DNV·GL

Digital Solutions

READI for the CFIHOS RDL: An OTTR use case

OTTR user forum, 2021-01-28

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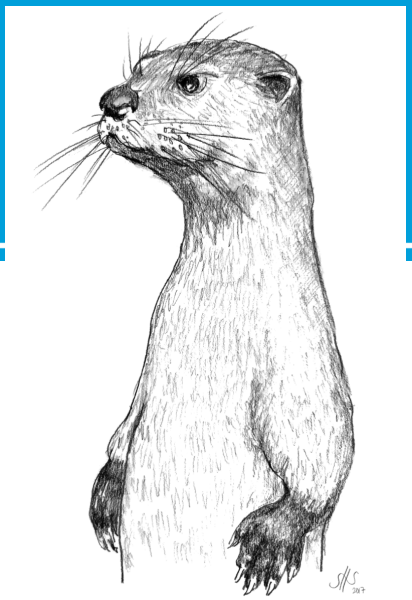

READI

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READI and CFIHOS

Toolset

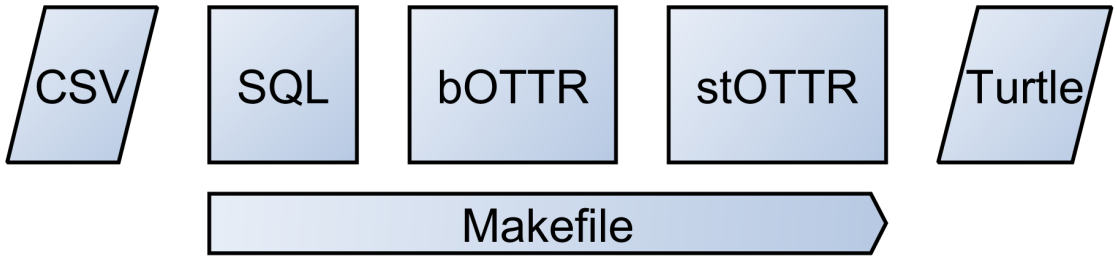
Workflow

CFIHOS as ontology

Q&A

Today's topics

- The READI project: Digitalisation in O&G
- The CFIHOS project: RDL and Data Dictionary
- *Converting CFIHOS to an OWL 2, ISO 15926-14 ontology using OTTR*
- Tools that work well with OTTR
- The work process
- Evaluation



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READI

READI (2018–) is a Joint Industry Project, organised by the Sector Board Petroleum, an entity administrated by Standards Norway.

The READI JIP was originally initiated as the "NORSOK Z-TI project" in 2017 by the Sector Board Petroleum, an entity administrated by Standards Norway, mandated to ensure overall standardization in the industry through coordination of international standardization work in ISO and CEN and the industry standardization work of NORSOK.

Members of the READI JIP represents all parts of the oil and gas value chain, and they are categorized as large operators, medium operators and small operators, EPC's and suppliers. In addition, regulators and authorities and standardization organisations participate.

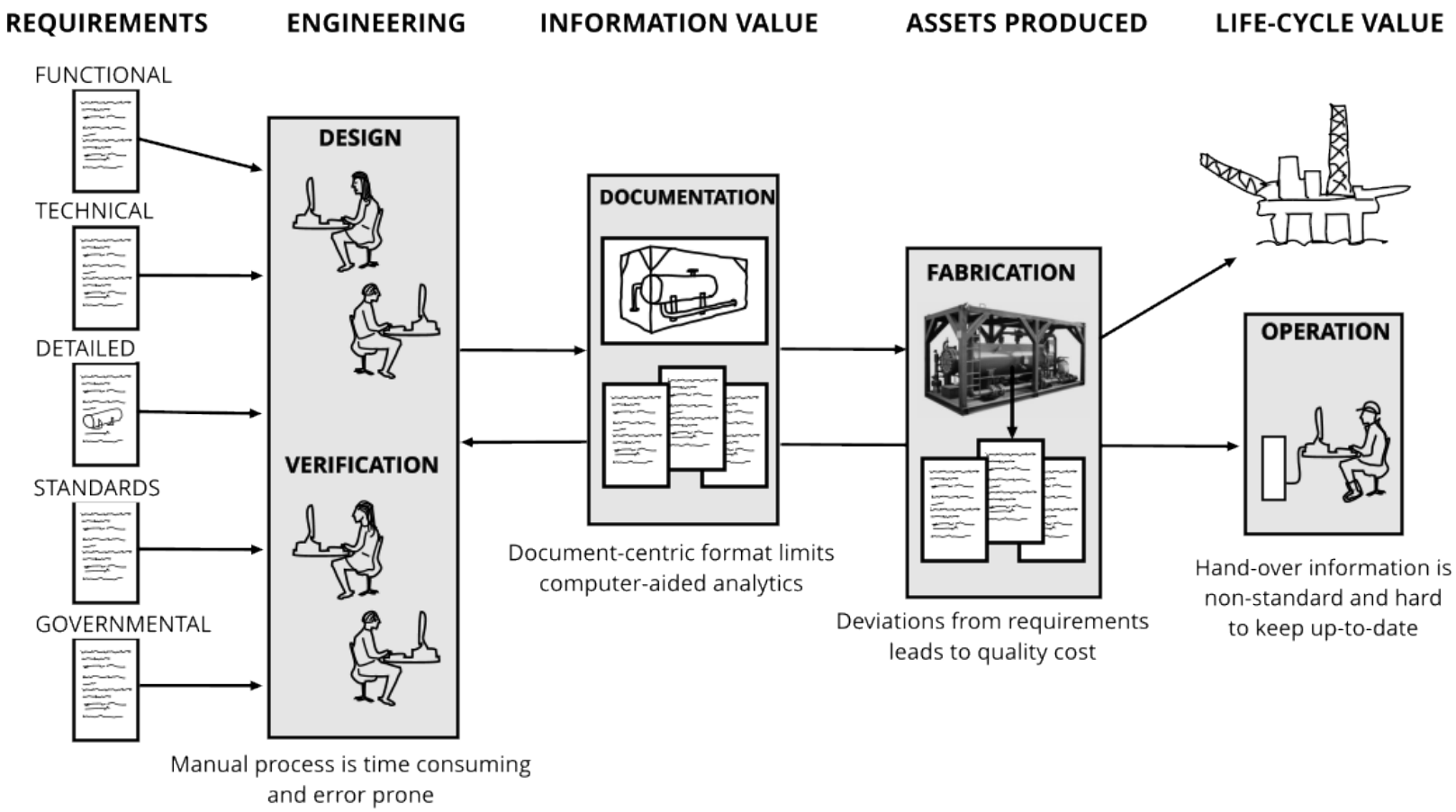
(https://readi-jip.org/about-us/)

READI

READI members

READI: The need for better requirements management

Current work processes are manual, inefficient, and costly.



Existing resources and related initiatives

READI is one of several ongoing industrial ontology projects

- ISO 15926 widely accepted in O&G
  - Part 14 *upper ontology* enables OWL DL for automated reasoning
- PCA, CFIHOS reference data libraries
- Industrial Ontology Foundry
- SKOS, PROV-O from W3C
- Unit of measure ontologies including QUDT
- OMG ontologies including countries and languages
- FIBO for organisations
- ISO/IEC 81346 – multidimensional breakdown of assets
- Reified Requirements Ontology

CFIHOS

CFIHOS (2012–) is a Joint Industry Project, currently organised by the International Association of Oil & Gas Producers (IOGP).

"CFIHOS' aim is to offer practical standardised specifications for information handover that work for: anyone involved in making, operating, maintaining or decommissioning industrial facilities everyone in the information supply chain – operators, contractors and equipment manufacturers and suppliers."

People from over 40 member organizations [including] some of the world's largest operators, not just in Oil & Gas but in other process industries – as well as engineering contractors, software providers, equipment suppliers and academic institutions.

(https://www.jip36-cfihos.org/about/)

Collaboration READI – CFIHOS

Ongoing pilot collaboration

- methods and tools
- reference data
- alignment on digital standards

READI is ontology-based

- and supports development of ISO 15926-14.

Work presented here

- Can CFIHOS benefit from ontology-based methods?
- *Is ISO 15926-14 suitable for CFIHOS?*

CFIHOS information resources

CFIHOS provides a managed vocabulary 2300 classes, 800 relations

Maintained in a relational database *link*

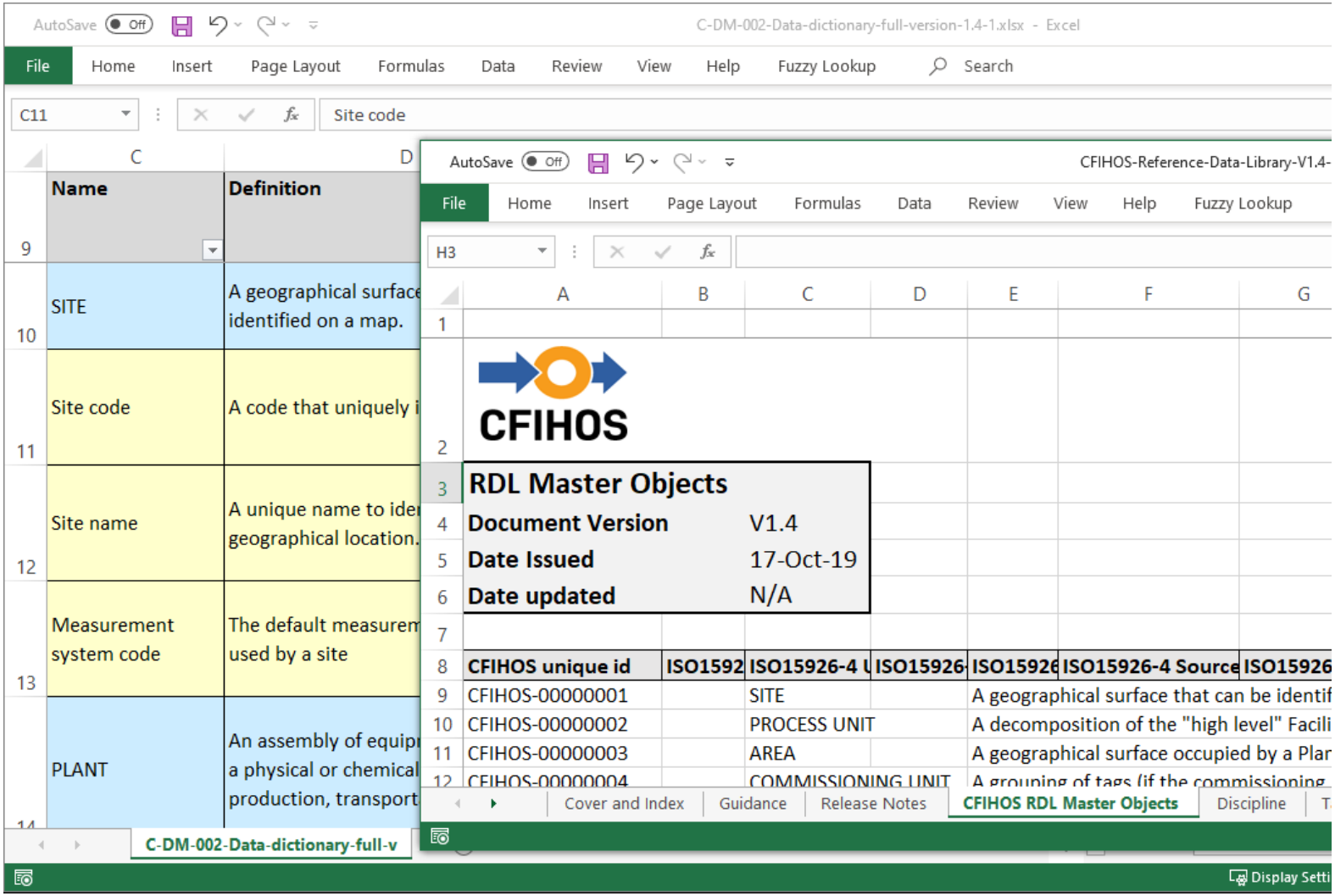
- Nearly all entities already have unique identifiers

Available for download as tabular data *link*

- Reference Data Library, CSV
  - *Reference-Data-Library-csv-files-V1.4-1.zip*
- Data Dictionary, MS Excel
  - *C-DM-002-Data-dictionary-full-version-1.4-1.xlsx*

The version used here is CFIHOS RDL version 1.4 (October 2019).

CFIHOS Data Dictionary and Reference Data Library



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Tools used in CFIHOS translation to ontology

Command-line tools

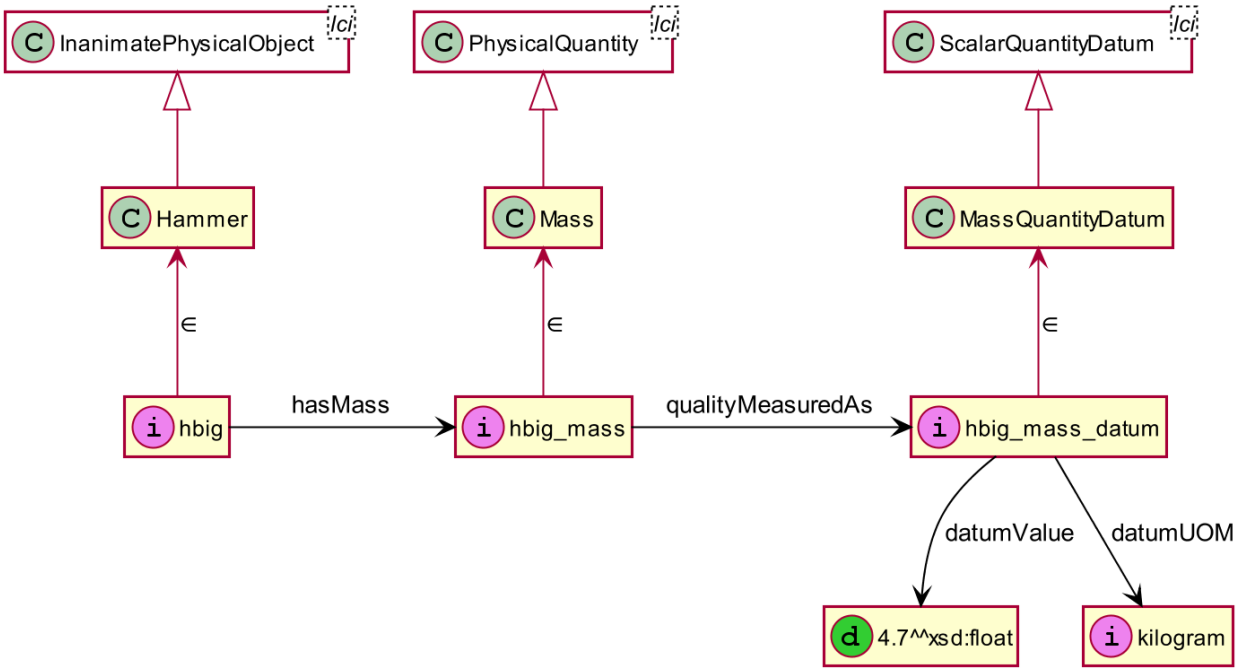
csvkit	Inspect, query (csvsql), and convert csv data	link
lutra	The OTTR reference implementation	link
make	Organise the build process	link
Jena riot	Command-line tool for RDF	link

Optional

Protégé	Ontology viewer	link
emacs	Editor and development environment	link
	syntax checker for stOTTR, csv-mode, ttl-mode, ++	
Unix	When in Windows, e.g. WSL or Cygwin	

The upper ontology

- ISO 15926-14 as upper ontology guides the representation by providing reliable representation patterns



… these patterns should all be available from an OTTR library!

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Steps in the conversion process

1.	Prepare CSV data	csvkit
2.	Select/join columns to interpret	csvsql
3.	Extend core ontology with new vocabulary as needed	edit RDF
4.	Write/select templates to capture interpretation	edit stOTTR
5.	Connect columns to templates	edit bOTTR
6.	Add to the build	Makefile
7.	Lift to RDF fragments	lutra
8.	Combine into ontology	Jena riot
9.	Inspect	Protégé
10.	*back to 2. until done*	

Preparing CSV data

Prepare data as nicely structured, UTF-8 csv files

- 17 csv files, 1 Excel file in CFIHOS

- Check encoding with `file`

```
$ file -k CFIHOS-RDL-v1.4/CFIHOS\ RDL\ Master\ Objects\ V1.4.csv
CFIHOS-RDL-v1.4/CFIHOS RDL Master Objects V1.4.csv: CSV text\012- ,
UTF-8 Unicode text, with very long lines, with CRLF, LF line terminators
```

- Get statistics with `csvstat`

column id	column name	type	nulls	unique	len	freq
1	Section	Text	True	82	77	None, A.2.01 (Formerly section A.2.01), A.2.02 (Formerly section A.2.02), A.2.03 (Formerly
2	Object	Text	True	3	13	None, Entity : , Attributes :
3	Name	Text	False	302	58	Plant code, Document number, Document revision code, CFIHOS unique code, Property nam
4	Definition	Text	False	392	176	The full name of the tag or equipment class, A name that uniquely identifies the property, A
5	Note / comment	Text	True	62	825	"None

Uniform CSV files

: c:/Data/DNVGL-IRM/readi-tools-contexts/readi-context-Z018/resources/rdlCFIHOS/CFIHOS-RDL-v1.4/CFIHOS unit of measure dimension V1.4.csv

File Edit Options Buffers Tools CSV Text Projectile Help

"unit of measure dimension code"	"unit of measure dimension name"	"CFIHOS unique id"	"synonym"	"created date"	"modified date"	"terminate
"CAPACI"	"Capacitance"	"CFIHOS-45000001"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"DENSI"	"Density"	"CFIHOS-45000002"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"VISDYN"	"Dynamic Viscosity"	"CFIHOS-45000004"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"CHARGE"	"Electrical Charge"	"CFIHOS-45000005"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"ECURR"	"Electrical Current / Amperage"	"CFIHOS-45000007"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"FREQU"	"Frequency"	"CFIHOS-45000009"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"VISKIN"	"Kinematic Viscosity"	"CFIHOS-45000010"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"LENGTH"	"Length"	"CFIHOS-45000011"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"LECURD"	"Linear Electric Current Density"	"CFIHOS-45000012"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	
"MASS"	"Mass / Weight"	"CFIHOS-45000013"		"2019-03-06T16:01:12.715Z"	"2019-08-09T14:50:26.975Z"	

- 4.3k -\ CFIHOS unit of measure dimension V1.4.csv CSV Projectile[readi-context-Z018:make] Git-master 6 : 86 Top

"parent tag class name"	"tag class name"	"tag class definition"
"other mechanical equipment"	"beam clamp"	"An equipment item that can be clamped to a beam to pr
"vehicle"	"bicycle"	"A two or three wheeled vehicle designed to be propell
"other mechanical equipment"	"blow out preventer"	"An artefact which is a stack or an assembly of heavy-
"health, safety and environment equipment class"	"break glass unit"	"A device for actuating an alarm system that required
"health, safety and environment equipment class"	"breathing apparatus"	"A respirator in which air or oxygen is fed to a face
"infrastructure"	"bridge"	"Is a support structure intended to span a space."
"enclosure"	"cabinet"	"Is an enclosure intended to hold and protect electric
"enclosure"	"caisson"	"A protective device used to protect equipment (e.g. r
"level transmitter"	"capacitance level transmitter"	"A level transmitter which uses the capacitance of the
"vehicle"	"car"	"A vehicle of less than 3.5 tonnes for transporting pe
"IT and telecom equipment"	"cctv camera"	"Closed-Circuit TeleVision Camera capable of acquiring
"lifting device"	"chain hoist"	"A hoist utilizing a chain-rope for suspending load. C
"infrastructure"	"chimney"	"Is a shaft (civil) intended to transport flue gas to
"other mechanical equipment"	"clamp"	"A mechanical device made for keeping objects firmly i

- 226k -\ CFIHOS tag class V1.4.csv CSV Projectile[readi-context-Z018:make] Git-master 11 : 54 Top

"tag class name"	"discipline document type short code"	"document type name"	"referenced standard"	"create
"NRA ball valve"	"NA4354"	"Spare Part List"	"ARC"	"2019-0
"NRA ball valve"	"OA4811"	"Operating Manual"	"ARC"	"2019-0
"NRA ball valve"	"VA1453"	"Country Regulation Compliance Certificate"	"ARC"	"2019-0
"NRA butterfly valve"	"NA4354"	"Spare Part List"	"ARC"	"2019-0
"NRA butterfly valve"	"OA4811"	"Operating Manual"	"ARC"	"2019-0
"NRA butterfly valve"	"VA1453"	"Country Regulation Compliance Certificate"	"ARC"	"2019-0
"NRA choke valve"	"NA4354"	"Spare Part List"	"CFIHOS"	"2019-0
"NRA eccentric rotating disc valve"	"NA4354"	"Spare Part List"	"CFIHOS"	"2019-0
"NRA gate valve"	"NA4354"	"Spare Part List"	"ARC"	"2019-0
"NRA gate valve"	"OA4811"	"Operating Manual"	"ARC"	"2019-0

- 117k -\ CFIHOS Tag Class Required Discipline Document Type V1.4.csv CSV Projectile[readi-context-Z018:make] Git-master 5 :104 Top

Build ontology to cover the material

New terms will be discovered while working through the CFIHOS content. Manually record these in a new ontology, aligned to the upper ontology and any core ontologies in use.

```
# CFIHOS units of measure
rrdl:D101001516 a owl:Class ; rdfs:subClassOf lis:PhysicalQuantity ;
    rdfs:label "CFIHOS physical quantity" ;
    rdfs:comment "A grouping of units of measure sharing the same base or combination
    rdfs:subClassOf [ a owl:Restriction ; owl:someValuesFrom lis:PhysicalObject ; owl
    rdfs:isDefinedBy rrdl:CFIHOS-00000072 .
```

- Keep the CFIHOS-specific vocabulary in a separate ontology
  - Extend as needs arise
- Take care of your namespaces
  - and decide on shortcut prefixes
- Use non-informative identifiers – CFIHOS already does this

Selecting, joining, adding RDF prefixes

The `csvsql` tool comes in handy.

```
select
  tag_class."CFIHOS unique id" as tag_class,
  disc_doc."CFIHOS unique id" as discdoc_class,
  case tag_doc."referenced standard"
    when 'CFIHOS' then 'D101001539'
    when 'ARC' then 'D101001540'
    when 'Core Team Review' then 'D101001541'
  end as positer,
  tag_doc.*
from
  tag_doc inner join tag_class
    on tag_doc."tag class name" = tag_class."tag class name"
    inner join disc_doc
      on tag_doc."discipline document type short code" =
         disc_doc."discipline document type short code"
```

Write OTTR templates to interpret tables of data

Use the stOTTR format. Start trivial, then structure into a reusable library.

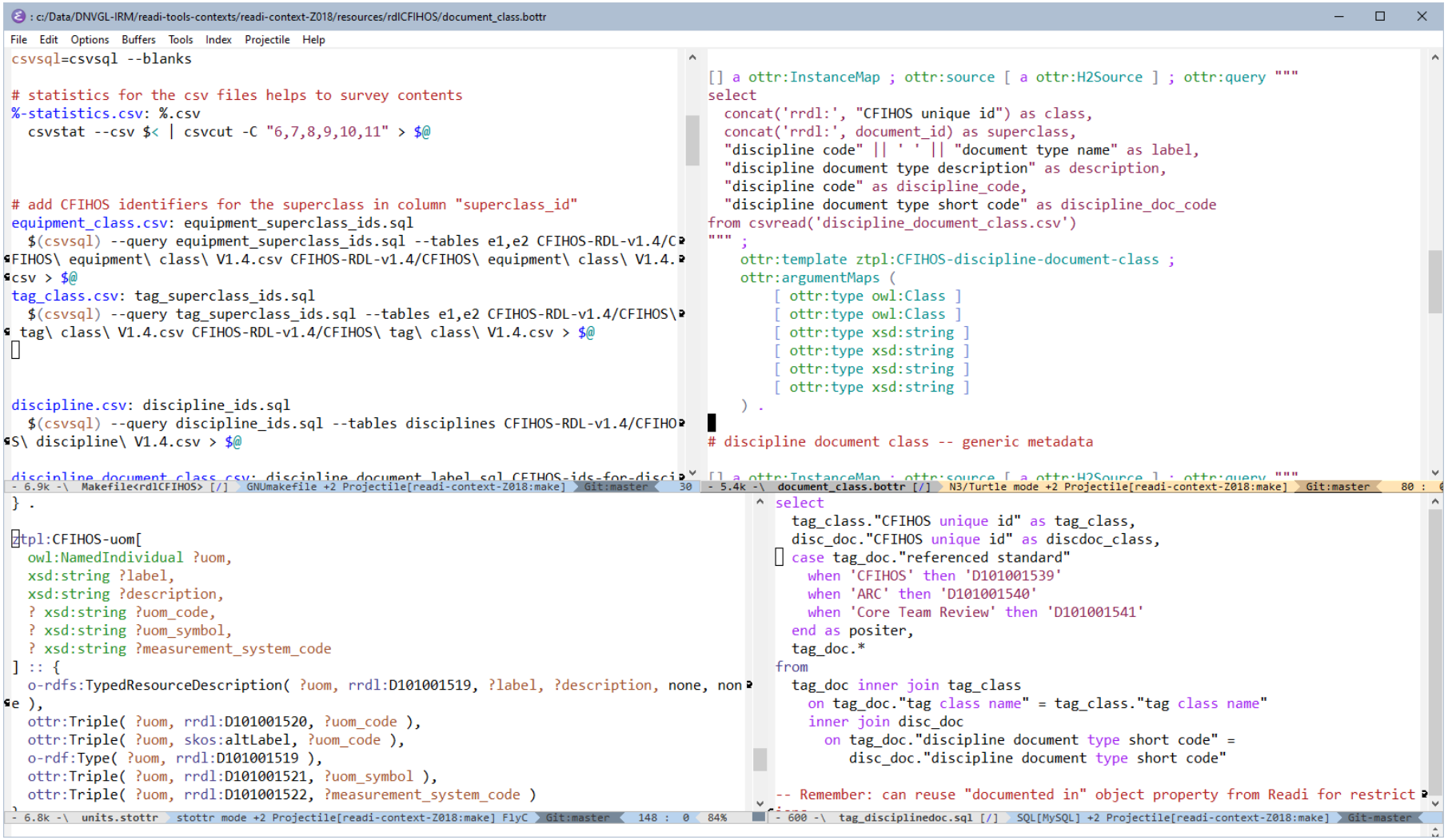
```
ztpl:CFIHOS-uom[
  owl:NamedIndividual ?uom,
  xsd:string ?label,
  xsd:string ?description,
  ? xsd:string ?uom_code,
  ? xsd:string ?uom_symbol,
  ? xsd:string ?measurement_system_code
] :: {
  o-rdfs:TypedResourceDescription( ?uom, rrdl:D101001519, ?label, ?description, none,
  ottr:Triple( ?uom, rrdl:D101001520, ?uom_code ),
  ottr:Triple( ?uom, skos:altLabel, ?uom_code ),
  o-rdf:Type( ?uom, rrdl:D101001519 ),
  ottr:Triple( ?uom, rrdl:D101001521, ?uom_symbol ),
  ottr:Triple( ?uom, rrdl:D101001522, ?measurement_system_code )
} .
```

Map tables to templates with bOTTR

RDF prefixes added here.

```
[] a ottr:InstanceMap ; ottr:source [ a ottr:H2Source ] ; ottr:query """
select
  concat('rrdl:', "CFIHOS unique id") as class,
  concat('rrdl:', document_id) as superclass,
  "discipline code" || ' ' || "document type name" as label,
  "discipline document type description" as description,
  "discipline code" as discipline_code,
  "discipline document type short code" as discipline_doc_code
from csvread('discipline_document_class.csv')
""" ;
    ottr:template ztpl:CFIHOS-discipline-document-class ;
    ottr:argumentMaps (
        [ ottr:type owl:Class ] [ ottr:type owl:Class ]
        [ ottr:type xsd:string ] [ ottr:type xsd:string ] [ ottr:type xsd:string ] [ o
    ) .
```

Editor view: working with mappings



The Makefile

Manage the flow of data from csv to finished ontology.

Select and join with `csvsql`

```
equipment_class.csv: equipment_superclass_ids.sql
    $(csvsql) --query equipment_superclass_ids.sql \
    --tables e1,e2 CFIHOS-RDL-v1.4/CFIHOS\ equipment\ class\ V1.4.csv \
    CFIHOS-RDL-v1.4/CFIHOS\ equipment\ class\ V1.4.csv > $@
```

Expand Turtle fragments with `lutra`

```
units.ttl: units.stottr units.bottr uom_dimension.sql phys-quant-property.sql phys-qua
    $(lutraexpand) units.bottr > $@
```

Combine Turtle fragments with `riot`

```
CFIHOS-RDL-equipment.ttl: CFIHOS-RDL-equipment-header.ttl equipment_taxonomy.ttl disc
    $(riot) --out=ttl --stop --check --time $^ > $@
```

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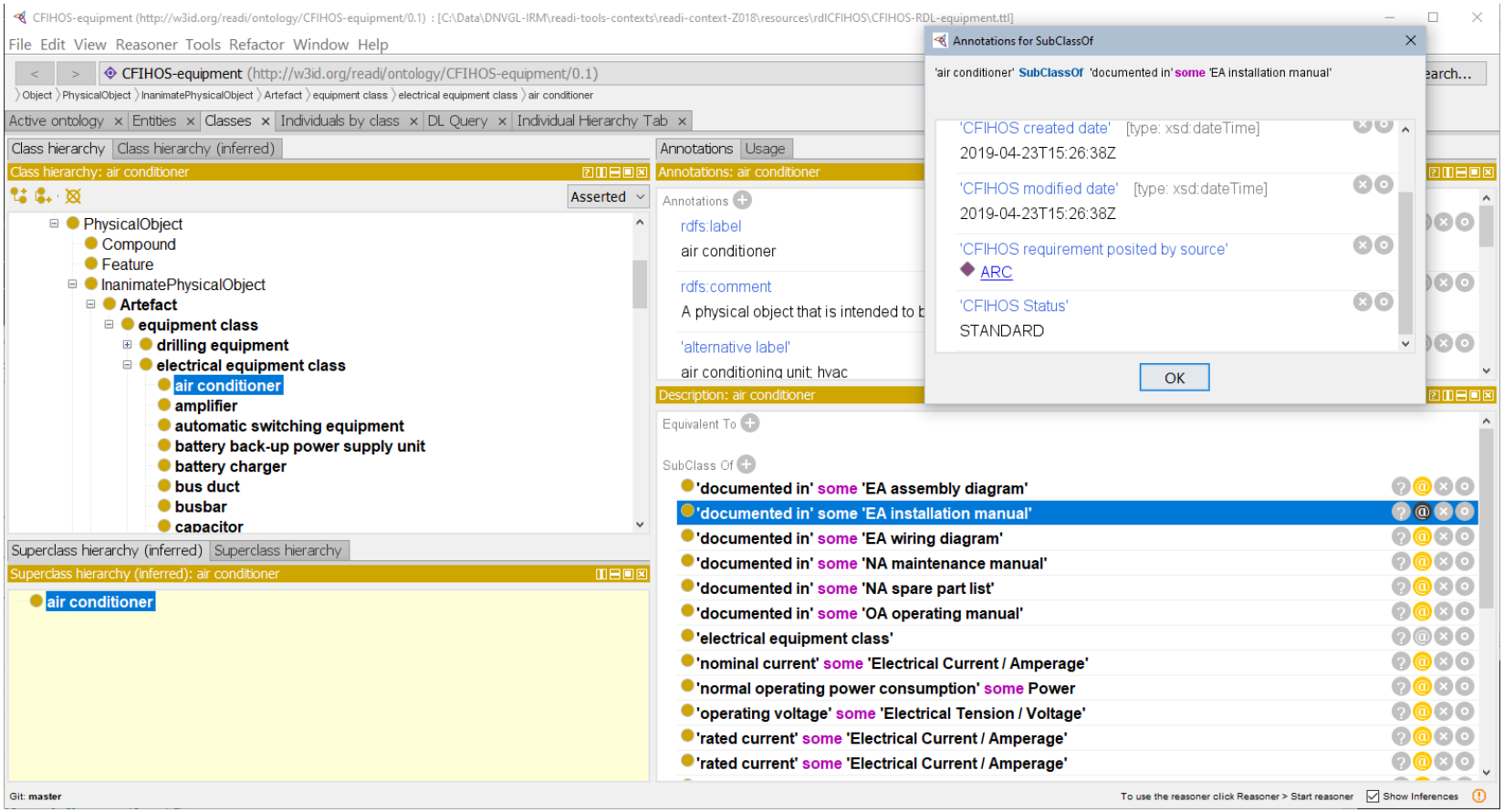
The result, in Protégé



- Verdict: CFIHOS is a great match for ISO 15926-14.

Why ontology

- See RDL items in context
- Check (formal) consistency
- Quality control of contents
- Align with semantic web standards (W3C OWL 2)
- Apply established modelling and upper ontology (ISO 15926-14)
- Enable web publishing
- Enable asset models as instantiations

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Questions. So many questions.

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