

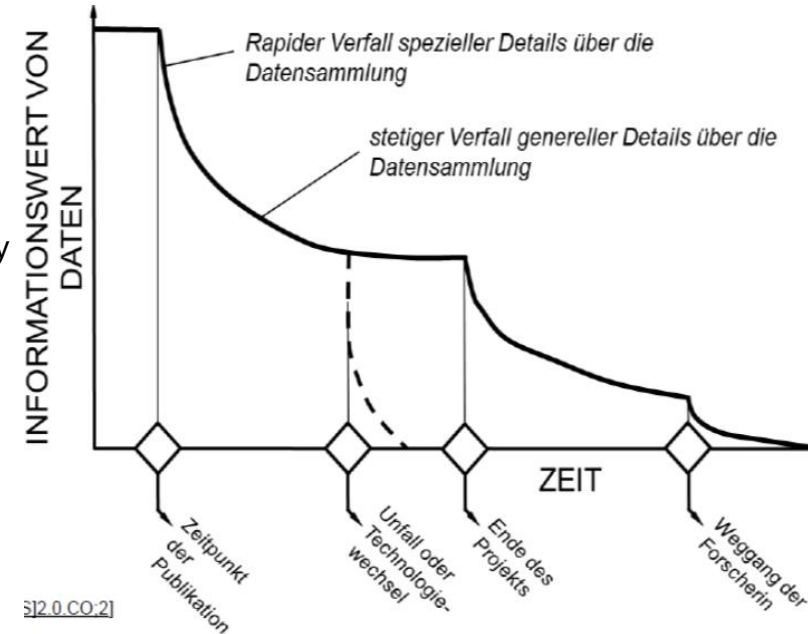
● Metadata and Terminology Services. A Toolchain for comprehensive Data- and Knowledge Management NFDI4Ing Conference 2022

Agenda

- **Introduction S-3** (Felix Engel)
- **S-3 Services**
 - Terminology Service (Felix Engel)
 - Application Profile (Matthias Grönewald)
 - Metadata Hub (Benedikt Heinrichs)
- **Example Application**
 - Generate profile compliant data (Matthias Grönewald, Nils Preuß)
 - Make existing profile-compliant data available (Benedikt Heinrichs)
- **Discussion**

Introduction

- **Research data** can only be **reused** if they are described in a way that is comprehensive, interpretable and comprehensible to outsiders.
- No data and knowledge management can lead to data incompatibility and loss

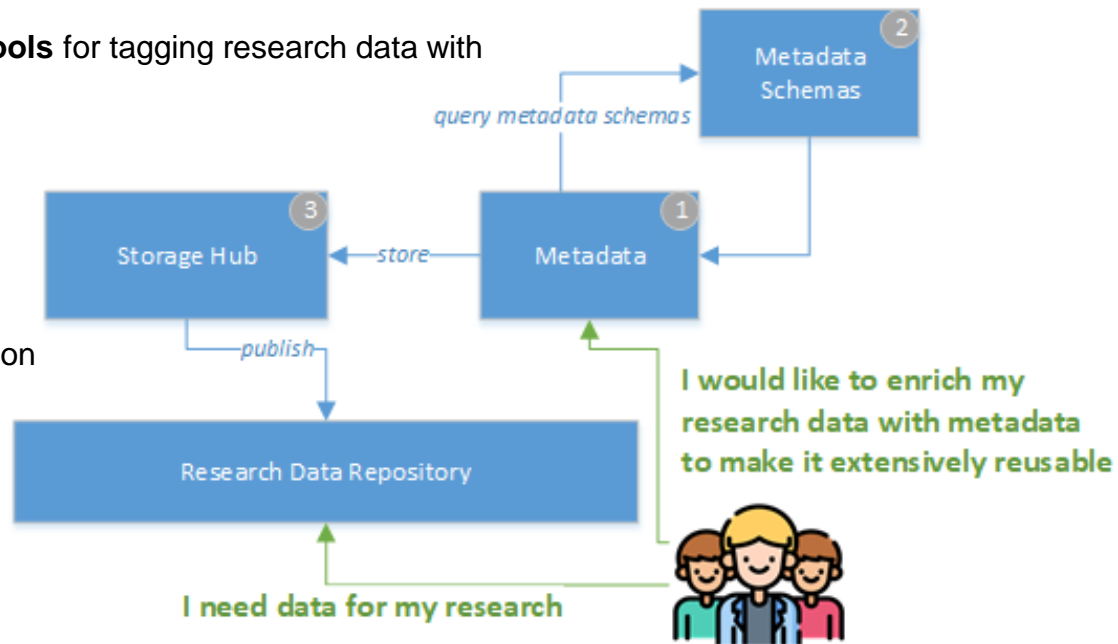


Introduction

Simplified Vision: Measure S-3 “Metadata and terminology services”

NFDi4ing Measure S-3: Provide **sophisticated tools** for tagging research data with metadata, to make it available for **reuse**

1. **Generating** metadata records
2. ... by means of **access** to existing schemas
3. ... using **different repositories** for publication

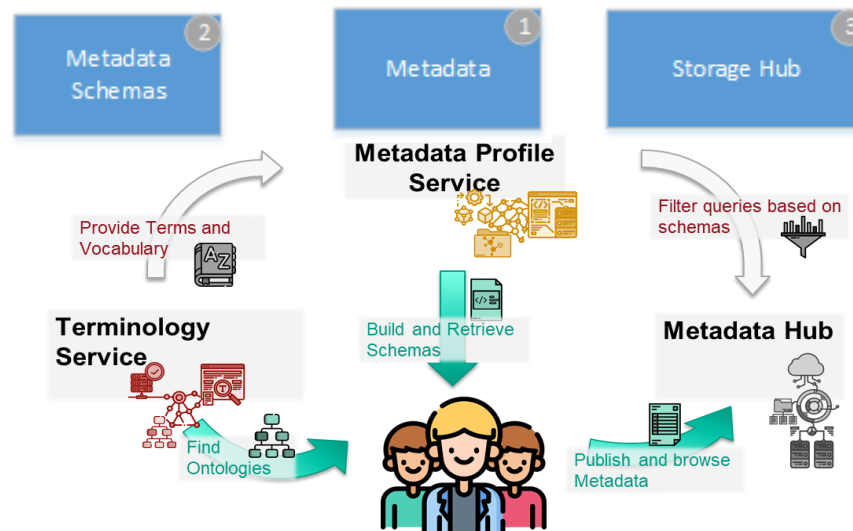




Introduction

S-3 will provide a toolchain of: ... services to facilitate the creation of subject and application specific standardised metadata and their integration into engineering workflows

<p><u>Application Profiles</u></p> <ul style="list-style-type: none"> Task S-3-1 TUDA, RWTH, KIT <p><u>Aim:</u> Flexible modelling of user specific schemes with maximum re-usability and interoperability</p> <p><u>Solution:</u> Flexible application-specific selection of suitable elements from controlled terminologies → Application Profiles</p>	<p><u>Terminology Service</u></p> <ul style="list-style-type: none"> Task S-3-2 TIB <p><u>Aim:</u> Build a technical infrastructure for terminology management and access</p> <p><u>Solution:</u> Provision of a web based service, that enables access, curation, and subscription to domain specific terminologies</p>	<p><u>Metadata Hub</u></p> <ul style="list-style-type: none"> Task S-3-3 TUDA, RWTH, KIT <p><u>Aim:</u> Data Management of metadata documents</p> <p><u>Challenge:</u></p> <ul style="list-style-type: none"> Techn. diversity Inconsistency of the functionalities <p><u>Solution:</u> Repository turntable: Uniform access through uniform API</p>
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Research Data Lifecycle

—● **Phases: Planning, Production, Analysis, Storage, Access, Re-Use**

—● **Example (*)**

—● *150 --> just a number*

—● *150°C am Karolingerplatz --> Nr. + Context = Information*

—● Which measuring instrument is used?

—● Which configurations? (characteristics, tolerances, ...)



→ **How to Re-Use** your research without having knowledge about its creation?

→ Comprehensive **metadata** is required to make your research **reproducible** and therefore **reusable**

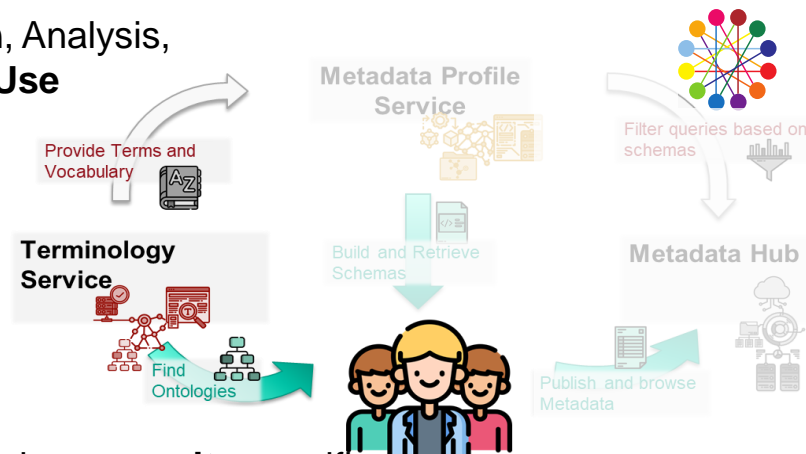
(*) https://git.rwth-aachen.de/nfdi4ing/education/data-life-cycle/-/blob/main/NFDi4Ing_Training_DLC_2_Daten_erheben.pdf



Planning, **Production**, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

Terminology Service



1. **Domain** specific (Engineering, Culture, Chemistry...) and **community** specific
2. **Evolving** continuously and dynamically over time
3. Must be accepted, developed and maintained by a **designated community** (avoid isolated solution!) Includes a.o.
 - a) promotion (make community aware of its existence)
 - b) aligned with further metadata initiatives (moving away from silos)
 - c) applicable in RDM (in RDM practise)

—● NFDI supports terminology development and use through introduction of community specific
Terminology Services

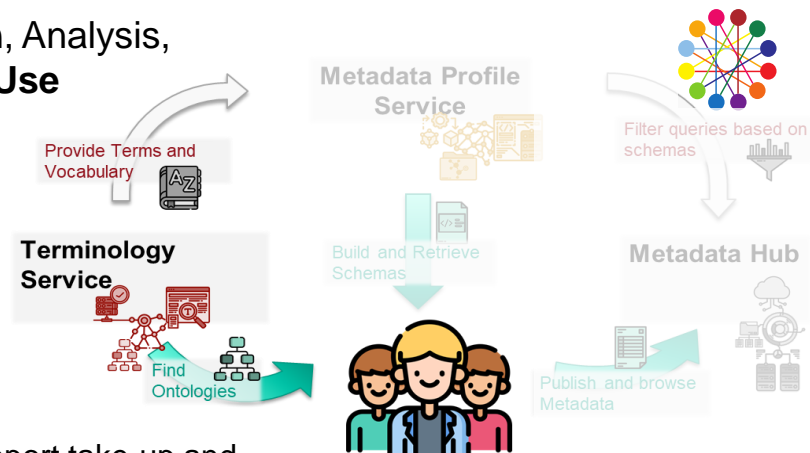


Planning, **Production**, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

Terminology Service

- In general: A Terminology Service is a web based platform that support take-up and standardisation of terminologies
- Used by **RDM tools** and **Knowledge Workers** as
 - **Entry Point** to prepare research data for effective later reuse
 - Tag/index with keywords from an terminologies (e.g. content indexation for retrieval)
 - Consolidate terminology: use the same keywords
 - Trace changes meaning
 - Search: Query reformulation, term suggestion, ...
 - **Hub**, that fosters awareness and alignment
 - Bundles terminologies of a domain
 - Provides meta data and statistics
 - Foster alignments



EMBL-EBI



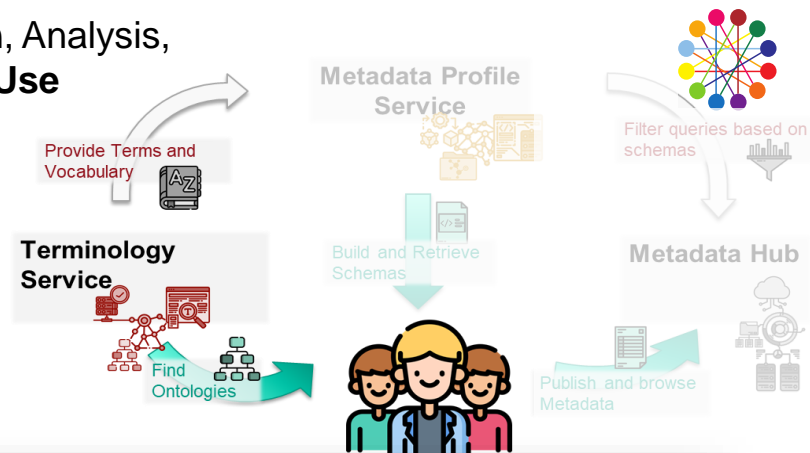


Planning, **Production**, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

Terminology Service

- **NFDI4Ing TS:** <https://terminology.nfdi4ing.de>
- **Some statistics**
 - 31 Terminologies
 - 4,089 properties
- **Functional service offer**
 - Freetext search searching (for- and within ontologies)
 - Browsing and filtering
 - Visualisation
 - Issue tracker
 - Machine to machine communication (REST interfaces)
 - Collection management



NFDI4Ing

Home | Ontologies | FAQ | Documentation | Usage | About

Welcome to the NFDI4Ing Terminology Service

Search TS...

Search

Examples: electric vehicle, agent

Looking for a particular ontology?

About NFDI4Ing Terminology Service

NFDI4Ing Terminology Service is a repository for engineering ontologies that aims to provide a single point of access to the latest ontology versions. You can browse engineering ontologies either through this website or via the Rest API. NFDI4Ing TS is developed and maintained by TIB as an extension of the TIB Central Terminology Service.

Community Vision of NFDI4Ing

NFDI4Ing Terminology Service is a **community driven offer**, that intends to reflect the interests of engineers (see respective DFG Subjects Area). We appreciate and encourage everyone interested to get involved in shaping it by proposing further existing ontologies and new features. To make such proposals please either write an email to felix.engel (AT) tib.eu or use our GitHub issue tracker.

Data Content

Updated 08 Sep 2022 09:10

- 31 ontologies
- 12,798 terms
- 4,122 properties
- 10,145 individuals

Tweets from @NFDI4Ing

NFDI4Ing @NFDI4Ing · 19h

Today at 4PM Jürgen Windeck (TU DA) is presenting the #NFDI4Ing Research Data Management Organiser (#RDMO) consortium service at the @NFDI_de tool talk. You can join the talk by registering here: nfdi.de/talks/

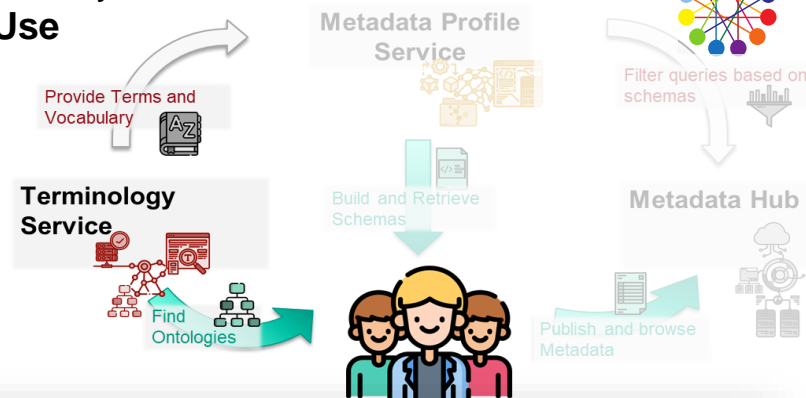


Metadata and Terminology Services

Terminology Service

List of all ontologies in the Terminology Service

Show				Search:	
10					
entries					
Ontology Name	Short name	Description	Loaded	Action	
Basic Formal Ontology	BFO	The upper level ontology upon which OBO Foundry ontologies are built.	Thu Oct 28 16:55:15 GMT 2021	Search Terms Properties Individuals	
Bioinformatics operations, data types, formats, identifiers and topics	EDAM	EDAM is a simple ontology of well established, familiar concepts that are prevalent within bioinformatics, including types of data and data identifiers, data formats, operations and topics. EDAM provides a set of terms with synonyms and definitions - organised into an intuitive hierarchy for convenient use.	Thu Oct 28 16:57:03 GMT 2021	Search Terms Properties Individuals	
Building Topology Ontology	bot	The Building Topology Ontology (BOT) is a minimal ontology for describing the core topological concepts of a building.	Thu Oct 28 16:55:17 GMT 2021	Search Terms Properties Individuals	
Core Ontology for Robotics and Automation (CORA)	CORA	This is the OWL implementation of CORA in IEEE 1872-2015. It only includes the taxonomy of concepts and relations, with some few axioms regarding disjointness, property characteristics and property ranges/domains. The OWL implementation is an underspecified version of the SUO-KIF implementation in IEEE 1872-2015. That is, the set of allowed models of the SUO-KIF implementation is a proper subset of the allowed models by the OWL implementation.	Thu Oct 28 16:56:10 GMT 2021	Search Terms Properties Individuals	
Data Privacy Vocabulary (DPV)	dpv	The Data Privacy Vocabulary (DPV) provides terms (classes and properties) to describe and represent information related to processing of personal data based on established requirements such as for the EU General Data Protection Regulation (GDPR). The DPV is structured as a	Thu Oct 28 16:56:45 GMT 2021	Search Terms Properties Individuals	



☐ Exact match ☐ Obsolete terms

Term type

class 110

individual 94

property 45

Ontology

Basic Formal Ontology (BFO)

Building Topology Ontology (bot)

Core Ontology for Robotics and Automation (CORA)

Search results for electric vehicle

Previous

Showing 1 to 10 of 219 results

Next

electric vehicle OEO:00000146

http://openenergy-platform.org/ontology/oeo/OEO_00000146

Ontology: [Repository for the Open Energy Ontology \(OEO\)](#) OEO

Electric Vehicle ElectricVehicle

<http://schema.mobivoc.org/#ElectricVehicle>

Ontology: [MobiVoc Open Mobility Vocabulary](#) MV

Electric Vehicle Charging Electric_Vehicle:Charging

http://www.w3id.org/ecsel-dr-PWR#Electric_Vehicle_Charging

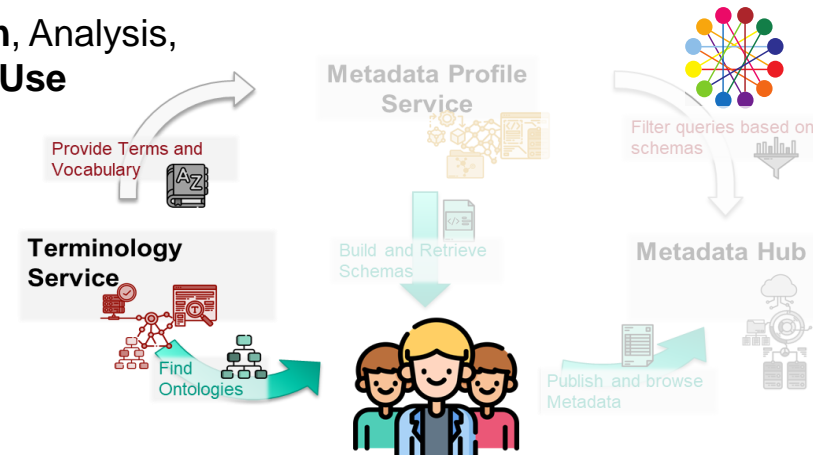
Ontology: [Digital Reference](#) dr



Planning, **Production**, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

Terminology Service



- Example **M2M** Communication
- Creation and sharing of metadata standards as so-called **Application Profiles**
- An application profile is a set of requirements for subject and use-case specific metadata and represented in RDF and SHACL
- Within the frontend, users can search and drag vocabulary terms into their application profile as properties. The TIB Terminology Service is used to retrieve these vocabulary terms, by automatically querying its **REST Interface**

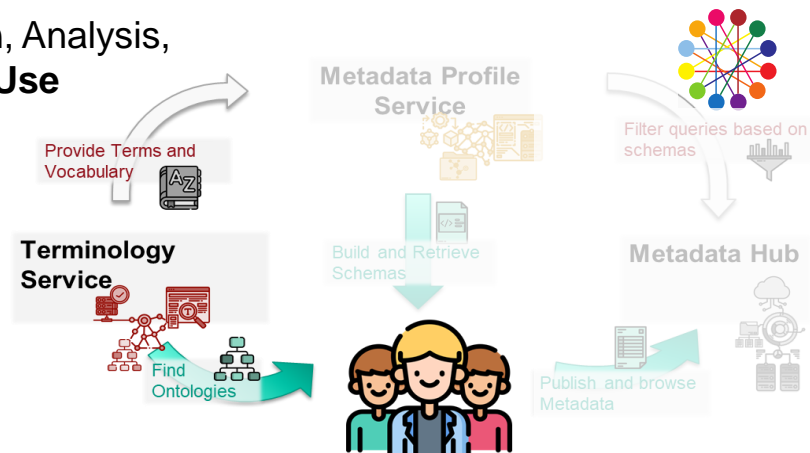


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Storage, Access, **Re-Use**

Metadata and Terminology Services

Terminology Service

- How we **differ from plain OLS** (an extract)
 - new and tailored **frontend**
 - extended **REST** interface incl. **Swagger** documentation
 - **collection management**
 - **CI Pipeline**
 - Ingestion pipeline to **check/validate ontologies**
- TS is a complex project. Currently only one NFDI4Ing developer.
Joined forces with:
 - **NFDI4Chem**: REACT based frontend
 - **CoyPu**: WebProtege-Git integration
 - **FairDS**: Integration of ontology analysis tools



 **NFDI₄Chem**

 **CoyPu**

 **FAIR Data Spaces**

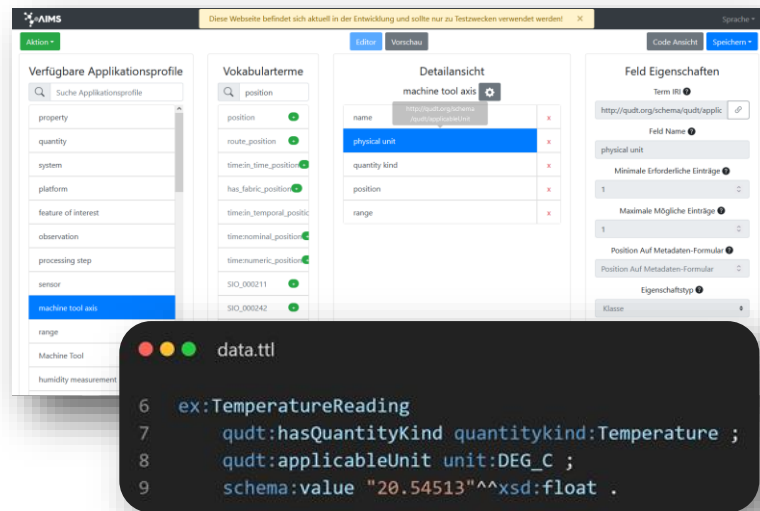
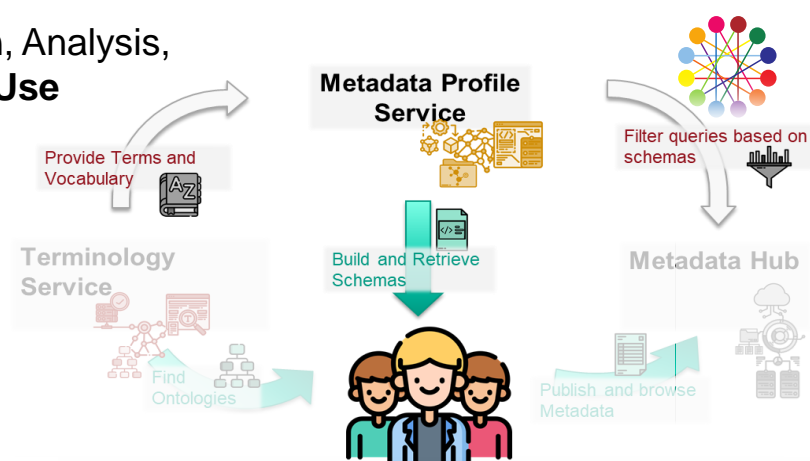


Planning, **Production**, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

Application Profiles

- **General description:** An online platform for generating and sharing metadata profiles
- Profiles allow for specific but interoperable metadata
- Focusing on controlled vocabularies creates conformity with existing domain knowledge
- **Service offer:** *Unified online platform for human- and machine readable metadata* – **Metadata Profile Service**



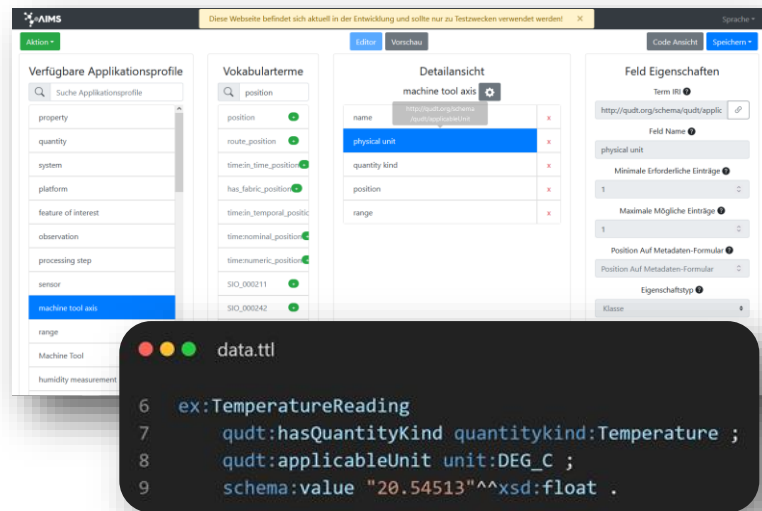
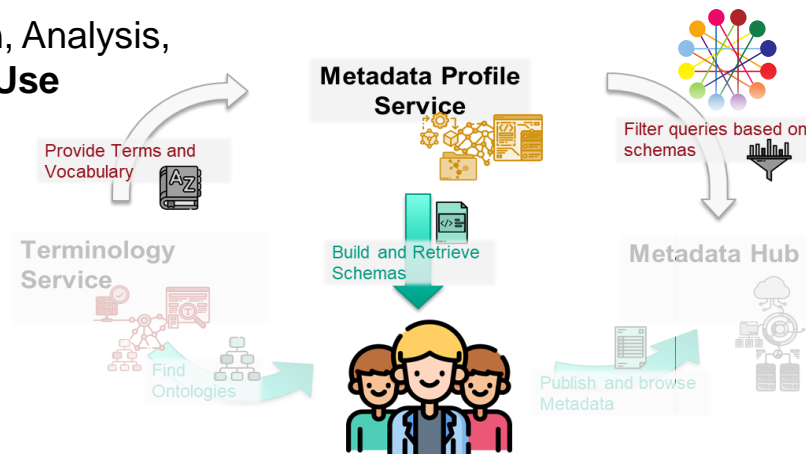


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Storage, Access, **Re-Use**

Metadata and Terminology Services

Application Profiles

- **User interaction:** *Build, retrieve and share schemas*
- Search for metadata profiles and related metadata
- Re-use, adapt and refine schemas based on controlled vocabularies
- Share schemas and publish metadata (via S3-3)
- Community-based curation of domain-specific metadata profiles
- **Technologies:** SHACL profiles, flexible serialisation (JSON-LD, TTL, XML, etc.)





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Metadata and Terminology Services

Application Profiles

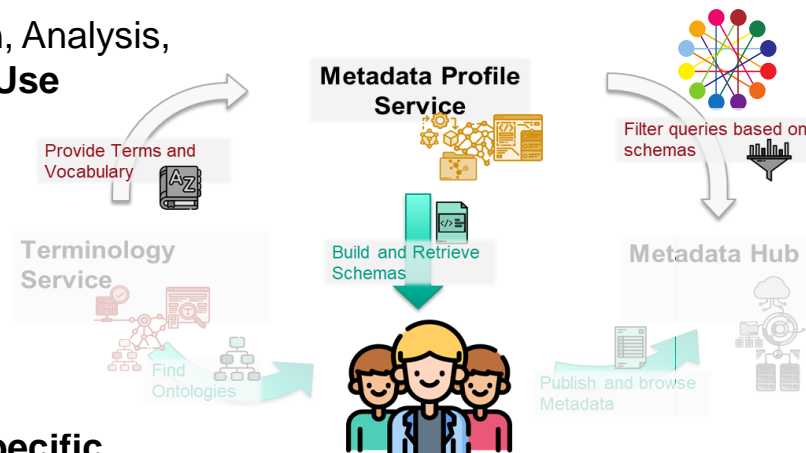
Search & Re-use

The screenshot shows the 'Available Application Profiles' list with 'temperature measurement' selected. The 'Vocabulary Terms' list shows 'hasUnit' as the selected term. The 'Detail View' for 'temperature measurement' shows the 'Current Application Profile' and 'Inherited Application Profiles'.

Refine & Adapt

Domain specific requirements

The screenshot shows the 'Field Properties' configuration interface for a field named 'kinematic chain'. It includes options for 'Term URI', 'Field Name', 'Minimum Required Entries', 'Maximum Possible Entries', 'Position On Metadata Form', 'Property Type', and 'Datatype'.



```

12 machine_tool.ttl
13
14 mt:MachineToolShape
15   a sh:NodeShape ;
16   dcterms:title "Machine Tool"@en ;
17   dcterms:description "Milling machine";
18   dcterms:creator "Matthias Bodenbenner";
19   dcterms:rights "https://spdx.org/licenses/CC0-1.0.html" ;
20   dcterms:date "2022-06-22"^^xsd:date ;
21   owl:imports aims:PlatformShape ;
22   sh:node aims:PlatformShape ;
23   sh:property [
24     sh:path qb:order ;
25     sh:name "kinematic chain"@en ;
26     sh:description "The machines kinematic chain according to ISO 841." ;
27     sh:minCount 1 ;
28     sh:maxCount 1 ;
29     sh:datatype xsd:string ;
30   ] ;
31   sh:property [
32     sh:path sosa:hosts ;
33     sh:name "Machine Tool axes"@en ;
34     sh:description "An axis of the machine." ;
35     sh:qualifiedValueShape mt:MachineAxisShape ;
36   ] ;
37

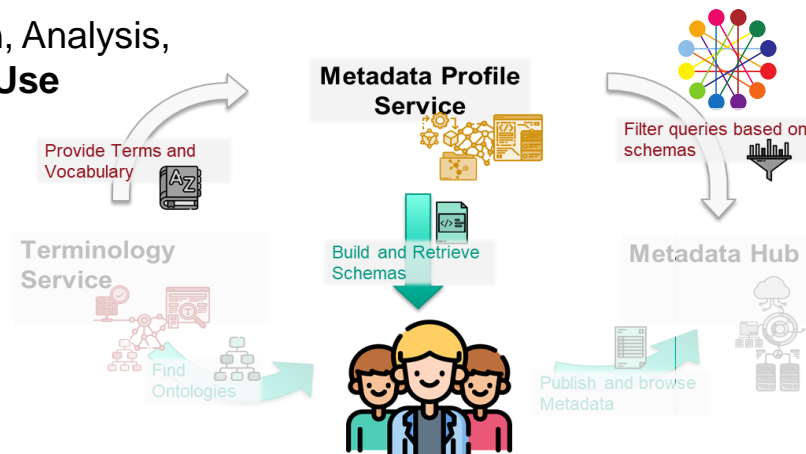
```



Planning, **Production**, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

Application Profiles



Forms

Metadaten-Formular

b6_c14n1

+

kinematic chain *

1

✓

+

name *

Machine Tool 1

✓

+

manufacturer *

Manufacturer

✓

+

serial number *

1234567890

✓

+

Metadaten-Ansicht

```

@prefix qb: <http://purl.org/linked-data/cube#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix schema: <http://schema.org/> .

_:b55 a <http://www.iot.v2i-mq.rwth-aachen.de/terms/machine-tools#MachineTool>
qb:order "1" ;
schema:name "Machine Tool 1" ;
schema:manufacturer "Manufacturer" ;
schema:serialNumber "1234567890" .

```

Senden

Libraries



```

20 sh:node aims:PlatformShape ;
21 sh:property [
22   sh:path qb:order ;
23   sh:property schema:shapeOf
24   acquisition.ttl
25 ]
26
27
28
29
30
31
32
33
34
35

```

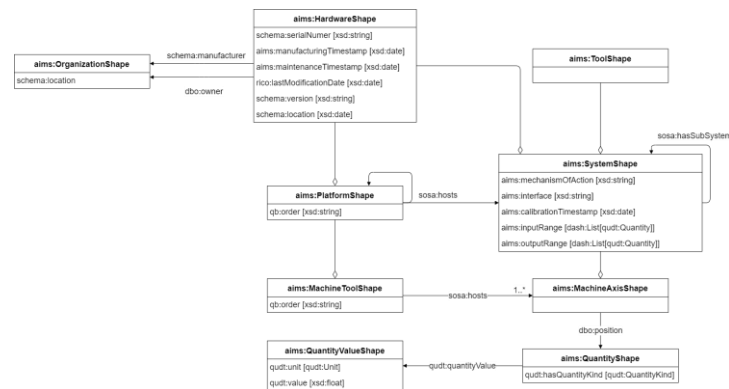
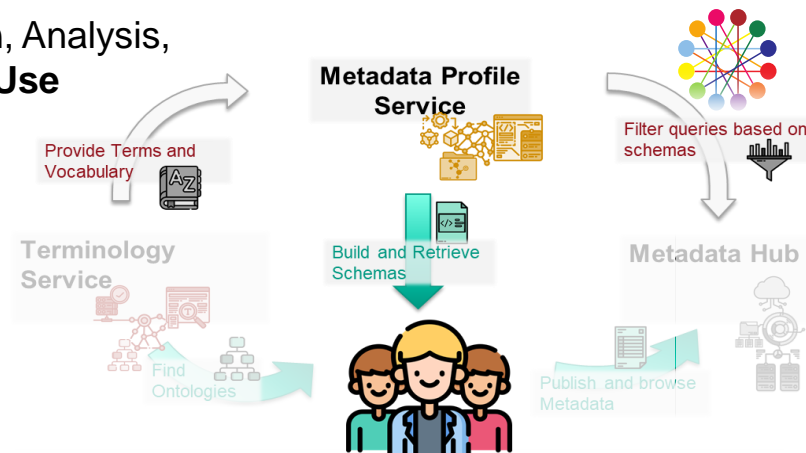



Planning, **Production**, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

Application Profiles

- **Goal:** More accessible metadata management to facilitate wider application of rich metadata and foster metadata standards.
- Complex profiles are far more powerful, but harder to manage.
- *Metadata Profile Service* will offer a platform for the community to collaborate on them.
- Toolchain relation: Make terms and content vom TS applicable, allow for even richer metadata description in MH



**Complex machine-actionable
profile of a sensor**

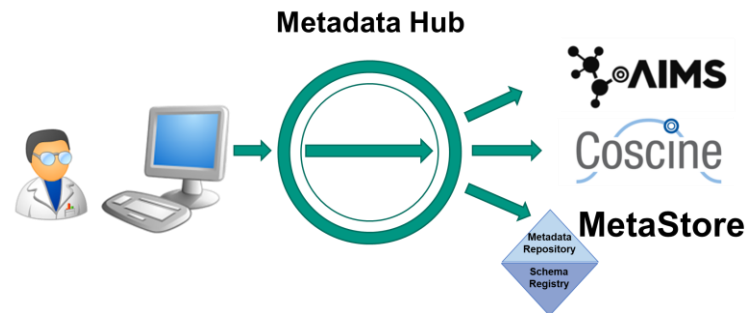
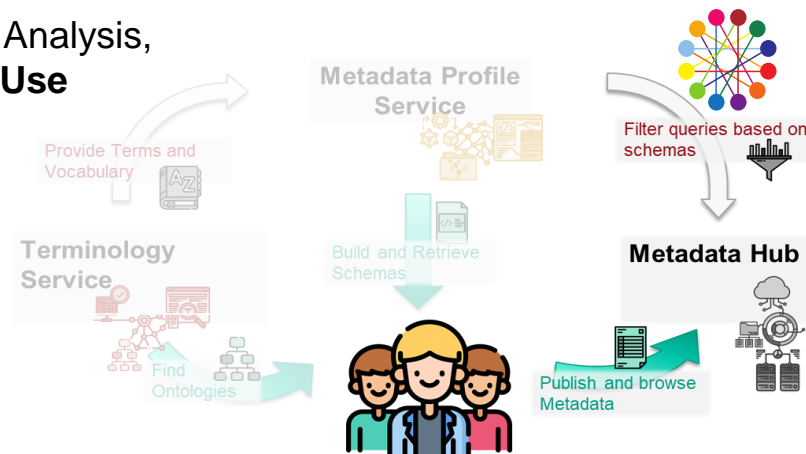


Planning, Production, Analysis,
Storage, Access, Re-Use

Metadata and Terminology Services

Metadata Hub

- Metadata repositories usually provide different interfaces
- Interoperability is wanted but cannot be achieved like this
- Goal:
 - Bring them together
- How:
 - A generic interface which combines different kinds of metadata repositories with one standard-based interface



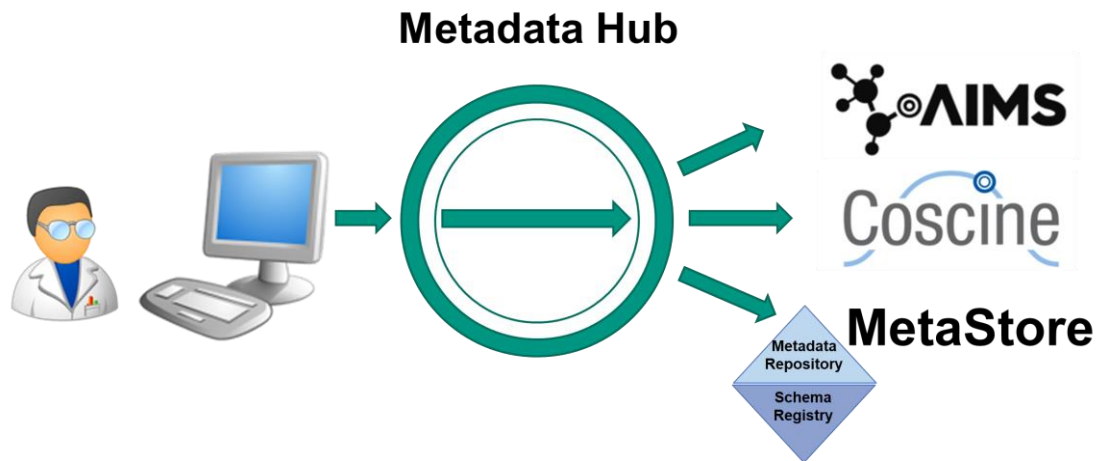
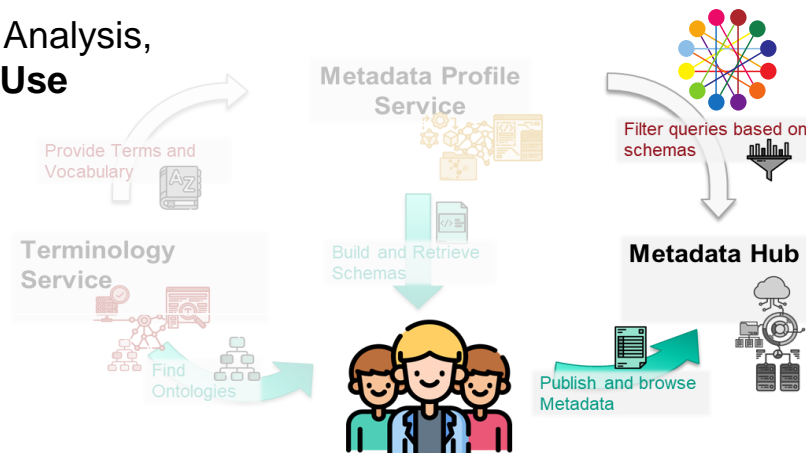


Planning, Production, Analysis,
Storage, Access, Re-Use

Metadata and Terminology Services

Metadata Hub

- Solution: The Metadata Hub
(<https://git.rwth-aachen.de/nfdi4ing/s-3/s-3-3/metadatahub>)
- Brings together
 - AIMS
 - Coscine
 - MetaStore
 - Your Solution?

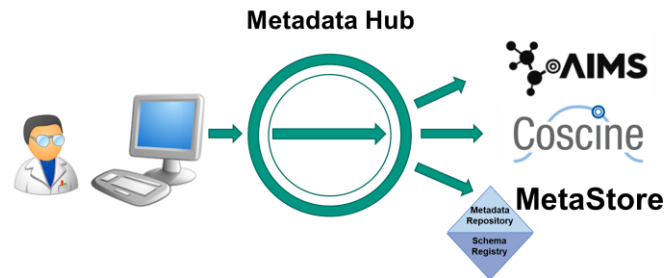
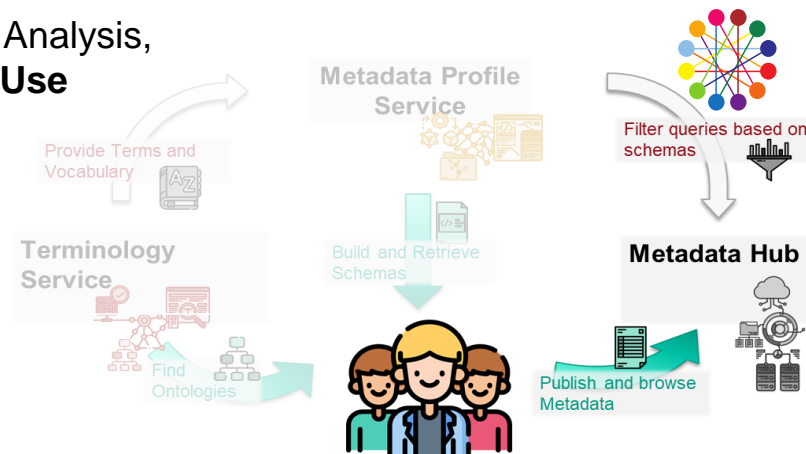




Metadata and Terminology Services

Metadata Hub

- For access => Turntable API
(<https://nfdi4ing.pages.rwth-aachen.de/s-3/s-3-3/turntable-interface/>)
- Standard-based API which gives methods for metadata and schemas (application profiles)
 - Create
 - Read
 - Update
 - Delete
 - List
 - Validate

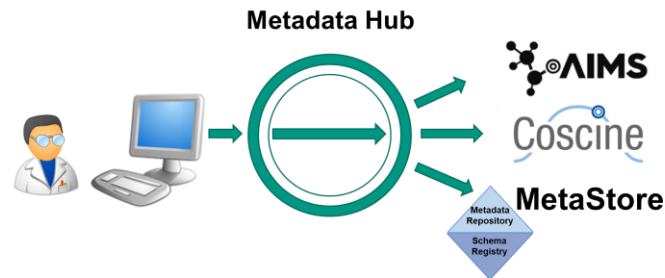
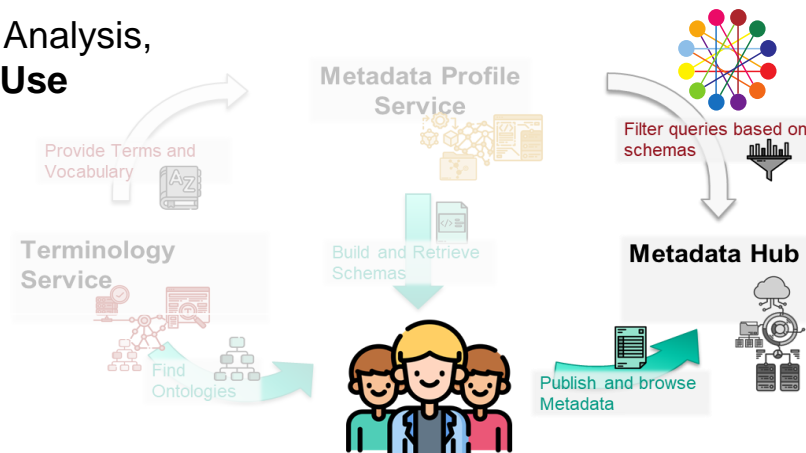




Metadata and Terminology Services

Metadata Hub

- Defined mappings
- Since services are very different
 - Mappings needed to be created for the individual services
- In a first step, Coscine and Metastore were mapped
- Especially, the difference between JSON/XML Schema and SHACL Application Profiles made this a challenge

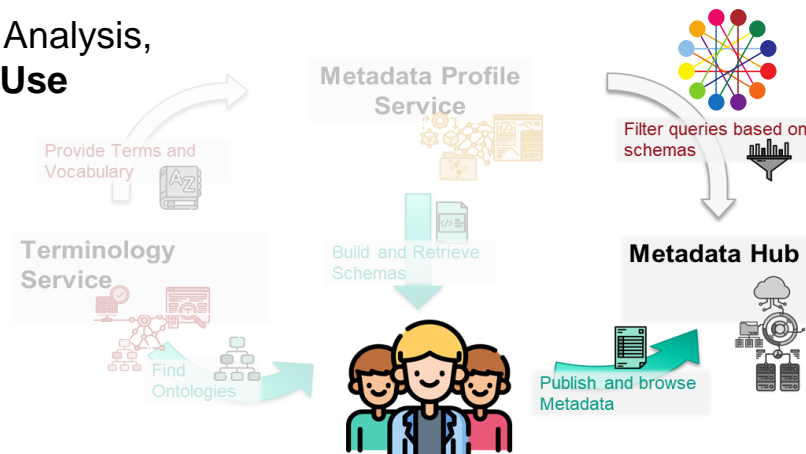




Metadata and Terminology Services

Metadata Hub

- How to use it?
(<https://git.rwth-aachen.de/nfdi4ing/s-3/s-3-3/metadatahubdemonstrator>)
- A demonstrating UI has been developed
- Different Metadata Repositories can be selected
- A request (like "Read") can be chosen
- With a request like "Read" metadata will be returned



MetadataHub Demonstrator

Select the targeted provider

Coscine

Input your User Token

eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJ0b2t1bklkIjoiaWJ1ZTZAyYmtZGUzZC00OWQ5LTZDZDZjZkMDQ4MGM2NDk0IiwiaXNzIjoiaHR0cHM6Ly9jb3NjaWw!

Select the wanted method

Read

Select the wanted type

Schema

Input the metadata path

<https://purl.org/coscine/ap/radar/>

Send Request

Response

```
{
  "id": "schema",
  "value": "[{"@id": "https://purl.org/coscine/ap/radar/", "@graph":
    [{"@id": "https://purl.org/coscine/ap/radar#subject", "http://www.w3.org/ns/shacl#path":
      [{"@id": "http://purl.org/dc/terms/subject"}, {"http://www.w3.org/ns/shacl#order":
        [{"@value": "3"}, {"@type": "http://www.w3.org/2001/XMLSchema#integer"}]}, {"http://www.w3.org/ns/shacl#maxCount":
```



Planning, Production, Analysis,
Storage, Access, Re-Use

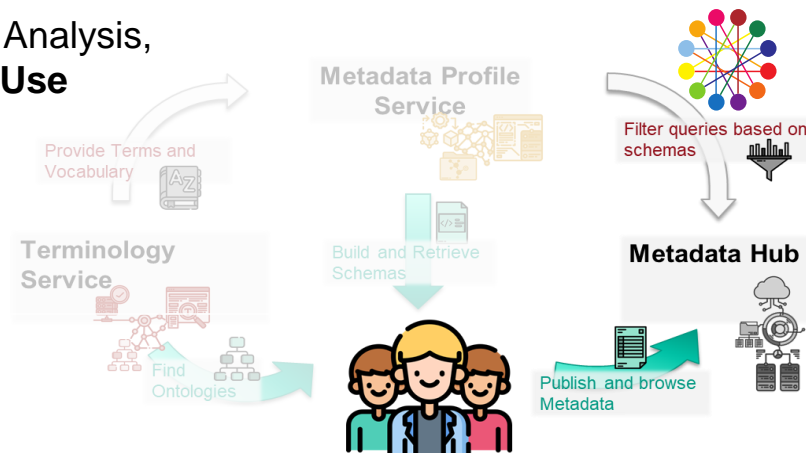
Metadata and Terminology Services

Metadata Hub



- Example Use Case: Coscine (<https://coscine.de/>)
- Uses SHACL Application Profiles and RDF Metadata to annotate stored research data as FAIR Digital Objects (FDOs)
- By using the persistent identifier of a FDO, metadata of research data can be created, read or updated
- Example result:

```
dcterms:creator "Benedikt Heinrichs" .  
dcterms:title "IC3K 2020 Poster" .  
dcterms:created "2020-09-09"^^<http://www.w3.org/2001/XMLSchema#date> .
```



MetadataHub Demonstrator

Select the targeted provider

Coscine

Input your User Token

eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJ0b2t1bklkIjoiaWJ1M1ZTAxImR5cGUzZC00OWQ5LTkzZDhZfjFkMDQ4MGM2NDk0IiwiaXNjaXZjoiaHR0cHM6Y9ja3NjaWw?

Select the wanted method

Read

Select the wanted type

Schema

Input the metadata path

https://purl.org/coscine/ap/radar/

Send Request

Response

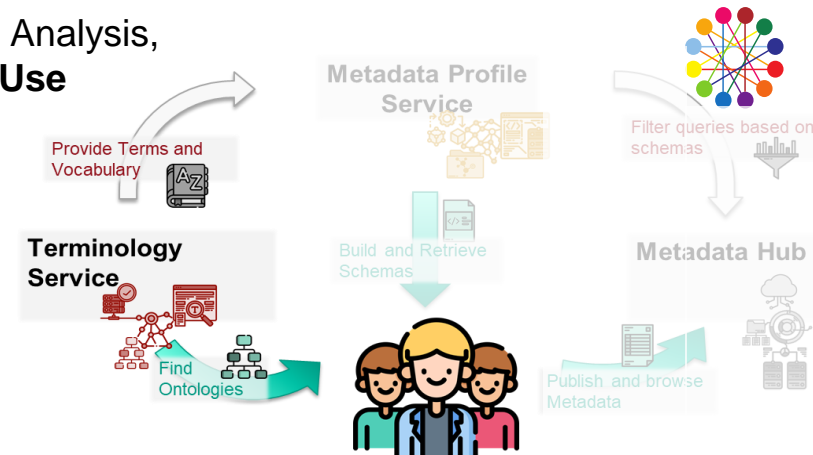
```
{  
  "id": "schema",  
  "value": [{"@id": "https://purl.org/coscine/ap/radar/", "@graph":  
    [{"@id": "https://purl.org/coscine/ap/radar#subject", "http://www.w3.org/ns/shacl#path":  
      [{"@id": "https://purl.org/dc/terms/subject", "http://www.w3.org/ns/shacl#order":  
        [{"@value": "3", "@type": "http://www.w3.org/2001/XMLSchema#integer", "http://www.w3.org/ns/shacl#maxCount":
```



Planning, Production, Analysis,
Storage, Access, **Re-Use**

Metadata and Terminology Services

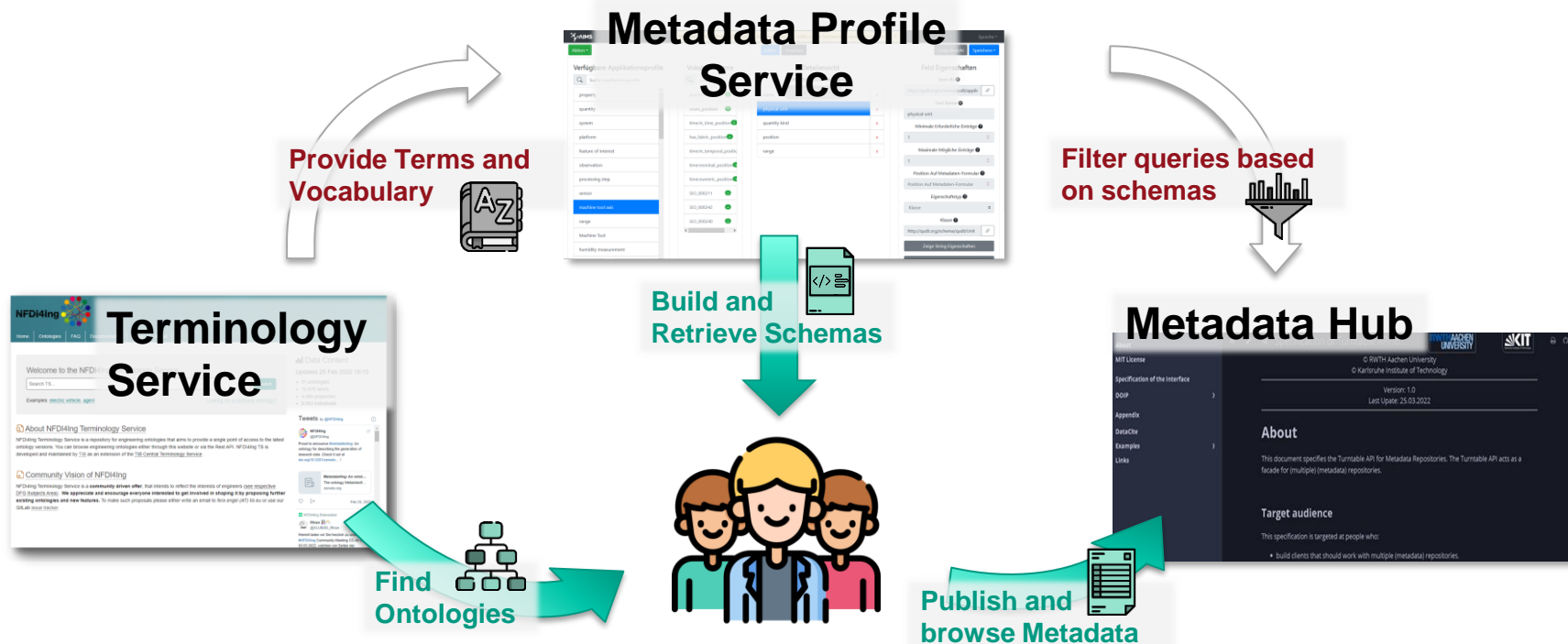
M4I Ontology



- **General description:** provide users with classes and properties to describe a data-generating research activity and its participants, inputs, variables and outputs.
- **User interaction:**
 - **Retrieve** stable, persistent ontology versions, serialisations and versioned documentation
 - **Find** application examples and training materials (WIP)
 - **Create** application profiles and RDF-based metadata
 - Re-Use during **creation** of more specific engineering ontologies



S-3 Service interplay



Building a metadata profile for a measurement result

20.54513 °C

e.g.
Result in
deg. C

```
9  aims:QuantityValueShape
10  a sh:NodeShape ;
11
12  dcterms:subject dfgfo:4 ;
13  dcterms:title "quantity value"@en ;
14  dcterms:description ""A Quantity Value expresses the magnitude and kind of a quantity and is given by the product
15  | of a numerical value n and a unit of measure U. The number multiplying the unit is referred to
16  | as the numerical value of the quantity expressed in that unit. Refer to NIST SP 811 section 7
17  | for more on quantity values."" ;
18  dcterms:creator "Nils Preuß" ;
19  dcterms:rights "https://spdx.org/licenses/CC0-1.0.html" ;
20  dcterms:created "2022-04-07"^^xsd:date ;
21
22  sh:property [
23    sh:path qdt:unit ;
24    sh:name "unit"@en ;
25    sh:description ""Relation to a a unit of measure, or unit, which is a particular quantity value that has been
26    | chosen as a scale for measuring other quantities the same kind."" ;
27    sh:minCount 1 ;
28    sh:maxCount 1 ;
29    sh:class qdt:Unit ;
30  ] ;
31
32  sh:property [
33    sh:path qdt:numericValue ;
34    sh:name "numeric value"@en ;
35    sh:description "Relation of an observable thing to its values, or reference to location where values are stored." ;
36    sh:minCount 1 ;
37    sh:maxCount 1 ;
38  ] ;
39
```

Profile info

Result must state a legit unit

Result must state or reference a numeric value

Building a metadata profile for a measurement result

20.54513 °C

e.g.
Result in
deg. C

9 `aims:QuantityValueShape`
10 `a sh:Node`
11 `URL des Applikationsprofils`
12 `https://aims-projekt.de/quantityValue`
13 `Titel`
14 `10/25/2022, 13:44:33` en
15 `Beschreibung`
16 `A Quantity Value expresses the magnitude and`
17 `the kind of a quantity and is given by the`
18 `product of a numerical value n and a unit of`
19 `Ersteller`
20 `Nils Preuß`
21 `Erstelldatum`
22 `07.14.2022`

Detailansicht
25.10.2022, 13:44:33
has unit

Feld Eigenschaften
Term IRI
`http://w3id.org/nfdi4ing/metadata4ing#hasUnit`
Feld Name
has unit
Minimale Erforderliche Einträge

Applikationsprofil
nsprofile
has numerical value:
Represents the numerical value of a real
(`http://w3id.org/nfdi4ing/metadata4ing#hasNumericalValue`)
point of a machine tool.

Vokabularterme
numerical
hasNumericalValue
hasNumericalValue
hasUnit

Detailansicht
25.10.2022, 13:44:33
has unit

Profile info

expresses the magnitude and kind of a quantity and is given by the product
and a unit of measure U. The number multiplying the unit is referred to
of the quantity expressed in that unit. Refer to NIST SP 811 section 7
values." ;
C0-1.0.html" ;

Result must state a legit unit

asure, or unit, which is a particular quantity value that has been
g other quantities the same kind." ;

Result must state or reference a numeric value

ng to its values, or reference to location where values are stored." ;

Building a metadata profile for a measurement

20.54513 °C

e.g.
Result in
deg. C



e.g.
Temperature
Measurement

```
9  aims:ObservationShape
10  a sh:NodeShape ;
11  sh:targetClass sosa:Observation ;
12
13  dcterms:subject dfgfo:4 ;
14  dcterms:title "observation"@en ;
15  dcterms:description ""Act of carrying out an (Observation) Procedure to estimate or calculate a value of a property of a FeatureOfInterest
16  | Links to a Sensor to describe what made the Observation and how; links to an ObservableProperty to describe what the r
17  | is an estimate of, and to a FeatureOfInterest to detail what that property was associated with."" ;
18  dcterms:creator "Nils Preuß" ;
19  dcterms:rights "https://spdx.org/licenses/CC0-1.0.html" ;
20  dcterms:created "2022-04-07"^^xsd:date ;
21
22  sh:property [
23    sh:path sosa:madeBySensor ;
24    sh:name "made by sensor"@en ;
25    sh:description "Relation between an Observation and the Sensor which made the Observations." ;
26    sh:minCount 1 ;
27    sh:maxCount 1 ;
28    sh:node aims:SensorShape ;
29  ] ;
30  owl:imports aims:SensorShape ;
31
32  sh:property [
33    sh:path sosa:hasResult ;
34    sh:name "has result"@en ;
35    sh:description "Relation linking an Observation and a Sensor, which contains a value representing the value associated with the observ
36    sh:minCount 1 ;
37    sh:node aims:QuantityValueShape ;
38  ] ;
39  owl:imports aims:QuantityValueShape .
40
```

profile info

Measurement must be linked to metadata
for sensor that made the measurement

Measurement must be linked to metadata
for the measurement result as a quantity value

Building a metadata profile for a sensor

20.54513 °C

e.g.
Result in
deg. C



e.g.
Temperature
Measurement



e.g.
Temperature
Sensor

```
10 aims:SensorShape
11   a sh:NodeShape ;
12   sh:targetClass sosa:Sensor ;
13
14   dcterms:subject dfgfo:4 ;
15   dcterms:title "sensor"@en ;
16   dcterms:description ""Device, agent (including humans), or software (simulation) involved in, or implementing, a Procedure.
17                       Sensors respond to a stimulus, e.g., a change in the environment, or input data composed from the results
18                       of prior Observations, and generate a Result. Sensors can be hosted by Platforms."" ;
19   dcterms:creator "Nils Preuß" ;
20   dcterms:rights "https://spdx.org/licenses/CC0-1.0.html" ;
21   dcterms:created "2022-10-26"^^xsd:date ;
22
23   sh:property [
24     sh:path ssn-system:hasSystemCapability ;
25     sh:name "system capability"@en ;
26     sh:description "Relation from a System to a SystemCapability describing the capabilities of the System under certain Conditions." ;
27     sh:maxCount 1 ;
28     sh:node aims:SensorCapabilityShape ;
29   ] ;
30   owl:imports aims:SensorCapabilityShape ;
31
32   sh:property [
33     sh:path sosa:observes ;
34     sh:name "observes"@en ;
35     sh:description "Relation between a Sensor and an ObservableProperty that it is capable of sensing." ;
36     sh:maxCount 1 ;
37     sh:node aims:PropertyShape ;
38   ] ;
39   owl:imports aims:PropertyShape .
40
```

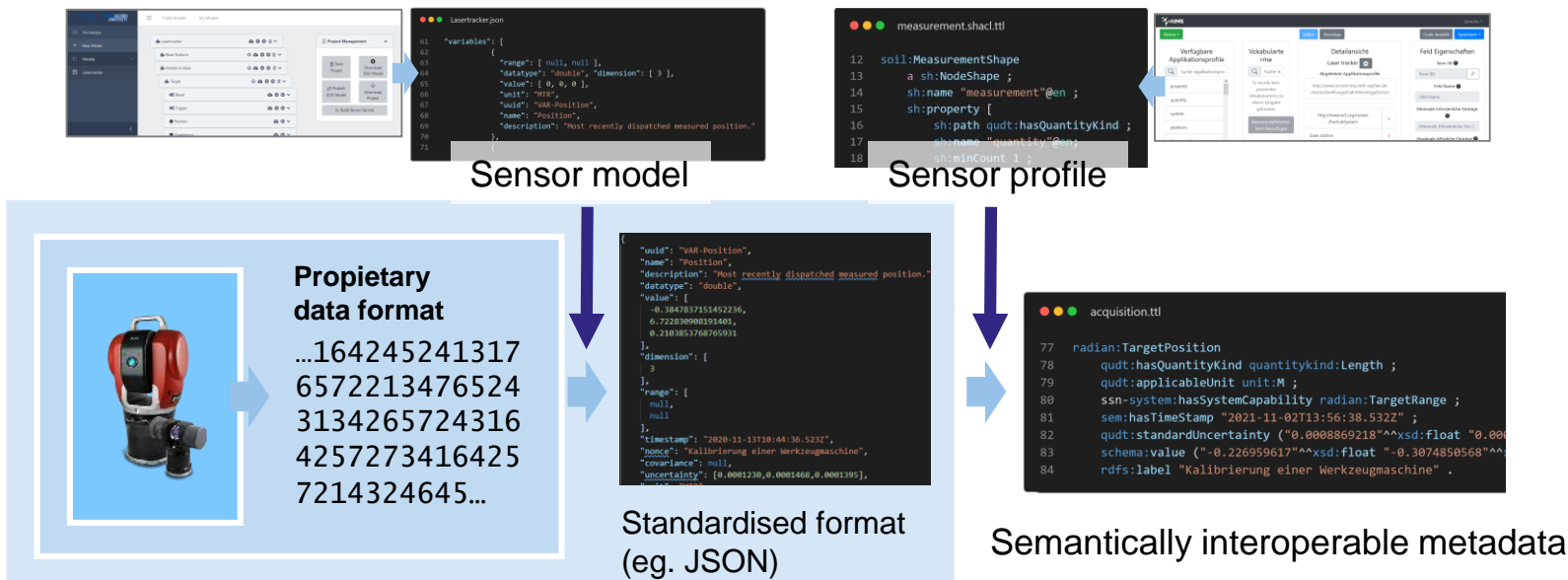
profile info

Sensor should be linked to metadata describing its capabilities

Sensor should be linked to metadata for the observed property

Sensor Data description & Validation of generated datasets

Generating profile-backed research metadata



Validation of already acquired datasets

e.g.
any **results**
that are legit
quantities

```
measurement.shacl.ttl
12 soil:MeasurementShape
13   a sh:NodeShape ;
14   sh:name "measurement"@en ;
15   sh:property [
16     sh:path qudt:hasQuantityKind ;
17     sh:name "quantity"@en;
18     sh:minCount 1 ;
19     sh:maxCount 1 ;
20     sh:class qudt:QuantityKind ;
21   ] ;
22   sh:property [
23     sh:path qudt:applicableUnit ;
24     sh:name "unit"@en;
25     sh:minCount 1 ;
26     sh:maxCount 1 ;
27     sh:class qudt:Unit ;
28   ] ;
```



Temperature sensor

- Quantity: Temperature
- Unit: °Celsius



```
data.ttl
6 ex:TemperatureReading
7   qudt:hasQuantityKind quantitykind:Temperature ;
8   qudt:applicableUnit unit:DEG_C ;
9   schema:value "20.54513"^^xsd:float .
```



Laser tracker

- Quantity: Length
- Unit: Meter



```
data.ttl
1 ex:TargetPosition
2   qudt:hasQuantityKind quantitykind:Length ;
3   qudt:applicableUnit unit:M ;
4   schema:value ("-0.226959617"^^xsd:float "-0.30745")
```

Validation of already acquired datasets

e.g.
only **results**
that are legit
temperatures

```
temperature_measurement.ttl

7  soil:TemperatureMeasurementShape
8    a sh:NodeShape ;
9    rdfs:label "temperature measurement"@en ;
10   sh:description "A measured temperature value";
11   sh:node soil:MeasurementShape ;
12   owl:imports soil:MeasurementShape ;
13   sh:property [
14     sh:path qudt:hasQuantityKind ;
15     sh:hasValue quantitykind:Temperature;
16   ] ;
17
18
```



Temperature sensor

- Quantity: Temperature
- Unit: °Celsius



```
data.ttl

6  ex:TemperatureReading
7    qudt:hasQuantityKind quantitykind:Temperature ;
8    qudt:applicableUnit unit:DEG_C ;
9    schema:value "20.54513"^^xsd:float .
```



Laser tracker

- Quantity: Length
- Unit: Meter



```
data.ttl




1  ex:TargetPosition
2    qudt:hasQuantityKind quantitykind:Length ;
3    qudt:applicableUnit unit:M ;
4    schema:value ("-0.226959617"^^xsd:float "-0.30741
```






➔ Individualization of metadata profiles

Publishing Sensor Data & Validated Metadata



Publishing



Ressourcen:


Test    131.76 KB / 1 GB


 Name	Geändert	Dateigröße	
 NEONDSTowerTemperatureData.hdf5	19.10.2022	2.86 MB	
 pipeline_runner.py	4.10.2022	5.21 KB	
 Heatmap.png	4.10.2022	126.55 KB	



Simulation


Contact *  


Creator *  


Worked 




Worked Note 




Title *  




Type 

Keywords 

Subject Area 

Creation Date *  Tuesday, October 18, 2022  

Publication Date *  Wednesday, October 19, 2022  

Embargo End Date *  Thursday, October 27, 2022  

Publishing Sensor Data & Validated Metadata

Receive Metadata

- MetadataHub can interact with productive metadata
- Example:

Simulation

Contact *	<input type="text" value="servicedesk@itc.rwth-aachen.de"/>	✓	+
Creator *	<input type="text" value="Benedikt Heinrichs"/>	✓	+
Worked	<input type="text" value="Yes"/>		+
Worked Note	<input type="text"/>		+
Title *	<input type="text" value="Simulationsmessung"/>	✓	+

MetadataHub Demonstrator

Select the targeted provider

Coscine

Input your User Token

eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJvc2VySWQiOiJ0dEwZjVjMS03YmVlLTQwMGYtOGQ3MS0zYTUyYjY3c3ODUwNWEiLCJpc3MiOiJ0dHRwczovL2Nvc2

Select the wanted method

Read

Select the wanted type

Metadata

Input the metadata path

21.1102/c2b9012d-13bd-4704-845c-f9374c61eeeb@path=/Simulation

Send Request

Response

```
{
  "id": "document",
  "value": {
    "data": {
      "metadataStorage": {
        "url": "https://hdl.handle.net/21.1102/c2b9012d-13bd-4704-845c-f9374c61eeeb@path=%2FSimulation";
        "terms/available": {
          "value": "2022-10-27";
          "datatype": "http://www.w3.org/2001/XMLSchema#date";
          "type": "literal";
        },
        "terms/created": {
          "value": "2022-10-18";
          "datatype": "http://www.w3.org/2001/XMLSchema#date";
          "type": "literal";
        },
        "terms/creator": {
          "value": "Benedikt Heinrichs";
          "datatype": "http://www.w3.org/2001/XMLSchema#string";
          "type": "literal";
        },
        "terms/issued": {
          "value": "2022-10-19";
          "datatype": "http://www.w3.org/2001/XMLSchema#date";
          "type": "literal";
        },
        "terms/publisher": {
          "value": "servicedesk@itc.rwth-aachen.de";
          "datatype": "http://www.w3.org/2001/XMLSchema#string";
          "type": "literal";
        },
        "terms/title": {
          "value": "Simulationsmessung";
          "datatype": "http://www.w3.org/2001/XMLSchema#string";
          "type": "literal";
        },
        "terms/type": {
          "value": "http://purl.org/dc/dcmitype/Dataset";
          "type": "uri";
        },
        "terms/model": {
          "value": "https://purl.org/coscine/terms/mode#simulation";
          "type": "uri";
        },
        "terms/dipling#step": {
          "value": "1";
          "datatype": "http://www.w3.org/2001/XMLSchema#string";
          "type": "literal";
        },
        "terms/dipling#version": {
          "value": "1";
          "datatype": "http://www.w3.org/2001/XMLSchema#string";
          "type": "literal";
        },
        "terms/dipling#worked": {
          "value": "true";
          "datatype": "http://www.w3.org/2001/XMLSchema#boolean";
          "type": "literal";
        }
      }
    }
  }
}
```

Publishing Sensor Data & Validated Metadata

Receive Metadata

- MetadataHub can interact with productive metadata
- Example:

Simulation

Contact *	<input type="text" value="servicedesk@itc.rwth-aachen.de"/>	✓	+
Creator *	<input type="text" value="Benedikt Heinrichs"/>	✓	+
Worked	<input type="text" value="Yes"/>		+
Worked Note	<input type="text"/>		+
Title *	<input type="text" value="Simulationsmessung"/>	✓	+

MetadataHub Demonstrator

Select the targeted provider

Coscine

Input your User Token

eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJvc2VySWQiOiJ0dEwZjVjMS03YmVlLTQwMGYtOGQ3MS0zYTUyYjY3c3ODUwNWEiLCJpc3MiOiJ0dHRwczovL2Nvc2

Select the wanted method

Read

Select the wanted type

Metadata

Input the metadata path

21.1102/c2b9012d-13bd-4704-845c-f9374c61eeeb@path=/Simulation

Send Request

Response

```
{
  "id": "document",
  "value": {
    "data": {
      "metadataStorage": {
        "url": "https://hdl.handle.net/21.1102/c2b9012d-13bd-4704-845c-f9374c61eeeb@path=%2FSimulation",
        "terms": {
          "available": {
            "value": "2022-10-27",
            "datatype": "http://www.w3.org/2001/XMLSchema#date",
            "type": "literal"
          },
          "created": {
            "value": "2022-10-18",
            "datatype": "http://www.w3.org/2001/XMLSchema#date",
            "type": "literal"
          },
          "creator": {
            "value": "Benedikt Heinrichs",
            "datatype": "http://www.w3.org/2001/XMLSchema#string",
            "type": "literal"
          },
          "issued": {
            "value": "2022-10-10",
            "datatype": "http://www.w3.org/2001/XMLSchema#date",
            "type": "literal"
          },
          "publisher": {
            "value": "servicedesk@itc.rwth-aachen.de",
            "datatype": "http://www.w3.org/2001/XMLSchema#string",
            "type": "literal"
          },
          "title": {
            "value": "Simulationsmessung",
            "datatype": "http://www.w3.org/2001/XMLSchema#string",
            "type": "literal"
          },
          "type": {
            "value": "http://www.ub.uni-stuttgart.de/dipling#model",
            "datatype": "http://www.w3.org/2001/XMLSchema#string",
            "type": "literal"
          },
          "mode": {
            "value": "https://purl.org/coscine/terms/mode#simulation",
            "datatype": "http://www.ub.uni-stuttgart.de/dipling#step",
            "type": "literal"
          },
          "version": {
            "value": "1",
            "datatype": "http://www.w3.org/2001/XMLSchema#string",
            "type": "literal"
          },
          "worked": {
            "value": "true",
            "datatype": "http://www.w3.org/2001/XMLSchema#boolean",
            "type": "literal"
          }
        }
      }
    }
  }
}
```

Publishing Sensor Data & Validated Metadata

Searching Metadata


Suchseite:

Alle Projekte ▾


Alle Ressourcen ▾

Suchen

Datei: [NEONDSTowerTemperatureData.hdf5](#)

Sichtbarkeit: Privat  **Erstelldatum:** 2022-03-03 **Erstellungsjahr:** 2022 **Erstellungsmonat:** March **Erstellungstag:** 3 **Date Available:** 2022-03-03
Date Available Year: 2022 **Date Available Month:** March **Date Available Day:** 3 **Ersteller:** Benedikt Heinrichs **Version:** 1
Datenerzeugungsmethode: <https://purl.org/coscine/terms/mode#simulation> **Step:** 1 **Titel:** Test Datei **Publisher:** Heinrichs@itc.rwth-aachen.de
Date Issued: 2022-03-03 **Date Issued Year:** 2022 **Date Issued Month:** March **Date Issued Day:** 3 **Gehört zu Projekt:** Demo Projekt 2022-03-03
Graphname: <https://hdl.handle.net/21.11102/c2f5b5e0-60cf-4cca-86ee-066277d7dd6c@path=%2FNEONDSTowerTemperatureData.hdf5>

Datei: [luh_fdm_umfrage_rohdaten_aggregiert \(1\).xlsx](#)

Sichtbarkeit: Privat  **Erstelldatum:** 2022-03-03 **Erstellungsjahr:** 2022 **Erstellungsmonat:** March **Erstellungstag:** 3 **Date Available:** 2022-03-03
Date Available Year: 2022 **Date Available Month:** March **Date Available Day:** 3 **Ersteller:** test **Version:** 1
Datenerzeugungsmethode: <https://purl.org/coscine/terms/mode#simulation> **Step:** 1 **Titel:** Test **Publisher:** Heinrichs@itc.rwth-aachen.de
Date Issued: 2022-03-03 **Date Issued Year:** 2022 **Date Issued Month:** March **Date Issued Day:** 3 **Gehört zu Projekt:** Demo Projekt 2022-03-03
Graphname: [https://hdl.handle.net/21.11102/c2f5b5e0-60cf-4cca-86ee-066277d7dd6c@path=%2FFluh_fdm_umfrage_rohdaten_aggregiert %281%29.xlsx](https://hdl.handle.net/21.11102/c2f5b5e0-60cf-4cca-86ee-066277d7dd6c@path=%2FFluh_fdm_umfrage_rohdaten_aggregiert%281%29.xlsx)

Thanks for your attention!