InteroperAble Descriptions of Observable Property Terminologies (I-ADOPT) WG - outputs and recommendations

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Table of Content

Executive Summary

The InteroperAble Description of Observable Property Terminologies Working Group (I-ADOPT WG) was formed in June 2019 under the auspices of the Research Data Alliance's Vocabulary and Semantic Services Interest Group. Its objective was to develop a framework to harmonise the way observable properties are named and conceptualised, in various communities within and across scientific domains. There was a realisation that the rapid demand for controlled vocabularies specialised in describing observed properties (i.e. measured, simulated, counted quantities, or qualitative observations) was presenting a risk of proliferation of semantic resources that were poorly aligned. This, in turn, was becoming a source of confusion for the end-users and a hindrance to data interoperability.

The development of the I-ADOPT Framework proceeded in multiple phases. Following the initial phase dedicated to the collection of user stories, the identification of key requirements, and an in-depth analysis of existing semantic representations of scientific variables and of terminologies in use, the group focused on identifying the essential components of the conceptual framework, reusing as much as possible concepts that were common to existing operational resources. The proposed framework was then tested against a variety of examples to ensure that it could be used as a sound basis for the creation of new variable names as needed. The results were formalised into the I-ADOPT ontology and subsequently extended with usage guidelines to form the I-ADOPT Framework presented in this document. The output can now be used to facilitate interoperability between existing semantic resources and to support the provision of machine-readable variable descriptions whose components are mapped to FAIR vocabulary concepts. The group also issued the following six key recommendations:

1. Data creators, curators or publishers should describe the variable(s) held in datasets in both a human- and a machine-readable format.
2. The variable's description should enable data reuse with minimum reliance on externally held free-text documentation.
3. The machine-readable description should make use of FAIR terminologies (e.g., controlled vocabularies, ontological relationships) adhering to Linked Data principles.
4. The translation from human readable to machine readable form should follow a decomposition approach that is compatible with the classes and relations defined in the I-ADOPT ontology (https://w3id.org/iadopt/).
5. Users should preferably reuse terminologies that are already aligned with the I-ADOPT Framework by either reusing existing concepts or extending collections, or by creating new concepts based on the I-ADOPT Framework.
6. For variables based on a different schema, a mapping to the I-ADOPT Framework should be provided.

The group also set up public repositories to continue open collaboration and give access to resources that will be maintained and/or developed beyond the lifetime of the official RDA working group: 1) a catalogue of terminologies relevant to observable properties, 2) a repository of design patterns, 3) a step-by-step guide for minting new variables, 4) use-case specific guidelines on implementing the framework, 5) a repository of applications, and user implementation stories, 6) additional materials including a list of alignments with other ontological resources.

Definitions

We are providing below the definition of terms as we use them in our recommendation document.

Concept	A concept is an umbrella term for classes, terms, relations, attributes, instances, individual instances of terminology resources.
FAIR semantic artefact	A FAIR semantic artefact is a semantic resource that follows the FAIR principles and complies with the FAIR semantic recommendations[1] and the 10 simple rules for making a vocabulary FAIR[2].
I-ADOPT Framework	The I-ADOPT Framework is a framework that contains the I-ADOPT ontology and associated guidelines for its applications.
Observable Property	An Observable Property is the description of something observed or derived.
Ontology	An ontology defines a set of representational primitives with which to model a domain of knowledge or discourse. The representational primitives are typically classes (or sets), attributes (or properties), and relationships (or relations among class members)[3].
Schema	A schema is a defined structure for knowledge representation
Terminology	A terminology is a curated collection of concepts with their definitions. This term may also include taxonomies, thesauri, or any other kinds of knowledge organisation systems.
User Story	A User Story is a short, simple description of a feature told from the perspective of the person who desires the new capability. I-ADOPT user stories followed the format “As a … I want to … So that …”
Use Case	A Use Case is a description of how a user uses a system to achieve a specific goal. I-ADOPT use cases were derived from submitted user stories and used to identify common and specific requirements.
Variable	Variable as used in I-ADOPT is used as a synonym for Observable Property. It is the description of something observed or derived.

[1] Hugo, Wim, Le Franc, Yann, Coen, Gerard, Parland-von Essen, Jessica, & Bonino, Luiz. (2020). D2.5 FAIR Semantics Recommendations Second Iteration (1.0). Zenodo. https://doi.org/10.5281/zenodo.5362010

[2] COX, Simon JD, et al. Ten Simple Rules for making a vocabulary FAIR. *PLOS Computational Biology*, 2021, 17. Jg., Nr. 6, S. e1009041.

[3] Tom Gruber. Encyclopedia of Database Systems, Ling Liu and M. Tamer Özsu (Eds.), Springer, 2009.

Introduction

The research community is creating ever increasing volumes and diversity of data. Our ability to exploit these data as a common resource is hampered by a lack of interoperability in how we describe data variables. A large number of independent terminologies and tools already exist to help with representing and annotating variables. However, the complexity and diversity of these representations often overwhelm data practitioners and users, creating a barrier to data reuse and data interoperability. Over the last decade, great progress has been made in providing machine-readable descriptions of sensors and their observations, e.g., the OGC's Sensor Web Enablement SensorML[4], Observations and Measurements[5], or the W3C's/OGC's Semantic Sensor Network (SSN) ontology[6]. However, "deep metadata" that further contextualises observations (e.g., methodology, variables, parameters[7]) is typically represented as coarsely qualified classes (e.g. "Procedure" or "Observed Property"). What exactly falls into these classes is currently unconstrained and could be anything ranging from unstandardized free-text to fully machine-accessible standardised descriptions such as, e.g., Climate and Forecast Standard Names[8] or the British Oceanographic Data Centre (BODC) Parameter Usage Vocabulary[9].

The I-ADOPT Working Group was created to address this gap and produce a common interoperability framework for representing observable properties. The discussions already started via an informal task group under the RDA Vocabulary Services Interest Group (VSSIG)[10] in January 2018. The initiative raised a huge interest and resulted in the formation of the official RDA WG in 2019 with more than 100 members, 20 of which participated regularly at the biweekly meetings and contributed to the development of the conceptual framework. The schema went through several iterations of review and improvement including consultation with terminology users including researchers, data curators, data service providers, terminology developers, in order to reach a consensus on the optimum representation. This effort has a strong focus on ***environmental research*** because it leverages existing efforts in the earth system sciences. However, many of the principles it rests on are relevant to, or will connect with, other domains.

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[4] https://www.opengeospatial.org/standards/sensorml
[5] https://www.opengeospatial.org/standards/om
[6] https://www.w3.org/TR/vocab-ssn/
[7] An information content entity which is about a property or set of properties that determine the state or behaviour of some entity.

[8] https://cfconventions.org/standard-names.html
[9] https://www.bodc.ac.uk/resources/vocabularies/parameter_codes/
[10] https://www.rd-alliance.org/groups/interoperable-descriptions-observable-property-terminology-wg-i-adopt-wg

Methodology

The I-ADOPT Framework development followed a 'bottom-up', and iterative methodology (Figure 1). The process was split into several stages as follows:

- To identify the core components of the framework from the perspective of the end-users, we developed a template to collect user stories from potential adopters of the framework. These user stories are short, simple descriptions of the high-level requirements of semantic descriptions of observable variables using the format: "As a … I want to … So that …"). A total of 20 user stories were submitted by scientists, data curators, terminology managers, and technical engineers.
- In collaboration with contributors of the user stories, we transformed the stories into use cases for further analysis. This process also included merging closely overlapping requirements specified in the stories, independent of their subject areas. This process resulted in 15 use cases representing four clusters: terminology generation and management; resource annotation; data discovery and exploration; data manipulation and integration. For details of the analysis, see GitHub I-ADOPT/usecase repository.
- The use cases were then used to scope the framework development by identifying their respective functional requirements. Functional requirements denote what the I-ADOPT Framework should support, from the end-user perspective.
- In addition to building the I-ADOPT Framework, one of the goals of the WG was to establish the degree of coverage and identify gaps in the semantic representations of variables used by existing terminologies. In order to determine this we performed two sub-activities:
    - We conducted two surveys on observation-centric terminologies, for terminology providers and consumers, respectively. The surveys resulted in a fine-grained collection of semantic representations of observable properties and the basis for a catalogue of suitable terminologies.
    - We analysed existing terminologies in relation to the concepts they used to represent essential information on variables. This helped in assessing the fitness for purpose of existing terminologies in addressing the requirements derived from the use cases. The terminologies have now been listed in a dedicated I-ADOPT catalogue of terminologies.
- The information requirements and the analysis of existing variable representation schema like CPM[11] and SVO[12] were used to identify the framework's core concepts, which we then applied to develop a first draft version of an I-ADOPT schema. We tested and refined the schema iteratively. After each iterative step, we obtained feedback from WG members and user story contributors, tested and adapted the schema.
- Once stable, the schema was published as an ontology and we developed guidelines on how to use it. This step was informed by a number of outreach workshops and training sessions (see "Publications and Outreach Activities" section). The resulting combination of the ontology and the guidelines constitutes the I-ADOPT Framework.

[11] http://adamml.github.io/opm-owl/
[12] https://scientificvariablesontology.org/svo/

- To facilitate the adoption of the framework in different contexts, we provided a set of patterns, or template variables, to demonstrate how the framework can be applied (for more information see I-ADOPT Variable Design Patterns (VDPs) and below).
- The specification of the I-ADOPT ontology is available online.

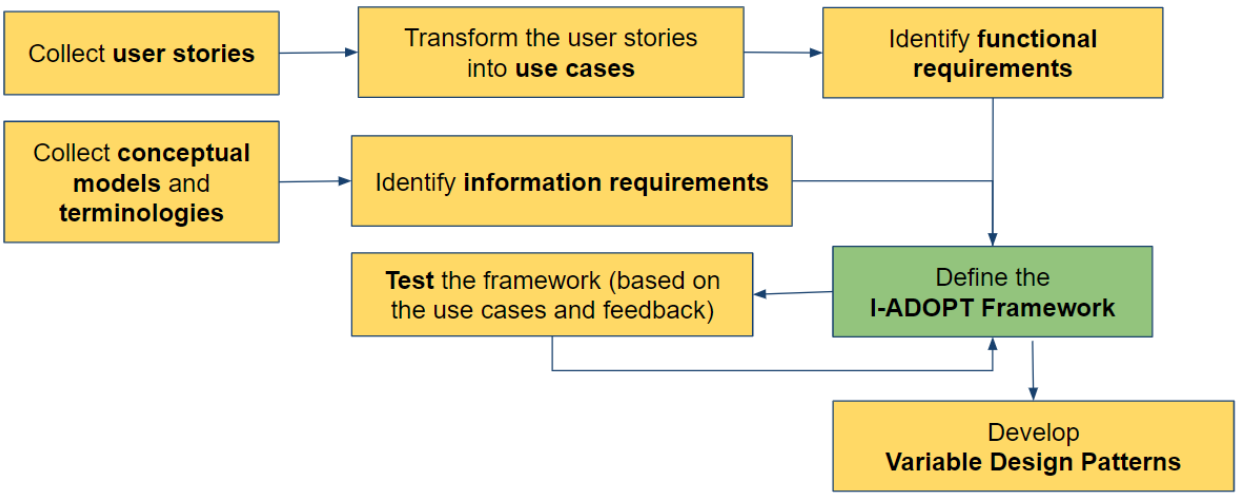

Figure 1. An overview of I-ADOPT Framework development.

The Interoperability Framework

The I-ADOPT Framework acts as a semantic broker and is based on an ontology in order to facilitate interoperability between existing variable description models (including ontologies, taxonomies, and structured controlled vocabularies). One of the challenges in representing semantic descriptions of variables is reaching a consensus about the components that define the variables. The interoperability framework addresses this by offering core atomic components and relations between them that can be applied to define machine-interpretable variable descriptions that reuse FAIR terminology concepts.

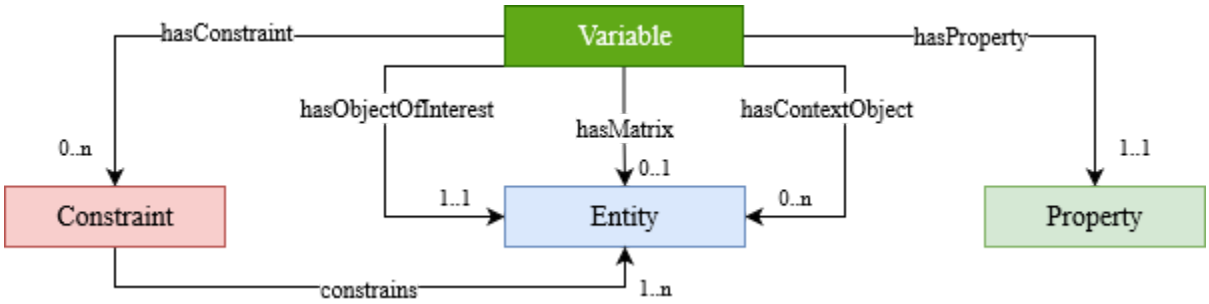

Figure 2: A conceptual overview of the Interoperability Framework ontology.

Figure 2 provides a conceptual overview of the ontology. It consists of four main classes/ concepts (Variable, Property, Constraints, and Entity) and six relations (hasProperty, hasObjectOfInterest, hasContextObject, hasMatrix, hasConstraint, constrains). The Variable is the top concept. In the I-ADOPT ontology the Variable is a complex semantic representation of something observed or mathematically derived. At a minimum, it is defined by the entity being observed (ObjectOfInterest) and by the corresponding characteristic, i.e. a quantity or a quality (Property). More complex variables can involve additional entities to further describe the context. Finally, Constraints may limit the scope of the observation. The framework does not cover additional concepts associated with variables such as units, instruments, methods, and geographical location information. Although these concepts provide essential information for the interpretation of actual observations, they go beyond the scope of the I-ADOPT Framework. Units are essential information for describing measures, but a quantitative variable might have many applicable units[13] which requires units to be modelled independently of variables[14]. In some contexts however, it might be necessary to add units to the variable description via an appropriate property (like saref:UnitOfMeasure or cpm:unitOfMeasure) following the Linked Data principles. For any additional information we recommend to build on existing observational ontologies rather than overloading a SKOS terminology.

[13] qudt:applicableUnit

[14] Magagna, B. et al (2021): The I-ADOPT Interoperability Framework for FAIRer Data Descriptions of Biodiversity. CEUR Workshop Proceedings (CEUR-WS.org, ISSN 1613-0073)

In the following, we use an example taken from marine environmental science, namely the measurement of the amount of the pesticide endosulfan sulfate in the wet flesh of the European flat oyster, or ostrea edulis.

Variable

A description of something observed or derived, minimally consisting of an ObjectOfInterest and its Property.
Example: concentration of endosulfan sulfate in wet flesh of ostrea edulis

Property

A type of a characteristic of the ObjectOfInterest.
Example: concentration

Entity

An object or occurrence that has a role in an observation. An Entity may play one of the following roles: ObjectOfInterest, ContextObject, Matrix. Whether the involvement of a particular entity is meaningful enough to include in the variable description depends on the specific context.
Example: endosulfan sulfate, flesh, ostrea edulis

Constraint

A Constraint limits the scope of the observation and restricts the context to a particular state. It describes conditions of the involved entities that are relevant to the particular observation.
Example: wet

These concepts are interconnected using the following relations:

hasProperty

Domain: Variable *Range: Property* *Cardinality: 1..1*
A Variable has a Property that characterises an Entity.
*Example: **concentration** of endosulfan sulfate in wet flesh of ostrea edulis*

hasObjectOfInterest

Domain: Variable *Range: Entity* *Cardinality: 1..1*
A Variable has an Entity whose Property is observed.
*Example: concentration of **endosulfan sulfate** in wet flesh of ostrea edulis*

hasMatrix

Domain: Variable *Range: Entity* *Cardinality: 0..1*
A Variable might have an Entity in which the ObjectOfInterest is contained.
*Example: concentration of endosulfan sulfate in wet **flesh** of ostrea edulis*

hasContextObject

Domain: Variable *Range: Entity* *Cardinality: 0..n*
A Variable has an Entity that provides additional background information regarding the ObjectOfInterest.

*Example: concentration of endosulfan sulfate in wet flesh of **ostrea edulis***

hasConstraint

Domain: Variable Range: Constraint Cardinality: 0..n

A Variable has a Constraint, that confines an Entity involved in the observation.

*Example: concentration of endosulfan sulfate in **wet** flesh of ostrea edulis*

constrains

Domain: Constraint Range: Entity Cardinality: 1..n

A Constraint constrains an Entity having a role in the Variable description.

Example: 'wet' constrains 'flesh' in concentration of endosulfan sulfate in wet flesh of ostrea edulis

Entities assume a role by the means of the relation they are associated with. Consequently, the same entity can appear as ObjectOfInterest, ContextObject, or Matrix. Therefore, it could have different roles depending on the particular variable.

The concepts and relations as described above have been formalised into an ontology that is available from https://w3id.org/iadopt/.

Once all components are identified they have to be linked with appropriate concepts from terminologies.

Below are three examples demonstrating the decomposition approach from different domains (Figures 3, 4, 5).

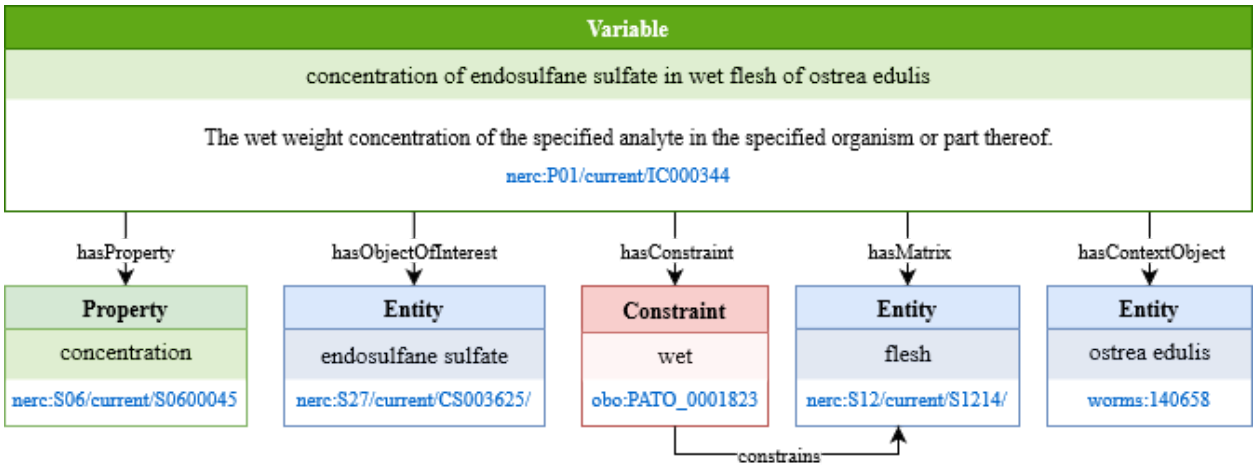

Figure 3. I-ADOPT variable for "concentration of endosulfan sulfate in wet flesh of ostrea edulis".

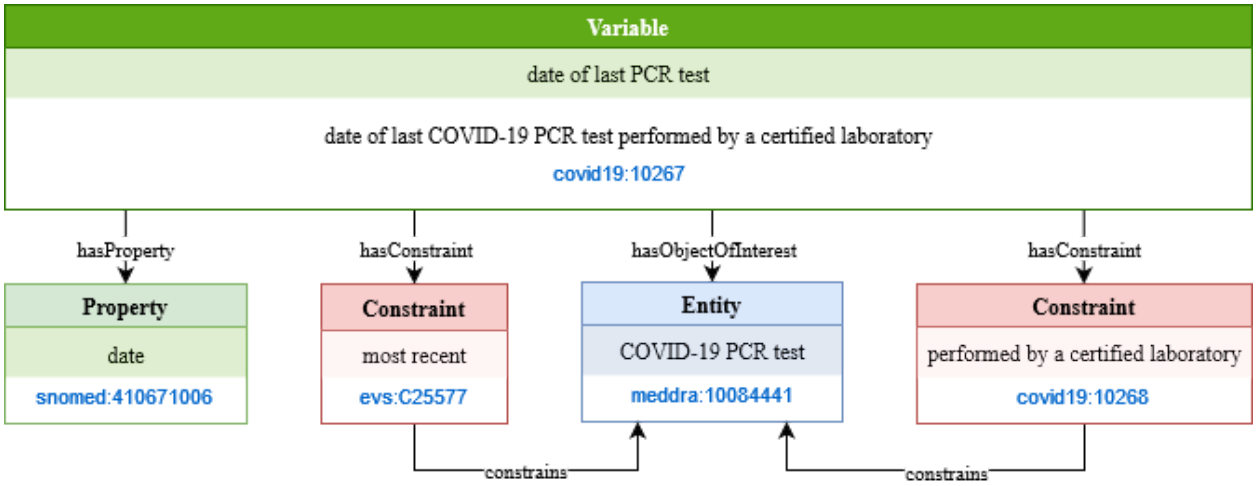

Figure 4. Example from the health domain: I-ADOPT variable for “date of last PCR test”.

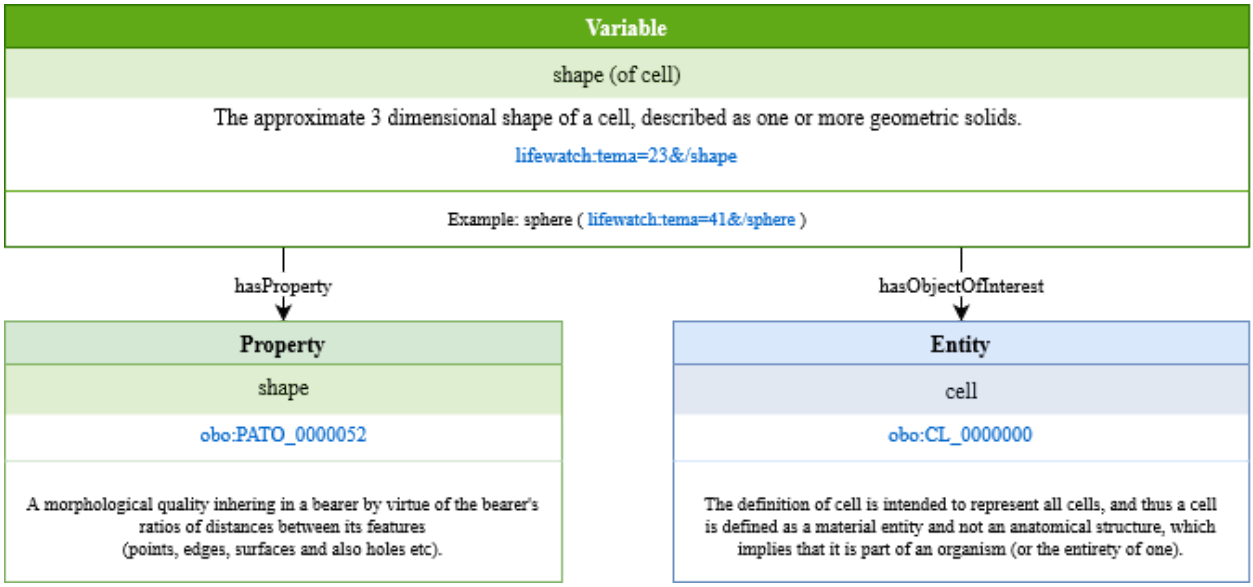

Figure 5. Example of a qualitative variable: I-ADOPT variable for “shape of cell”.

Six Key Recommendations for Variable Representations

The following are general recommendations for the descriptions of observable properties / variables.

1. Data creators, curators or publishers should describe the variable(s) held in datasets in both a human- and a machine-readable format.
2. The variable's description should enable data reuse with minimum reliance on externally held free-text documentation.
3. The machine-readable description should make use of FAIR terminologies (e.g., controlled vocabularies, ontological relationships) and be compatible with Linked Data principles.
4. The translation from human readable to machine readable form should follow a decomposition approach that is compatible with the classes and relations defined in the I-ADOPT ontology (https://w3id.org/iadopt/).
5. Users should preferably reuse terminologies that are already aligned with the I-ADOPT Framework by either reusing existing concepts or extending collections, or by creating new concepts based on the I-ADOPT Framework.
6. For variables based on a different schema, a mapping to the I-ADOPT Framework should be provided.

Supporting Outputs

Catalogue of Terminologies

The I-ADOPT Framework can be leveraged to describe the variables of a dataset in two ways. The preferable way is to reuse a terminology that is already I-ADOPT-enabled within the scientific domain of interest. If no such terminology is available however, existing variable descriptions can be extended using the I-ADOPT Framework and suitable terminologies for the components.

Regardless of which path is chosen, an overview of existing terminologies, for entire variables and components alike, can substantially speed up the process. With the help of the community, the I-ADOPT WG collected an initial list of such terminologies in spring 2020 (I-ADOPT/terminology-survey GitHub repository). This list has been expanded since and is now available as a catalogue of terminologies from the I-ADOPT/terminologies GitHub pages. For each of the four main concept classes of the I-ADOPT Framework, it provides a list of suitable terminologies. In addition, each entry in the list is further characterised by additional metadata like, their domain, supported languages, type (e.g., SKOS vocabulary or OWL ontology).

The catalogue of Terminologies is meant as a living resource and is maintained in a publicly available GitHub repository. Anybody wanting to contribute a terminology is invited to submit an issue to the I-ADOPT/terminologies GitHub repository or pull request. The proposal will be reviewed by the I-ADOPT governance group[15] prior to being added to the collection. Issues tickets can also be raised to highlight errors in the catalogue or gaps in existing terminology coverage.

Variable Design Patterns (VDPs)

I-ADOPT Variable Design Patterns (VDPs) are implementation guidelines for modelling I-ADOPT variables similar to how Ontology Design Patterns are to be used as templates or as inspiration for specific modelling solutions when creating ontologies. VDPs are domain-independent and theoretic (more abstract) I-ADOPT Variables that must be instantiated to be reused as variables. Variables themselves are also abstract as they represent types but, in contrast, these can be directly reused in different observation situations by instantiating them with additional metadata like the location and the time information. VDPs do not include any Constraints, which are used to refine a variable. Properties in VDPs are essentially the same Properties as in Variables. VDPs use for ObjectOfInterest and Matrix concepts that describe the nature of the entities (sometimes in thesauri used as parent concepts) more than concrete entities used in Variables, e.g. substance instead of nitrogen, organism instead of a species name, part of organism instead of liver.

The catalogue of VDPs is meant as a living resource and is maintained in a publicly available GitHub repository. Anybody wanting to contribute with new VDPs is invited to submit an issue to the I-ADOPT/patterns GitHub repository or pull request. The proposal will be reviewed by the I-ADOPT governance group prior to being added to the collection. Issues tickets can also be raised to highlight errors in the catalogue.

Step-by-step guide for Minting new Variables

When no terminology already offers variable descriptions that conform to the I-ADOPT Framework, new variable descriptions have to be created. The I-ADOPT WG has devised a step-by-step guide to guide users through this process. The guide outlines the steps necessary to decompose and formalise a human-readable variable description into an I-ADOPT Variable. While it is not intended as a compulsory specification, it summarises the experiences of the I-ADOPT WG members and can provide a starting point to users who are not yet experienced with modelling I-ADOPT Variables.

[15] The I-ADOPT governance group will be established in a VSSIG meeting in February 2022. One of the first activities will be to define a governance model which will be published in the I-ADOPT GitHub.

Alignments to other ontological frameworks

We aligned the I-ADOPT Framework with existing ontological frameworks for describing variables or that refer to variables, such as Complex Property Model, Scientific Variables Ontology, and Sensor, Observation, Sample, and Actuator (SOSA) ontology. These frameworks are complex and involve many components, so for simplicity, the alignment only covers the components that can be mapped to the I-ADOPT Framework. For these mappings, see the I-ADOPT/supplementary/alignments GitHub repository. Mappings to even more ontologies could be added later on.

Guidelines for use-case specific scenarios

In Table 1 we capture high level guidelines on how to make use of the I-ADOPT Framework within the four main use case clusters we identified. The work initiated by the RDA I-ADOPT WG can only be a starting point and further developments will be necessary, specifically in providing tools and services to support the efficient use of the framework. This will happen partly as part of the applications of the I-ADOPT Framework into operational workflows and resources (see section below) which will help to design the supporting tools. Ultimately the goal is to hide the necessary complexity of the framework and provide the users with a suite of user-friendly tools and UIs. The end user should simply be able to profit from the rich associations of the I-ADOPT concepts to optimally find the desired data and/or to understand properly what the data represents and how best they can be reused when combined with data from other sources.

Applications

This section highlights ongoing and planned applications of the I-ADOPT Framework. We will use the I-ADOPT/implementations GitHub repository to collate and document progress on on-going and future applications.

The applications are centred on

- how to use existing terminologies to feed into the I-ADOPT Framework using and possibly extending the I-ADOPT catalogue of terminologies
- how to use the framework to connect existing terminologies that are not interoperable
- how to use the model to represent new variables names for machine-readability

Table 2 summarises each of the applications. For their detailed descriptions, see I-ADOPT/supplementary/applications GitHub repository.

Table 1. Guidelines per use case group

Use case group	Brief Description	Actors	Guideline
Terminology generation and management	Generate, curate, maintain, align and search for I-ADOPT variable concepts with their decompositions	terminology developers and managers	- to generate I-ADOPT concepts use the step-by-step guideline and the VDPs for identifying the appropriate modelling approach, but supporting terminology services need to be developed - to align use and contribute to the I-ADOPT alignments - to search use the I-ADOPT catalogue of terminology
Resource annotation	Automated or semi-automated annotation of column headers or file headers of datasets or metadata records describing datasets to provide human and machine-readable identification of variables in datasets or parts thereof	repository curators data providers/ researchers	- reuse I-ADOPT concepts via annotation services that need to be developed (see work beyond I-ADOPT WG) - reuse VDPs for discovering suitable variables
Data discovery and exploration	Facilitate search across multiple sources via keyword and faceted semantic data search based on semantic classifications	end users/ researchers web application developers	Once datasets are annotated with I-ADOPT Variables, faceted search is easy to apply reusing the components of the variables
Data manipulation and integration	Combine and transform datasets from various sources and from different presentations/formats being described with the same variables	end users/ researchers software developers and product owners	When working with datasets containing variables aligned to I-ADOPT, use the components of the I-ADOPT Framework to compare, filter, merge, aggregate data streams. For data annotated using a different scheme, use alignments with I-ADOPT or use I-ADOPT as a bridge ontology. Alternatively decompose the source variables according to the I-ADOPT Framework components.

Table 2. Applications of I-ADOPT by research communities

Title	Summary	Status
EnvThes (Environmental Thesaurus) parameters	Refine the representation of the EnvThes 'Parameter' based on the I-ADOPT variable concept. Test the new representation against selected 173 parameters of eLTER Standard Observations.	A first demonstrable output is expected by the first quarter of 2022.
MONERIS emission model - use case of the OBARIS Project	Apply the I-ADOPT Framework to express the inputs of the data used by the MONERIS model so that heterogeneous data coming from different sources are interoperable.	The application follows the project's timeline.
NERC Vocabulary Server	Apply I-ADOPT Framework to align two major earth sciences parameter labelling schemes in NERC Vocabulary Server - the Climate and Forecast (CF) Standard Names and the British Oceanographic Data Centre Parameter Usage Vocabulary (BODC PUV).	A first demonstrable output is expected by February 2022.
OGC / ISO Observations and Measurements (O&M) revision	The O&M and I-ADOPT collaborate to ensure semantic consistency and coherence of both models. The O&M based API (SensorThings API) will be used as a test-case.	1st half of 2022 (potentially over 2022 and down to 2023 if I-ADOPT work embarked in the upcoming Water Quality Interoperability Experiment).
OMOP implementation guide in WorldFAIR project	Annotate the WHO COVID-19 Core CRF variables following the I-ADOPT representation. Use I-ADOPT to represent variables associated with electronic health records (EHR).	A GitHub-based resource library to provide support on how to use the OMOP data harmonisation by June 2023.
PANGAEA parameter modelling	Reuse I-ADOPT concepts in the context of existing metadata schemas such as schema.org/Dataset or DCAT-2 to represent parameters curated in PANGAEA.	A first demonstrable output expected in April/May 2022.
ACTRIS Research Infrastructure	While working on its vocabulary in order to achieve data FAIRness, ACTRIS will apply the I-ADOPT Framework and concepts right from the start.	First version envisaged for autumn 2022.

Continuation and future work beyond I-ADOPT WG

As part of the future work, we plan to maintain and promote the outputs developed (framework, catalogues of terminologies, patterns, and mappings) also in collaboration with the RDA Vocabulary Services Interest Group (VSSIG). We will continue to refine and extend the resources but also identify gaps documenting this process on the GitHub repositories. Services to support the use of the I-ADOPT Framework will be designed and developed. Status and outputs from the example applications will be documented in the Github. We will liaise with the user stories contributors to facilitate the adoption of the framework. The applicability of the framework beyond the environmental sciences and to multiple languages will also be explored.
Anybody wanting to discuss variable decompositions according to the I-ADOPT Framework is invited to submit an issue to the I-ADOPT/decomposition_of_I_ADOPT_variables GitHub repository. The I-ADOPT governance group led by Barbara Magagna will take care of this process, resolve issues, and report the progress at the VSSIG sessions.

Publications and Outreach Activities

In addition to the outputs listed in this document, members of the WG have been involved in many workshops and conferences over the last couple of years. These helped us shape our ideas, test our work in progress, and were important opportunities to obtain feedback from the community and potential users of the framework.

March 2022	Planned I-ADOPT training workshops for the ENVRI Community
December 2021	Poster at AGU Fall meeting
October 2021	SciDataCon 2021: I-ADOPT session, Earth and Environmental vocabularies session, Scientific vocabularies session
September 2021	S4BioDiv 2021: I-ADOPT paper
September 2021	DDI/CDI workshop, work session on I-ADOPT and OMOP
September 2021	CF 2021 meeting presentation on Standard Names and I-ADOPT
July 2021	RDA-US webinar on I-ADOPT
June 2021	GO FAIR M4M I-ADOPT workshop for ZonMw COVID-19
June 2021	EOSC Symposium 2021 presentation
April 2021	EGU2021 presentation
April 2021	IMDIS Conference presentation

March 2021	I-ADOPT development workshop series
December 2020	FAIR convergence Symposium2020: FAIR vocabularies and vocabulary services session
May 2020	EGU2020 presentation

RDA related activities:

November 2021	18 RDA PM Closing session minutes, recording
April 2021	17 RDA PM Working Session Minutes, recording
March 2021	I-ADOPT development workshop series
November 2020	16 RDA PM: Working Session Minutes, recording
March 2020	15 RDA PM Working Session Minutes, recording
October 2019	14 RDA PM Kick-Off Meeting of I-ADOPT minutes
June 2019	I-ADOPT case statement
April 2019	13 RDA PM BOF-Meeting minutes
March 2018	11 RDA PM Presentation at VSSIG and Task Group formed

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