifiers	http://purl.org/dc/terms/identifier			x	0...*
5.16	Development environment	http://purl.org/pav/createdWith			x	0...*
5.17.1	Aligned resources	https://w3id.org/mod#hasEquivalencesWith			x	0...*
5.17.2	Alignment files/ mapping files	http://purl.org/dc/terms/references			x	0...*
5.18	Competency questions	https://w3id.org/mod#competencyQuestion			x	0...*
5.19	Applied methodology	<http://omv.ontoware.org/2005/05/ontology# usedOntologyEngineeringMethodology>			x	0...*

section	metadatum	Preferred property	Mandatory	Recommended	Optional	Cardinality
5.20	Preferred ontology namespace	http://purl.org/vocab/vann/preferredNamespaceUri			x	0...1
5.21	Ontology issue date	http://purl.org/dc/terms/issued			x	0...1
5.22	Modification date	http://purl.org/dc/terms/modified			x	0...1
5.23	Textual version information	http://www.w3.org/2002/07/owl#versionInfo			x	0...1
5.24	Version notes	http://www.w3.org/ns/adms#versionNotes			x	0...*

7 Relations to related work

The following table shows the relation of the recommendations in this guide to related works. If these works recommend the same metadatum for an ontology, the corresponding cell will be marked as *true*, if the metadatum could not be identified in the source, the corresponding cell will be marked as *false*.

section	metadatum	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]
3.1	Title	true	true	true	true	true	true	true	false	false	true	true
3.2	Preferred ontology prefix/ acronym	true	true	true	false	true	true	true	false	false	true	false
3.3	License	true	true	true	true	true	true	true	true	true	true	true
3.4	Creator	true	true	true	true	true	true	true	true	true	false	true
3.5	Version IRI	false	false	false	false	true	true	true	true	true	false	true
3.6	Creation date	true	true	false	false	true	true	true	true	true	false	true
3.7	Abstract	false	true	false	true	true	true	true	false	false	true	true
3.8	Issue tracker	true	true	false	true	false	false	true	false	false	false	true
3.9	Documentation	false	false	false	false	false	false	false	false	true	false	false
4.1	Contributor(s)	false	true	true	true	true	true	true	true	false	false	true
4.2	Funder	true	true	false	false	true	false	true	false	false	false	true
4.3	Funding (grant)	false	false	false	false	true	false	false	false	false	false	true
4.4	Audience description	true	true	false	true	false	false	true	false	false	false	true
4.5	Subject(s)	true	true	false	true	false	false	true	false	true	true	true
4.6	Annotation language(s)	true	true	false	false	false	false	true	false	false	false	true
4.7	Applied logical framework	false	true	false	true	false	false	true	false	false	false	false
4.8	Serialization/ file format	true	true	false	false	false	false	true	false	false	false	true
4.9	Status	true	false	false	true	true	true	true	true	true	true	true
4.10	Code repository	false	true	false	true	false	false	true	false	false	true	false
4.11	Distributions/ products	true	true	false	false	false	false	true	false	true	false	true
4.12	Application example	false	true	false	true	false	false	true	false	false	false	false
4.13	Related resource(s)	true	true	false	false	true	true	true	false	true	true	true
4.14	Citation suggestion	false	true	false	false	true	true	true	true	false	false	true
4.15	Ontology sources (derived from)	true	true	false	true	true	true	true	true	true	false	true
4.16	Root classes	false	true	false	false	false	false	true	false	false	false	false
5.1	Description	true	true	true	true	true	true	true	false	true	true	true
5.2	Alternative ontology title	false	true	false	false	false	false	true	false	false	false	true
5.3	Alternative ontology prefix/ acronym	true	true	false	false	false	false	false	false	false	true	false
5.4.1	Prior ontology version	false	true	false	false	true	true	true	true	true	false	false
5.4.2	Related ontology version	false	true	false	false	false	false	true	false	false	false	false
5.4.3	Compatible ontology version	false	false	false	false	true	true	true	true	false	false	false
5.4.4	Incompatible ontology version	false	false	false	false	true	true	true	true	false	false	false
5.5	Social media	true	false	false	false	false	false	false	false	false	true	false
5.6	KOS type	false	false	false	false	false	false	false	false	false	false	true
5.7	Example ontology identifier	true	true	false	false	false	false	true	false	false	true	false
5.8	Ontology identifier pattern	true	true	false	true	false	false	true	false	false	true	false

section	metadatum	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]
5.9	Ontology homepage	true	true	false	false	false	false	true	false	false	true	false
5.10	Publisher	true	true	true	false	true	true	true	false	false	false	true
5.11	Ontology comments	true	true	true	false	false	false	true	false	false	true	false
5.12	Example ontology class	true	true	false	false	false	false	true	false	false	false	true
5.13	Ontology mailing list	true	true	false	true	false	false	true	false	false	false	false
5.14	Ontology logo/ depiction/ related visualizations	true	true	false	true	true	true	true	false	false	true	false
5.15	Related identifiers	true	true	false	false	true	false	true	false	false	true	true
5.16	Development environment	true	true	false	true	false	true	true	false	false	false	false
5.17.1	Aligned resources	false	true	false	false	false	false	true	false	true	false	false
5.17.2	Alignment files/ mapping files	false	false	false	false	false	false	false	false	true	false	false
5.18	Competency questions	false	true	false	false	false	false	true	false	false	false	false
5.19	Applied methodology	true	true	false	true	false	false	true	false	false	false	false
5.20	Preferred ontology namespace	true	true	true	false	true	true	true	false	false	false	true
5.21	Ontology issue date	false	true	true	false	true	true	false	false	false	false	false
5.22	Modification date	false	true	true	false	true	true	true	true	false	false	true
5.23	Textual version information	false	true	true	false	true	true	true	true	false	true	true
5.24	Version notes	false	true	true	false	false	true	false	true	false	false	false

8 Sources

1. GO FAIR (n/a): FAIR Principles. URL: https://www.go-fair.org/fair-principles/ (last access: 28 April 2023).

2. Yann Le Franc, Luiz Bonino, Hanna Koivula, Jessica Parland-von Essen, & Robert Pergl (2022): D2.8 FAIR Semantics Recommendations Third Iteration (V1.0). Zenodo. URL: https://doi.org/10.5281/zenodo.6675295 (last access: 04 April 2024).

3. OBO Foundry (n/a): Principle: Versioning (principle 4). URL: http://obofoundry.org/principles/fp-004-versioning.html (last acchess: 04 April 2024).

4. Garijo, Daniel (2017): WIDOCO: a wizard for documenting ontologies. In: International Semantic Web Conference (Proceedings), 94-102. Springer, Cham. DOI: 10.1007/978-3-319-68204-4_9. URL: http://dgarijo.com/papers/widoco-iswc2017.pdf (last access: 04 April 2024).

5. Daniel Garijo et al. (2023): WIzard for DOCumenting Ontologies (WIDOCO) - Code Repository. URL: https://github.com/dgarijo/Widoco/tree/v1.4.21 (last access: 04 April 2024).

6. Internet Assigned Numbers Authority (2024): Media Types. URL https://www.iana.org/assignments/media-types/media-types.xhtml (last access: 04 April 2024).

7. World Wide Web Consortium (W3C) (2015): Unique URIs for File Formats. URL: https://www.w3.org/ns/formats/ (last access: 04 April 2024).

8. OBO Foundry (n/a): Ontology status. URL: https://obofoundry.org/docs/OntologyStatus.html (last access: 04 April 2024).

9. Samples, Phenotypes and Ontologies (SPOT) at EMBL-EBI (2022): Ontology Lookup Service (OLS) Version 3 - Code Repository - Release 3.2.5. URL: https://github.com/EBISPOT/OLS/releases/tag/v3.2.5-main-test (last access: 04 April 2024).

10. Samples, Phenotypes and Ontologies (SPOT) at EMBL-EBI (2024): Ontology Lookup Service (OLS) - Version 4 - Code Repository - Latest Release. URL: https://github.com/EBISPOT/ols4 (last access: 04 April 2024).

11. Marcia Zeng & Maja Žumer (2019): KOS Type Vocabulary. URL: https://nkos.dublincore.org/nkos-type.html, https://nkos.dublincore.org/nkostype/nkostype.rdf (last access: 04 April 2024).

12. Nicolas Matentzoglu et al. (2024): Simple Standard for Sharing Ontological Mappings (SSSOM) - Editors Draft version 0.15.2. URL: https://github.com/mapping-commons/sssom/tree/0.15.2 (last access: 04 April 2024).

13. OBO Foundry (2021): Derived registry files - context file for the generation of rdf-based ontology metadata. URL: http://purl.obolibrary.org/meta/context.jsonld, https://github.com/OBOFoundry/OBOFoundry.github.io/blob/5ba7e5db94565691853db7b476637fd303c4fb94/registry/context.jsonld (last access: 04 April 2024).

14. Dutta, B., Toulet, A., Emonet, V. and Jonquet, C. (2017): New Generation Metadata vocabulary for Ontology Description and Publication. In E. Garoufallou, S. Virkus, R. Siatri and D. Koutsomiha (eds.): *Communications in Computer and Information Science (CCIS) 755, proceedings of 11th Metadata and Semantics Research Conference (MTSR 2017), November 28 - December 1, 2017, Tallinn, Estonia*. Springer Nature, pp. 173-185. URL: https://w3id.org/mod/2.0 (last access: 04 April 2024).

15. Pierre-Yves Vandenbussche & Bernard Vatant (2021): Metadata Recommendations For Linked Open Data Vocabularies - Version 1.1. URL: https://lov.linkeddata.es/Recommendations_Vocabulary_Design.pdf (last access: 04 April 2024).

16. Robert Stevens et al. (2017): MIRO – Minimum Information for Reporting of an Ontology. URL: https://github.com/owlcs/miro/blob/master/miro.md (last access: 04 April 2024).

17. Daniel Garijo & María Poveda-Villalón (2023): A checklist for complete vocabulary metadata - Revision 1.0.2. URL: https://w3id.org/widoco/bestPractices (last access: 04 April 2024).

18. Daniel Garijo & María Poveda-Villalón (2020): Best Practices for Implementing FAIR Vocabularies and Ontologies on the Web. *ArXiv.org.* URL: https://doi.org/10.48550/arXiv.2003.13084 (last access: 04 April 2024).

19. E. Amdouni, S. Bouazzouni, C. Jonquet (2022): O'FAIRe: Ontology FAIRness evaluator - FAIR questions. URL: https://github.com/agroportal/fairness/commit/f5767d417465bcb2602f5400cf921169c5f10a65 (last access: 04 April 2024).

20. Cox, Simon J. D. et al. (2021): Ten simple rules for making a vocabulary FAIR. *PLOS Computational Biology 17(6)*, pp. 1-15. URL: https://doi.org/10.1371/journal.pcbi.1009041 (last access: 04 April 2024).

21. Fuqi Xu et al. (2022): Features of a FAIR vocabulary. In: Katy Wolstencroft et al. (eds.): *Proceedings of the 13th International Conference on Semantic Web Applications and Tools for Health Care and Life Sciences (SWAT4HCLS)* (= CEUR Workshop Proceedings 3127). Aachen, 118-148. URL: http://ceur-ws.org/Vol-3127/#paper-15 (last access: 04 April 2024).

22. Charles Tapley Hoyt (2024): Bioregistry JSON Schema. URL (latest): https://bioregistry.io/schema.json, URL (v0.10.190): https://github.com/biopragmatics/bioregistry/blob/v0.10.190/src/bioregistry/schema/schema.json (last access: 04 April 2024).

23. Schema.Org Community Group (n/a): DefinedTermSet. A Schema.org Type. URL: https://schema.org/DefinedTermSet (last access: 04 April 2024).