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30 National Groups
4 Regional Groups
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2021 Webinar Series
Highlighting RDA Outputs

Decomposing Observable Property Descriptions into Machine-Readable Components

Hosted by RDA-US

Register Here:
#RDAwebinar

July 28th 15:00 UTC
Working Group Chairs

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Environment Agency Austria
Austria

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Germany

John Graybeal, Stanford University, School of Medicine, USA  
Robert Huber, University Bremen, Germany  
Simon J D Cox, CSIRO Land and Water, Australia

And thank you to all of our regular meeting attendees and those who have provided feedback over the years!

https://www.rd-alliance.org/node/61856/members
Introduction to the I-ADOPT WG

Alison Pamment
Introduction to the I-ADOPT WG

Motivation - The I-ADOPT Working Group addresses the ‘I’ in FAIR by:

● Building a conceptual framework to support interoperability between existing terminologies and address a broad range of known user requirements

● Promoting the use of FAIR terminologies to annotate research data with well identified, unambiguous and machine readable vocabularies
Introduction to the I-ADOPT WG

Task group formed under Vocabulary Semantic Services Interest Group (VSSIG)
Conceptualisation of measurement parameters - Michael Diepenbroek & Barbara Magagna

BoF - Harmonizing FAIR descriptions of observational data
New Title of the planned WG:
Interoperability of Observable Property Descriptions WG

WG Kick-off meeting
InteroperAble Descriptions of Observable Property Terminology
# Introduction to the I-ADOPT WG

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1: Collect user stories and formalise into use cases</td>
<td>Nov 19 - February 20</td>
</tr>
<tr>
<td>Task 2: Survey observation-centric terminologies</td>
<td>Jan 20 - February 20</td>
</tr>
<tr>
<td>Task 3: Derive use case requirements</td>
<td>March 20 - April 20</td>
</tr>
<tr>
<td>Task 4: Analyse semantic representation of OP against requirements</td>
<td>May 20 - October 20</td>
</tr>
<tr>
<td>Task 5: Develop Interoperability Framework</td>
<td>Nov 20 - Feb 21</td>
</tr>
<tr>
<td>Task 6: Test local mapping design patterns</td>
<td>March 21 - October 21</td>
</tr>
</tbody>
</table>
Introduction to the I-ADOPT WG

- Our work fits well with existing semantic models and extends them.
- Variables are used in many different semantic models, but often they are not specified in a machine-readable way.
- The next two slides give some examples.
Introduction to the I-ADOPT WG

OGC Observation and Measurement Model (O&M) and SOSA/SSN

**Feature of Interest** and **Observed Property** are components of the observed variable.

- **feature of interest**
  - Feature-type is taken from a domain-model (e.g. Geology)

- **observed property**
  - Belongs to feature-of-interest-type

See [https://ngmdb.usgs.gov/Info/dmt/docs/cox07.pdf](https://ngmdb.usgs.gov/Info/dmt/docs/cox07.pdf)
Introduction to the I-ADOPT WG

Schema.org has a property 'VariableMeasured', applied to datasets that in turn can be described with PropertyValue combinations or freeform Text.

<table>
<thead>
<tr>
<th>Property</th>
<th>Expected Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>distribution</td>
<td>DataDownload</td>
<td>A downloadable form of this dataset, at a specific location, in a specific format.</td>
</tr>
<tr>
<td>includedInDataCatalog</td>
<td>DataCatalog</td>
<td>A data catalog which contains this dataset. Supersedes catalog, includedDataCatalog. Inverse property: dataset</td>
</tr>
<tr>
<td>issn</td>
<td>Text</td>
<td>The International Standard Serial Number (ISSN) that identifies this serial publication. You can repeat this property to identify different formats of, or the linking ISSN (ISSN-L) for, this serial publication.</td>
</tr>
<tr>
<td>measurementTechnique</td>
<td>Text or URL</td>
<td>A technique or technology used in a Dataset (or DataDownload, DataCatalog), corresponding to the method used for measuring the corresponding variable(s) (described using variableMeasured). This is oriented towards scientific and scholarly dataset publication but may have broader applicability; it is not intended as a full representation of measurement, but rather as a high level summary for dataset discovery. For example, if variableMeasured is molecule concentration, measurementTechnique could be &quot;mass spectrometry&quot; or &quot;nmr spectroscopy&quot; or &quot;colorimetry&quot; or &quot;immunoassay&quot;. If the variableMeasured is &quot;depression rating&quot;, the measurementTechnique could be &quot;Zung Scale&quot; or &quot;HAM-D&quot; or &quot;Beck Depression Inventory&quot;. If there are several variableMeasured properties recorded for some given data object, use a PropertyValue for each variableMeasured and attach the corresponding measurementTechnique.</td>
</tr>
<tr>
<td>variableMeasured</td>
<td>PropertyValue or Text</td>
<td>The variableMeasured property can indicate (repeated as necessary) the variables that are measured in some dataset, either described as text or as pairs of identifier and description using PropertyValue.</td>
</tr>
</tbody>
</table>

variableMeasured

A Schema.org Property

This term is proposed for full integration into Schema.org, pending implementation feedback and adoption from applications and websites.

Thing > Property :: variableMeasured

The variableMeasured property can indicate (repeated as necessary) the variables that are measured in some dataset, either described as text or as pairs of identifier and description using PropertyValue.

Values expected to be one of these types

<table>
<thead>
<tr>
<th>PropertyValue</th>
<th>Text</th>
</tr>
</thead>
</table>

Used on these types

<table>
<thead>
<tr>
<th>Dataset</th>
</tr>
</thead>
</table>

Source

https://github.com/schemaorg/schemasorg/issues/1063
Introduction to the I-ADOPT WG

• The concept “Variable” in I-ADOPT represents WHAT has been observed, independently of WHERE, HOW and WHEN the data acquisition took place

• The WHERE, HOW and WHEN are provided by the existing semantic models

• The purpose of the interoperability framework is to capture the necessary elements to fully and unambiguously specify a variable in a discipline neutral way

• Our initial focus has been on the environmental sciences, but potential to apply the framework more widely
Current Top-level Domain Independent Ontologies and Conceptual Models for Variables

Maria Stoica
Top level ontologies define **hierarchical** or **taxonomic** categorization of entities.

These serve as the foundation for many current domain ontologies and thus provide a common framework for communicating about entity types across domains.

We will review the three most popular such ontologies: Basic Formal Ontology (BFO), Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) and Suggested Upper Merged Ontology (SUMO).

Specifics of categorizations and their location in the hierarchy vary across ontological viewpoint, but three primary categories emerge across ontologies.

Other successor upper ontologies, such as Unified Foundational Ontology (UFO), also exist.
Inventory of Current Top-Level Ontologies - Basic Formal Ontology (BFO)

- basis of numerous ontologies, among them Environment Ontology (ENVO) and Food Ontology (FoodOn)
- 3D ontology with primary classes
  - **continuant**
    - independent: material entity and object
    - dependent: quality and role
  - **occurrent** - processes and temporal regions

see [https://basic-formal-ontology.org](https://basic-formal-ontology.org)
Inventory of Current Top-Level Ontologies - Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE)

- ontology of particulars
- divided into four primary categories:
  - **endurant** including physical object, feature, amount of matter
  - **perdurant** including events, states and processes
  - **quality** including physical, temporal and abstract
  - **abstract** including time interval and space region

see [http://www.loa.istc.cnr.it/dolce/overview.html](http://www.loa.istc.cnr.it/dolce/overview.html)
Inventory of Current Top-Level Ontologies - Suggested Upper Merged Ontology (SUMO)

- developed by IEEE working group
- mapped to entirety of WordNet
- ‘largest free formal ontology available’
- categorizes all entities into two primary classes:
  - **physical** including objects and processes
  - **abstract** including quantities and attributes

Physical
  - Object
    - SelfConnectedObject
    - ContinuousObject
    - CorpuscularObject
    - Collection
  Process
Abstract
  - SetClass
  - Relation
  Proposition
  Quantity
    - Number
    - PhysicalQuantity
  Attribute

see [http://www.ontologyportal.org](http://www.ontologyportal.org)
Categories of entities related to variables are divided into:

- independent continuants, endurants -- including objects, material entities, substances, etc.
- dependent continuants, qualities, attributes
- perdurants, ocurrents, processes

In general, qualities (or properties) are represented as, e.g., ‘quality of object inheres in object’ which makes faceted searching and adding new terms a complex endeavor.
Inventory of Current Semantic Models for Variables

Examine two models for atomizing components of a Variable.

Both demonstrated need and usefulness of decomposing facets of a variable for interoperability.

One developed from perspective of observation and measurement (Complex Property Model, CPM) and one developed from perspective of modeling and simulation (Scientific Variables Ontology, SVO).
Inventory of Current Semantic Models for Variables -- Complex Properties Model (CPM)

- developed to expand Observed Property and Feature of Interest components of O&M

See http://purl.org/voc/cpm
Inventory of Current Semantic Models for Variables -- Complex Properties Model (CPM)

- **observable property** - element that points to a phenomenon indexed in a codelist, such as a standard name

- **object of interest** - the substance, taxon or other physical/chemical phenomenon of the Feature Of Interest that is being observed
  - phenomenon, taxon, and substance are subclasses of object of interest

- **property** - the property of the environment which the ObservableProperty is describing

See [http://purl.org/voc/cpm](http://purl.org/voc/cpm)
Inventory of Current Semantic Models for Variables -- Complex Properties Model

- **matrix** - special case of a feature-of-interest that provides the context (container feature or medium) for an observable property.

- **constraint** - provides additional constraints to the observable property

See [http://purl.org/voc/cpm](http://purl.org/voc/cpm)
Inventory of Current Semantic Models for Variables -- Complex Properties Model

Table 4. Examples of terms from established published vocabularies (including the BODC Parameter Usage Vocabulary), broken down according to the Complex Properties Model.

<table>
<thead>
<tr>
<th>Web address of base concept</th>
<th>Statistical measure</th>
<th>Property</th>
<th>Object of Interest</th>
<th>Matrix</th>
<th>Constraint</th>
<th>Unit of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://vocab.nerc.ac.uk/collection/P01/current/MMUSDTBT/">http://vocab.nerc.ac.uk/collection/P01/current/MMUSDTBT/</a></td>
<td>Concentration</td>
<td>tributyltin</td>
<td>Mytilus galloprovincialis</td>
<td>flesh of Mytilus</td>
<td>μg kg⁻¹</td>
<td></td>
</tr>
<tr>
<td><a href="http://vocab.nerc.ac.uk/collection/P01/current/A118GCD1/">http://vocab.nerc.ac.uk/collection/P01/current/A118GCD1/</a></td>
<td>Concentration</td>
<td>2,3’,4,4’,5-</td>
<td>water body</td>
<td>dissolved plus</td>
<td>ng l⁻¹</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>pentachlorobiphenyl</td>
<td></td>
<td>reactive particulate</td>
<td>&lt;GF/F phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>unspecified</td>
<td>unspecified datum</td>
<td></td>
</tr>
<tr>
<td><a href="http://vocab.nerc.ac.uk/collection/P01/current/ASLVMNDY/">http://vocab.nerc.ac.uk/collection/P01/current/ASLVMNDY/</a></td>
<td>Daily mean</td>
<td>Surface elevation</td>
<td>water body</td>
<td></td>
<td>m</td>
<td></td>
</tr>
</tbody>
</table>

See Adam M. Leadbetter & Peter N. Vodden (2016) DOI: 10.1080/17538947.2015.1033483
Inventory of Current Semantic Models for Variables -- Scientific Variables Ontology (SVO)

- created to enable principled machine creation, detection, and alignment of components of a scientific variable (expressed as freeform text or standard name)

- created within the context of scientific modeling to perform tasks such as aligning data to scientific model inputs and model inputs to model outputs
Inventory of Current Semantic Models for Variables -- Scientific Variables Ontology (SVO)

variable - a pairing of a phenomenon with a property

- (spatiotemporal)phenomenon - something that is or can be observed to happen or exist
- property - a quality or characteristic of a phenomenon
- reference - a phenomenon-property-value that provides spatial or temporal reference for the evaluation of a Variable

See http://scientificvariablesontology.org
Inventory of Current Semantic Models for Variables -- Scientific Variables Ontology (SVO)

Phenomena may be further specified using attributes.

- **attribute** - a property-value pair that can be attached to a phenomenon to create a narrower phenomenon

See [http://scientificvariablesontology.org](http://scientificvariablesontology.org)
Inventory of Current Semantic Models for Variables -- Scientific Variables Ontology (SVO)

Phenomena are recursively defined in terms of other phenomena and their roles from the observer perspective are identified using modular patterns.

- **contextphenomenon** - a phenomenon that provides spatial or temporal context to a focus Phenomenon

See [http://scientificvariablesontology.org](http://scientificvariablesontology.org)
Inventory of Current Semantic Models for Variables -- Scientific Variables Ontology (SVO)

Phenomena are recursively defined in terms of other phenomena and their roles from the observer perspective are identified using modular patterns.

- mediumphenomenon - a phenomenon that provides a context for a focus phenomenon and is also a focus phenomenon itself
Inventory of Current Semantic Models for Variables -- Scientific Variables Ontology (SVO)

carbon dioxide emissions from gaseous fuel consumption (kg)

See
http://scientificvariablesontology.org
Inventory of Current Semantic Models for Variables -- Summary

An **observable property** or **variable** description has two core components -- an **object of interest** (independent continuant, endurant, phenomenon, etc.) and a corresponding **property** (dependent continuant, quality, etc.)

Additionally, the description *may optionally include* further *restrictions* on the object of interest (constraint, attribute, etc) and *additional context objects* (matrix, medium, etc).
Overview of the I-ADOPT Framework

Sirko Schindler
The I-ADOPT Framework

Running Example

coloration of endosulfane sulfate

in wet flesh of ostrea edulis
A Variable is the combination of all descriptive components that are considered necessary to understand what was actually observed, measured, simulated, or calculated.

*concentration of endosulfane sulfate in wet flesh of ostrea edulis*
The I-ADOPT Framework

iop:ObjectOfInterest

The entity that plays the role of the observation target for which the property is being observed.

concentration of *endosulfane sulfate* in wet flesh of *ostrea edulis*
The I-ADOPT Framework

**iop:Property**

A Property is a type of characteristic of the ObjectOfInterest.

*concentration* of endosulfane sulfate
*in wet flesh of ostrea edulis*
The I-ADOPT Framework

iop:Matrix

The entity that plays the role of the material context (surface or medium) of the ObjectOfInterest.

concentration of endosulfane sulfate in wet flesh of ostrea edulis
The I-ADOPT Framework

iop:ContextObject

The entity that plays a descriptive role to give the context of the ObjectOfInterest. It provides additional background information regarding the ObjectOfInterest.

concentration of endosulfane sulfate in wet flesh of *ostrea edulis*
The I-ADOPT Framework

**iop:Entity**

An object or process that has a role in an observation. Whether the involvement of a particular entity is meaningful enough to include in the variable description depends on the specific context.

*concentration of* **endosulfane sulfate** *in wet* **flesh of** **ostrea edulis**
**The I-ADOPT Framework**

**iop:Constraint**

A Constraint limits the scope of the observation and confines the context to a particular state. It describes properties of the involved entities that are relevant to the particular observation.

concentration of endosulfane sulfate
in *wet* flesh of *ostrea edulis*
The I-ADOPT Framework
The I-ADOPT Framework

I-ADOPT Framework ontology

Release June 24, 2021

This version: https://w3id.org/adopt/ont/0.8.0

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Provenance of this page

Abstract
Examples of Applying the I-ADOPT Framework

Barbara Magagna
Example 1: Concentration of substance in biota

Example provided by Gwen Moncoiffe (BODC)
Example 1: BODC Parameter - a quantitative example

Representation based on the I-ADOPT ontology
Example 1: BODC Parameter using SKOS concepts for variable components

Variable

concentration of endosulfane sulfate in wet flesh of ostrea edulis

The wet weight concentration of the specified analyte in the specified organism or part thereof.

nerc:P01/current/IC000344

hasProperty

Property

concentration

nerc:S06/current/S0600045

hasObjectOfInterest

Entity

endosulfane sulfate

nerc:S27/current/CS003625/

obo:PAITO_0001823

hasConstraint

Constraint

wet

nerc:S12/current/S1214/

hasMatrix

Entity

flesh

nerc:S12/current/S1214/

hasContextObject

Entity

ostrea edulis

worms:140658

constrains
Example 1: BODC parameter Representation in a sheet

<table>
<thead>
<tr>
<th>Variable definition within I-ADOPT framework</th>
<th>type of concept</th>
<th>category of variable</th>
<th>variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable (preferred label)</td>
<td></td>
<td>concentration of substance in biota</td>
<td>concentration of endosulfane sulfate in wet flesh of ostrea edulis</td>
</tr>
<tr>
<td>hasProperty</td>
<td></td>
<td>concentration</td>
<td>concentration</td>
</tr>
<tr>
<td>hasObjectOfInterest</td>
<td></td>
<td>substance</td>
<td>endosulfan sulfate</td>
</tr>
<tr>
<td>hasConstraint</td>
<td></td>
<td>wet</td>
<td>wet</td>
</tr>
<tr>
<td>hasMatrix</td>
<td></td>
<td>biomass</td>
<td>flesh</td>
</tr>
<tr>
<td>hasContextObject</td>
<td></td>
<td></td>
<td>ostrea edulis</td>
</tr>
</tbody>
</table>
Example 1: BODC Parameter Representation in a sheet including additional metadata about the measurement

<table>
<thead>
<tr>
<th>variable definition within I-ADOPT framework</th>
<th>type of concept</th>
<th>category of variable</th>
<th>variable</th>
<th>variable+M</th>
<th>variable+M+P+S+D</th>
<th>variable+M+P+S+D+</th>
<th>variable+M+P+S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable (preferred label)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hasProperty</td>
<td>concentration</td>
<td>concentration</td>
<td></td>
<td>concentration of endosulfane sulfate in wet flesh of ostrea edulis</td>
<td>concentration of endosulfane sulfate in wet flesh of ostrea edulis</td>
<td>concentration of endosulfane sulfate in wet flesh of ostrea edulis</td>
<td>concentration of endosulfane sulfate in wet flesh of ostrea edulis per unit mass expressed in µg/kg, measured daily</td>
</tr>
<tr>
<td>hasObjectOfInterest</td>
<td>substance</td>
<td>endosulfane sulfate</td>
<td>endosulfane sulfate</td>
<td>endosulfane sulfate</td>
<td>endosulfane sulfate</td>
<td>endosulfane sulfate</td>
<td>endosulfane</td>
</tr>
<tr>
<td>hasConstraint</td>
<td>wet</td>
<td>wet</td>
<td>wet</td>
<td>wet</td>
<td>wet</td>
<td>wet</td>
<td>wet</td>
</tr>
<tr>
<td>hasMatrix</td>
<td>biomass</td>
<td>flesh</td>
<td>flesh</td>
<td>flesh</td>
<td>flesh</td>
<td>flesh</td>
<td>flesh</td>
</tr>
<tr>
<td>hasContextObject</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>usedModifier</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>usedProcedure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>usedSensor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>usedTimeResolution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>usedUnit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>wasDerivedFrom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- M: usedModifier
- P: usedProcedure
- S: usedSensor
- D: hasDimensionVector
- U: usedUnit
- T: usedTimeResolution
- F: wasDerivedFrom

- concentration of endosulfane sulfate in wet flesh of ostrea edulis per unit mass expressed in µg/kg, measured daily

cc by sa
Example 2: provide semantic descriptions of column headers of data tables -&gt; MONERIS variable: soil loss

The MONERIS model calculates the emissions of nitrogen and phosphorus to the surface water, by different pathways as well as the instream retention in the surface water network.

data table, tab Basicinfo (=input parameters); description for cell BE2

description table, line 13 -&gt; variable description for cell BE2
Example 2: MONERIS variable using SKOS concepts for variable components

<table>
<thead>
<tr>
<th>Property</th>
<th>Entity</th>
<th>Constraint</th>
<th>Matrix</th>
<th>Context Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>mass per area per time</td>
<td>soil erosion</td>
<td>slope &lt; 1%</td>
<td>arable land</td>
<td>catchment</td>
</tr>
<tr>
<td>qudt:MassPerAreaTime</td>
<td>envthes:21286</td>
<td>tbd</td>
<td>obo:ENVO_01001177</td>
<td>envthes:10092</td>
</tr>
</tbody>
</table>

mass per area per time of soil erosion in slope <1% arable land of catchment

soil loss from arable land with less than 1% slope in a river catchment

\textit{tbd}
Example 3: LifeWatch trait - a qualitative example

Shape of cell

Representation based on the I-ADOPT ontology
Example 3: LifeWatch trait using SKOS concepts for variable components

<table>
<thead>
<tr>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>shape (of cell)</td>
</tr>
<tr>
<td>The approximate 3 dimensional shape of a cell, described as one or more geometric solids.</td>
</tr>
<tr>
<td>lifewatch:tema=23/shape</td>
</tr>
</tbody>
</table>

Example: sphere (lifewatch:tema=41/sphere)

<table>
<thead>
<tr>
<th>Property</th>
<th>Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>shape</td>
<td>cell</td>
</tr>
<tr>
<td>obo:PATO 0000052</td>
<td>obo:CL 0000000</td>
</tr>
</tbody>
</table>

A morphological quality inhering in a bearer by virtue of the bearer's ratios of distances between its features (points, edges, surfaces and also holes etc).

The definition of cell is intended to represent all cells, and thus a cell is defined as a material entity and not an anatomical structure, which implies that it is part of an organism (or the entirety of one).
Check out our resources

Thank you for your interest! Please join I-ADOPT if interested!

Check out our resources:
I-ADOPT WG wiki on RDA
https://www.rd-alliance.org/group/interoperable-descriptions-observable-property-terminology-wg-i-adopt-wg/wiki/i-adopt-0
I-ADOPT Framework documentation
I-ADOPT ontology
https://w3id.org/iadopt
I-ADOPT pre-print
https://arxiv.org/abs/2107.06547
I-ADOPT on GitHub
https://github.com/i-adopt
2021 Webinar Series
Highlighting RDA Outputs

Hosted by RDA-US
Upcoming Webinars Hosted by RDA-US

10 August 2021 - 19:00 UTC
RRIDs: A Way To Track Samples Through The Scientific Literature

26 August 2021 - 19:00 UTC
FAIR Island: Networked, Machine-Actionable DMPs for Open Science
RDA Plenary Meetings?

RDA Plenaries are held every six months

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Thank You For Joining Us!