DOME 4.0

www.dome40.eu

WP1 – Demo and Update

Report and status P2

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January 25th 2024

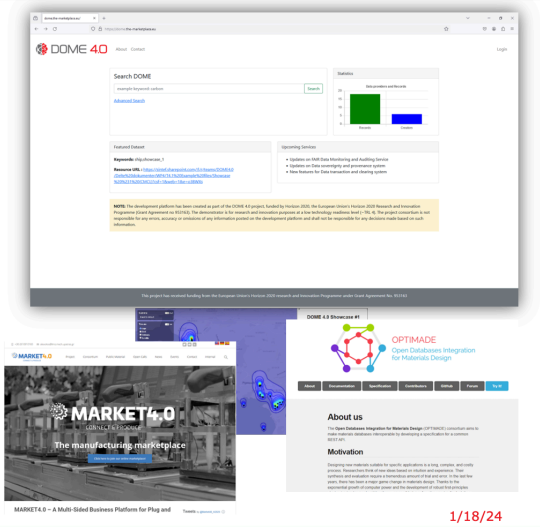
UCL INSTITUTE FOR MATERIALS DISCOVERY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 953163

DOME 4.0 – A high level summary

DOME 4.0

- DOME 4.0 Core
  - Front end: features and external onboarding
  - Back end: semantic interoperability
- 9 B2B showcases
  - Offline development and execution
  - Online currently in progress



Outline

- Focus on the Semantic Discovery and Knowledge Base backend components
- Demonstrate mapping and linking of communities semantically
- Integration of third party **ontology** and *data*
  - EU data infrastructure
- Demo: Synthetic case study of the backend - linking materialsproject.org, EuroSciVoc and DOME 4.0!

Outline of the Steps

- Load the ontology eco system - as basis for all data and knowldge!
- Create fully semantic data sets (Tier1: compliant with DOME 4.0 data Set Ontology)
- Demonstrate Visualisation and SparQL and python query

Note:

This work is largely based on D3.6, it extends SimPhoNy-Future into a new Package developed specifcally with DOME requirements in mind: **Ontology_Manager**, **OntoVIS** and **sigraDB**.

DomeDataSetfrom D3.6 is in /Users/adham/dev/dome/Ontology-matters/domeo/domeo.ttl

In [2]:
```
from ontology_manager.ontology_utils import OntologyManager # loading the
from rdflib import Graph, URIRef, Namespace, Literal, BNode, collection
from rdflib.namespace import SKOS, RDF, RDFS, OWL
from datetime import date
```

In [3]:
```
from rdflib.extras.external_graph_libs import rdflib_to_networkx_multidig
import networkx as nx
import matplotlib.pyplot as plt
```

In [4]:
```
from ontodot.ontodot import vis, random_date_time, auto_bind_namespaces,
from ontodot.ontodot import OntoVis
```

In [5]:
```
from types import SimpleNamespace # We use simple name spaces, it is a ba
import os, random
```

In [6]:
```
dome=SimpleNamespace() # This is equivalent to a *SimPhoNy lightweight se
```

Load the DOME 4.0 ecosystem CORE ontology

In [7]:
```
dome.g=Graph(bind_namespaces="rdflib")  # We are using RDFLIB directly, w
dome.ns=Namespace('https://dome40.eu/semantics/dome4.0_core#')
dome.path = "/Users/adham/dev/ontology/dome/Ontology-matters/"
dome.file='dome4.0_core_tbox.ttl'
```

In [8]:
```
dome.g.parse(os.path.join(dome.path, dome.file))
```

Out[8]:
```
<Graph identifier=N6973b87c13804d45832885c342b4caf8 (<class 'rdflib.grap
h.Graph'>)>
```

Visualise

We will be available in enhanced - interactive/modern form - on the front end with final release

In [9]:
```
vis(dome.g)
```

Load the Materials Informatics Ontology (MIO)

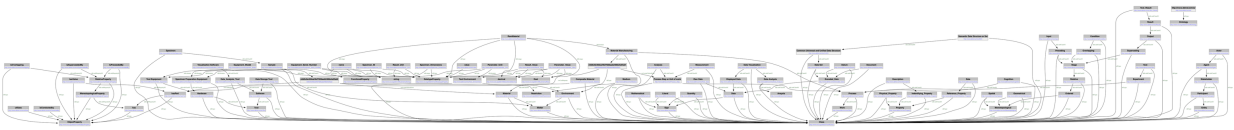
- MIO is a new top level ontology compliant with EMMO but is optimised for practical applications
- EMMO requires heavy use of reasoners as it is built on logic,
- This poses heavy constraints on applications, as one has to deal with complex structures, e.g., composite complex classes requiring intensive inference in real time
- MIO is simple and focuses on practical applications, especially for software engineering perspective

In [10]:
```
mio=Graph(bind_namespaces="rdflib")
mio.parse("/Users/adham/dev/ontology/ontology_manager/MIO/mio/mio.ttl")
```

Out[10]:
```
<Graph identifier=N3edc34ad292d44c0b4b7245278a635b9 (<class 'rdflib.grap
h.Graph'>)>
```

Visualise

In [11]:
```
vis(mio)
```



Advanced Visualisation and integration of ontology

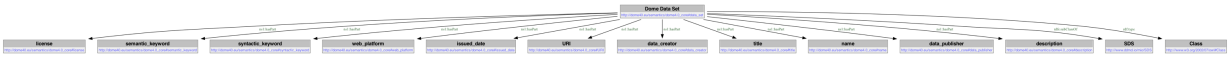
We rely on RDFLIB like many other open source programs for RDF management, but augment it with additional tools both in house and external!

- OntoVis, SimPhoNy-Future, Ontology Manager, SigraDB, OMI, are in house

Combine ontology from multiple resources and zoom into the data set with cross connections

In [12]:
```
# Using the power of RDFLIB it is easy to combine ontology:
gc=dome.g+mio
# Using the new OntoVis: Visualisation and inspection is easy
ovis = OntoVis(gc)
```

In [13]:
```
vis(ovis.zoom_in(URIRef("http://dome40.eu/semantics/dome4.0_core#data_set
```



DOME 4.0 eco system supports all standard ontology

In [14]:
```
# these are bindings (RDFLIB)
binds="""
@prefix domeES: <http://dome40.eu/semantics/dome4.0_core#> .
@prefix mio: <http://www.ddmd.io/mio/> .
@prefix dcat: <http://www.w3.org/ns/dcat#> .
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix euroscivoc: <http://data.europa.eu/8mn/euroscivoc/> .
@prefix evmpo: <https://emmc.eu/semantics/evmpo/evmpo.ttl#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix http-meth: <http://www.w3.org/2011/http-methods#> .
@prefix msm: <http://iserve.kmi.open.ac.uk/ns/msm#> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix xs: <http://www.w3.org/2001/XMLSchema#> .
"""
```

In [15]:
```
nsbinds=auto_bind_namespaces(dome.g, binds)
```

```
g.bind(domeES, http://dome40.eu/semantics/dome4.0_core#)
g.bind(mio, http://www.ddmd.io/mio/)
g.bind(dcat, http://www.w3.org/ns/dcat#)
g.bind(dcterms, http://purl.org/dc/terms/)
g.bind(euroscivoc, http://data.europa.eu/8mn/euroscivoc/)
g.bind(evmpo, https://emmc.eu/semantics/evmpo/evmpo.ttl#)
g.bind(foaf, http://xmlns.com/foaf/0.1/)
g.bind(http-meth, http://www.w3.org/2011/http-methods#)
g.bind(msm, http://iserve.kmi.open.ac.uk/ns/msm#)
g.bind(owl, http://www.w3.org/2002/07/owl#)
g.bind(rdf, http://www.w3.org/1999/02/22-rdf-syntax-ns#)
g.bind(rdfs, http://www.w3.org/2000/01/rdf-schema#)
g.bind(skos, http://www.w3.org/2004/02/skos/core#)
g.bind(xs, http://www.w3.org/2001/XMLSchema#)
```

In [16]:
```
print(nsbinds)
```

```
{'domeES': Namespace('http://dome40.eu/semantics/dome4.0_core#'), 'mio':
Namespace('http://www.ddmd.io/mio/'), 'dcat': Namespace('http://www.w3.or
g/ns/dcat#'), 'dcterms': Namespace('http://purl.org/dc/terms/'), 'eurosci
voc': Namespace('http://data.europa.eu/8mn/euroscivoc/'), 'evmpo': Namesp
ace('https://emmc.eu/semantics/evmpo/evmpo.ttl#'), 'foaf': Namespace('htt
p://xmlns.com/foaf/0.1/'), 'http-meth': Namespace('http://www.w3.org/201
1/http-methods#'), 'msm': Namespace('http://iserve.kmi.open.ac.uk/ns/ms
m#'), 'owl': Namespace('http://www.w3.org/2002/07/owl#'), 'rdf': Namespac
e('http://www.w3.org/1999/02/22-rdf-syntax-ns#'), 'rdfs': Namespace('htt
p://www.w3.org/2000/01/rdf-schema#'), 'skos': Namespace('http://www.w3.or
g/2004/02/skos/core#'), 'xs': Namespace('http://www.w3.org/2001/XMLSchem
a#')}
```

We create now a SimPhoNy-CUDS

- CUDS: Common Universal/Unified Data Structures!
- Check the MIO and domeES ontology!

In [17]:
```
cuds=SimpleNamespace() # we use now simple version, no checks for the dem
cuds.g=Graph()
cuds_collection=set()
#cuds.ds=URIRef("http://dome40.eu/semantics/dome4.0_core#data_set")
```

In [18]:
```
num_data_sets=10 # the number of synthetic data sets we want to create
domeES=nsbinds['domeES']
mioNS=nsbinds['mio']
```

In [19]:
```
# Since this is a demo, we make our own creator, publisher, ...
## Note we do not claim any relation to materials project by the followin
# these will be instances later of a User/Dataproider etc.
random_creator = lambda: random.choice(["Perosn 1", "Person 2", "Person 3
# these will be instances later of a User/Dataproider etc.
random_publisher = lambda: random.choice(["Company 1", "Company 2", "Comp
random_keywords = lambda k: random.sample(s.split('\n'), random.randint(3
```

Let us use EuroSciVoc as True Semantic keywords!

and integrate with `MIO+domeES` ontology!

- Load the EuroSciVoc ontology (mostly individuals, but with clear hierarchy)
- Use SPARQL to pick all the concepts that are relevant for engineering and technology
- for the demo: Make a function to select randomly 1 to 5 such semantic keywords, and add it to the dataset.

Attain practical and real compliance, and use of European Infrastrcutre and investments.

In [20]:
```
esvoc = SimpleNamespace()
esvoc.g = Graph()
esvoc.desc = "the EuroSciVoc"
esvoc.path = "/Users/adham/dev/dome/Ontology-matters/external/EuroSciVoc-
esvoc.g.parse(esvoc.path)
# SPARQL query to choose all elements narrower than engineering and techn
q="""
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>

SELECT ?narrowerConcept ?narrowerLabel
WHERE {
    ?narrowerConcept skos:broader+ <http://data.europa.eu/8mn/euroscivoc/
    ?narrowerConcept skos:prefLabel ?narrowerLabel .
        FILTER(LANGMATCHES(LANG(?narrowerLabel), "en"))
}
"""
# Noe the UUID may change between versions,  need to confirm!
```

In [21]:
```
# run the query
esvoc.r = esvoc.g.query(q)
```

In [22]:
```
#for i in esvoc.r:
#    print(i)
printH(f" We find {len(esvoc.r)} semantic keywords relevant for technolog
```

```
 We find 208 semantic keywords relevant for technology and engineering:
========================================================================
```

In [23]:
```
esvoc.r_formated = [{'IRI': str(row.narrowerConcept), 'Label': str(row.na
esvoc.random = lambda r: random.sample([[r_['IRI'], r_['Label']] for r_ i
for i in range(3):
    print(esvoc.random(esvoc.r_formated))
```

```
[['http://data.europa.eu/8mn/euroscivoc/c2a8caf5-4ee8-43ff-a3cd-bae7430e4
e18', 'supercomputers'], ['http://data.europa.eu/8mn/euroscivoc/0085a6d1-
0b32-479f-a560-0cbf6cffee9b', 'astronautical engineering'], ['http://dat
a.europa.eu/8mn/euroscivoc/8d83b645-355f-4cf1-abf3-ce4cd3172c34', 'radio
frequency'], ['http://data.europa.eu/8mn/euroscivoc/abadc19a-13ab-4bc6-95
1b-8f12226b3e8b', 'cognitive radio']]
[['http://data.europa.eu/8mn/euroscivoc/ece8d70d-2311-4d6d-ae12-473fc5c09
a5d', 'sustainable architecture'], ['http://data.europa.eu/8mn/euroscivo
c/e4062af9-fc49-4826-9bdb-e549f3f0f191', 'food technology'], ['http://dat
a.europa.eu/8mn/euroscivoc/eeb88fa8-7b5a-440f-a3c9-add16c6b5cd2', 'mobile
radio']]
[['http://data.europa.eu/8mn/euroscivoc/7b002931-b33d-4f72-87db-4ae7db02e
938', 'bioleaching'], ['http://data.europa.eu/8mn/euroscivoc/c835a32d-04c
8-493b-9644-203414287c92', 'composites'], ['http://data.europa.eu/8mn/eur
oscivoc/e4062af9-fc49-4826-9bdb-e549f3f0f191', 'food technology'], ['htt
p://data.europa.eu/8mn/euroscivoc/53d318ec-2f1b-41e4-8317-24b35f9a9120',
'structural engineering'], ['http://data.europa.eu/8mn/euroscivoc/f08d8db
c-70a6-4d8c-8f83-62e58a17bf2d', 'food safety'], ['http://data.europa.eu/8
mn/euroscivoc/7f86cf31-2001-4f17-8941-3318bb68bc21', 'marine energy']]
```

In [24]:

```python
for i in range(1, num_data_sets + 1):
    cuds.ds = URIRef(f"{domeES}DS_{i}")
    cuds.uri = URIRef(f"{domeES}DS_{i}")
    cuds.g.add((cuds.ds, RDF.type, domeES.data_set))

    # Add the required DOME 4.0 Data Set Ontology attributes
    # These are cuds.add(spo triplet)
    # cuds.uri = URIRef(f"http://materialsproject.org/data/calc_{i}")

    mpid=generate_random_materialproject_id()
    #uri = URIRef("https://next-gen.materialsproject.org/materials/mp-191
    uri=URIRef(f"https://next-gen.materialsproject.org/materials/{mpid}")
    cuds.g.add( (uri, RDF.type, domeES.URI) )
    cuds.g.add((cuds.ds, domeES.hasPart, uri))

    printH(f"this is a DOME 4.0 Data Set: {cuds.ds}")
    printH(f"this Data Set point to: {uri}")

    wp = URIRef("https://next-gen.materialsproject.org/")
    cuds.g.add( (wp, RDF.type, domeES.web_platform) )
    cuds.g.add((cuds.ds, domeES.hasPart, wp))

    dc = URIRef(f"{domeES}/{generate_uuid()}")
    cuds.g.add( (dc, RDF.type, domeES.issued_date) )
    the_date=Literal(random_date_time())
    cuds.g.add( (cuds.ds, domeES.hasPart, dc) )
    cuds.g.add( (dc, mioNS.hasValue, the_date) )

    dc = URIRef(f"{domeES}/{generate_uuid()}")
    cuds.g.add( (dc, RDF.type, domeES.description) )
    the_value=Literal("This is a description that will change later")
    cuds.g.add( (cuds.ds, domeES.hasPart, dc) )
    cuds.g.add( (dc, mioNS.hasValue, the_value) )

    dc = URIRef(f"{domeES}/{generate_uuid()}")
    cuds.g.add( (dc, RDF.type, domeES.data_creator) )
    the_value=Literal(random_creator())
    cuds.g.add( (cuds.ds, domeES.hasPart, dc) )
    cuds.g.add( (dc, mioNS.hasValue, the_value) )

    dc = URIRef(f"{domeES}/{generate_uuid()}")
```

```
    cuds.g.add( (dc, RDF.type, domeES.license) )
    the_value=Literal("CC-BY 4.0")
    cuds.g.add( (cuds.ds, domeES.hasPart, dc) )
    cuds.g.add( (dc, mioNS.hasValue, the_value) )


    dc = URIRef(f"{domeES}/{generate_uuid()}")
    cuds.g.add( (dc, RDF.type, domeES.data_publisher) )
    the_value=Literal(random_publisher())
    cuds.g.add( (cuds.ds, domeES.hasPart, dc) )
    cuds.g.add( (dc, mioNS.hasValue, the_value) )

    dc = URIRef(f"{domeES}/{generate_uuid()}")
    cuds.g.add( (dc, RDF.type, domeES.title) )
    the_value=Literal("this is a title placeholder")
    cuds.g.add( (cuds.ds, domeES.hasPart, dc) )
    cuds.g.add( (dc, mioNS.hasValue, the_value) )


    # get some semantic EUROSCIVOC keywords for demo
    ks=esvoc.random(esvoc.r_formated)
    for k in ks:
        print(k[1])
        dc = URIRef(k[0])
        cuds.g.add( (dc, RDF.type, domeES.semantic_keyword) )
        cuds.g.add( (dc, RDFS.label, Literal(k[1]) ))
        cuds.g.add( (cuds.ds, domeES.hasPart, dc) )

   # g.add((data_set_uri, mio.hasPart, domeES.syntactic_keyword))
```

```
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_
1:
================================================================================
this Data Set point to: https://next-gen.materialsproject.org/materials/m
p-77:
================================================================================
food safety
telecommunications
environmental biotechnology
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_
2:
================================================================================
this Data Set point to: https://next-gen.materialsproject.org/materials/m
p-91:
================================================================================
other engineering and technologies
environmental engineering
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_
3:
================================================================================
this Data Set point to: https://next-gen.materialsproject.org/materials/m
p-27:
================================================================================
computer hardware
```

architecture engineering
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_4:
==========
this Data Set point to: https://next-gen.materialsproject.org/materials/mp-113:
==========
electrodialysis
civil engineering
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_5:
==========
this Data Set point to: https://next-gen.materialsproject.org/materials/mp-75:
==========
solar thermal
electric power generation
geothermal energy
tidal energy
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_6:
==========
this Data Set point to: https://next-gen.materialsproject.org/materials/mp-39:
==========
solar energy
fossil energy
natural gas
urban engineering
chemical process engineering
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_7:
==========
this Data Set point to: https://next-gen.materialsproject.org/materials/mp-131:
==========
reverse osmosis
subtractive manufacturing
microtechnology
environmental engineering
drones
electronic engineering
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_8:
==========
this Data Set point to: https://next-gen.materialsproject.org/materials/mp-84:
==========
fossil energy
urban engineering
geological engineering

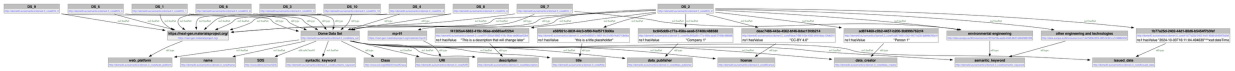
```
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_
9:
================================================================================
this Data Set point to: https://next-gen.materialsproject.org/materials/m
p-45:
================================================================================
metabolic engineering
wearable medical technology
this is a DOME 4.0 Data Set: http://dome40.eu/semantics/dome4.0_core#DS_1
0:
================================================================================
this Data Set point to: https://next-gen.materialsproject.org/materials/m
p-27:
================================================================================
hydrogen energy
mechatronics
nanocrystals
radar
WiFi
```

Any data set (given as a IRI in general) **can be a DOME 4.0 Data Set**, this is simply achieved with the following line:

```
g.add((someURI, RDF.type, domeES.data_set))
```

In [25]:
```
gc=cuds.g+dome.g+mio
ovis = OntoVis(gc)
```

In [26]:
```
vis(ovis.zoom_in(URIRef("http://dome40.eu/semantics/dome4.0_core#DS_2"),
```



In [27]:
```
inspect_iri=URIRef("http://dome40.eu/semantics/dome4.0_core#DS_2")
q="""
SELECT ?predicate ?object
WHERE {
    <http://dome40.eu/semantics/dome4.0_core#DS_2> ?predicate ?object .
}
"""
DS99 = Graph()
r=gc.query(q)
for i in r:
    DS99.add((inspect_iri, i.predicate, i.object))
    q2 = f"""
    SELECT ?predicate ?object
    WHERE {{
        <{i.object}> ?predicate ?object .
    }}
    """
    r2 = gc.query(q2)
    for j in r2:
        DS99.add((j.object, j.predicate, j.object))
        print(j.object, j.predicate, j.object)
```

```
http://dome40.eu/semantics/dome4.0_core#data_creator http://www.w3.org/19
99/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#data_
creator
Perosn 1 http://www.ddmd.io/mio/hasValue Perosn 1
environmental engineering http://www.w3.org/2000/01/rdf-schema#label envi
ronmental engineering
http://dome40.eu/semantics/dome4.0_core#semantic_keyword http://www.w3.or
g/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#s
emantic_keyword
http://dome40.eu/semantics/dome4.0_core#title http://www.w3.org/1999/02/2
2-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#title
this is a title placeholder http://www.ddmd.io/mio/hasValue this is a tit
le placeholder
http://dome40.eu/semantics/dome4.0_core#data_publisher http://www.w3.org/
1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#dat
a_publisher
Company 1 http://www.ddmd.io/mio/hasValue Company 1
http://dome40.eu/semantics/dome4.0_core#web_platform http://www.w3.org/19
99/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#web_p
latform
http://dome40.eu/semantics/dome4.0_core#description http://www.w3.org/199
9/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#descri
ption
This is a description that will change later http://www.ddmd.io/mio/hasVa
lue This is a description that will change later
http://dome40.eu/semantics/dome4.0_core#URI http://www.w3.org/1999/02/22-
rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#URI
http://dome40.eu/semantics/dome4.0_core#semantic_keyword http://www.w3.or
g/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#s
emantic_keyword
other engineering and technologies http://www.w3.org/2000/01/rdf-schema#l
abel other engineering and technologies
CC-BY 4.0 http://www.ddmd.io/mio/hasValue CC-BY 4.0
http://dome40.eu/semantics/dome4.0_core#license http://www.w3.org/1999/0
2/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#license
http://dome40.eu/semantics/dome4.0_core#issued_date http://www.w3.org/199
9/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#issued
_date
```

```
2024-10-03T16:11:04.494639 http://www.ddmd.io/mio/hasValue 2024-10-03T16:
11:04.494639
http://dome40.eu/semantics/dome4.0_core#web_platform http://www.ddmd.io/m
io/hasPart http://dome40.eu/semantics/dome4.0_core#web_platform
http://dome40.eu/semantics/dome4.0_core#data_creator http://www.ddmd.io/m
io/hasPart http://dome40.eu/semantics/dome4.0_core#data_creator
http://dome40.eu/semantics/dome4.0_core#syntactic_keyword http://www.ddm
d.io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#syntactic_keywor
d
http://dome40.eu/semantics/dome4.0_core#license http://www.ddmd.io/mio/ha
sPart http://dome40.eu/semantics/dome4.0_core#license
http://dome40.eu/semantics/dome4.0_core#name http://www.ddmd.io/mio/hasPa
rt http://dome40.eu/semantics/dome4.0_core#name
http://dome40.eu/semantics/dome4.0_core#description http://www.ddmd.io/mi
o/hasPart http://dome40.eu/semantics/dome4.0_core#description
http://dome40.eu/semantics/dome4.0_core#issued_date http://www.ddmd.io/mi
o/hasPart http://dome40.eu/semantics/dome4.0_core#issued_date
http://dome40.eu/semantics/dome4.0_core#URI http://www.ddmd.io/mio/hasPar
t http://dome40.eu/semantics/dome4.0_core#URI
http://dome40.eu/semantics/dome4.0_core#data_publisher http://www.ddmd.i
o/mio/hasPart http://dome40.eu/semantics/dome4.0_core#data_publisher
http://dome40.eu/semantics/dome4.0_core#title http://www.ddmd.io/mio/hasP
art http://dome40.eu/semantics/dome4.0_core#title
http://dome40.eu/semantics/dome4.0_core#semantic_keyword http://www.ddmd.
io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#semantic_keyword
A dome specific representation of a Semantic Data Set  http://www.w3.org/
2000/01/rdf-schema#comment A dome specific representation of a Semantic D
ata Set
http://www.ddmd.io/mio/SDS http://www.w3.org/2000/01/rdf-schema#subClassO
f http://www.ddmd.io/mio/SDS
Dome Data Set http://www.w3.org/2000/01/rdf-schema#label Dome Data Set
http://www.w3.org/2002/07/owl#Class http://www.w3.org/1999/02/22-rdf-synt
ax-ns#type http://www.w3.org/2002/07/owl#Class
```

In [28]:
```
for s, p, o in DS99:
    print(s, p, o)
```

```
Perosn 1 http://www.ddmd.io/mio/hasValue Perosn 1
this is a title placeholder http://www.ddmd.io/mio/hasValue this is a tit
le placeholder
http://dome40.eu/semantics/dome4.0_core#issued_date http://www.w3.org/199
9/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#issued
_date
http://dome40.eu/semantics/dome4.0_core#URI http://www.ddmd.io/mio/hasPar
t http://dome40.eu/semantics/dome4.0_core#URI
http://dome40.eu/semantics/dome4.0_core#name http://www.ddmd.io/mio/hasPa
rt http://dome40.eu/semantics/dome4.0_core#name
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/d
ome4.0_core#hasPart https://next-gen.materialsproject.org/
other engineering and technologies http://www.w3.org/2000/01/rdf-schema#l
abel other engineering and technologies
2024-10-03T16:11:04.494639 http://www.ddmd.io/mio/hasValue 2024-10-03T16:
11:04.494639
http://dome40.eu/semantics/dome4.0_core#web_platform http://www.w3.org/19
99/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#web_p
latform
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/d
ome4.0_core#hasPart http://dome40.eu/semantics/dome4.0_core#/deac7486-443
e-4562-bf46-8dac13fdb214
http://dome40.eu/semantics/dome4.0_core#data_creator http://www.ddmd.io/m
io/hasPart http://dome40.eu/semantics/dome4.0_core#data_creator
```

http://www.w3.org/2002/07/owl#Class http://www.w3.org/1999/02/22-rdf-syntax-ns#type http://www.w3.org/2002/07/owl#Class
CC-BY 4.0 http://www.ddmd.io/mio/hasValue CC-BY 4.0
environmental engineering http://www.w3.org/2000/01/rdf-schema#label environmental engineering
http://dome40.eu/semantics/dome4.0_core#issued_date http://www.ddmd.io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#issued_date
Dome Data Set http://www.w3.org/2000/01/rdf-schema#label Dome Data Set
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart http://data.europa.eu/8mn/euroscivoc/14e75836-6f05-46f9-9c82-ca12468b0452
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart http://dome40.eu/semantics/dome4.0_core#/bc845dd9-c77a-458a-aea6-57408c488588
http://dome40.eu/semantics/dome4.0_core#license http://www.w3.org/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#license
This is a description that will change later http://www.ddmd.io/mio/hasValue This is a description that will change later
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart http://dome40.eu/semantics/dome4.0_core#/f41305a4-6862-419c-96ae-ab685aef22b4
http://dome40.eu/semantics/dome4.0_core#description http://www.w3.org/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#description
http://dome40.eu/semantics/dome4.0_core#web_platform http://www.ddmd.io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#web_platform
http://dome40.eu/semantics/dome4.0_core#syntactic_keyword http://www.ddmd.io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#syntactic_keyword
http://dome40.eu/semantics/dome4.0_core#data_publisher http://www.w3.org/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#data_publisher
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart http://dome40.eu/semantics/dome4.0_core#/ad874460-c0b2-4457-b200-3b899b762cf4
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart http://dome40.eu/semantics/dome4.0_core#/e56f921c-883f-44c3-bf90-f4af5713b06a
http://dome40.eu/semantics/dome4.0_core#title http://www.w3.org/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#title
Company 1 http://www.ddmd.io/mio/hasValue Company 1
http://dome40.eu/semantics/dome4.0_core#DS_2 http://www.w3.org/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#data_set
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart https://next-gen.materialsproject.org/materials/mp-91
http://dome40.eu/semantics/dome4.0_core#semantic_keyword http://www.w3.org/1999/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#semantic_keyword
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart http://dome40.eu/semantics/dome4.0_core#/1b77a25d-2402-44d1-80d6-b5454f7b3fef
http://dome40.eu/semantics/dome4.0_core#DS_2 http://dome40.eu/semantics/dome4.0_core#hasPart http://data.europa.eu/8mn/euroscivoc/531bd18a-eedd-4345-8b2f-5464f96615f8
http://dome40.eu/semantics/dome4.0_core#data_publisher http://www.ddmd.io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#data_publisher
http://dome40.eu/semantics/dome4.0_core#title http://www.ddmd.io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#title
http://dome40.eu/semantics/dome4.0_core#license http://www.ddmd.io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#license
http://dome40.eu/semantics/dome4.0_core#description http://www.ddmd.io/mi

```
o/hasPart http://dome40.eu/semantics/dome4.0_core#description
http://www.ddmd.io/mio/SDS http://www.w3.org/2000/01/rdf-schema#subClassO
f http://www.ddmd.io/mio/SDS
A dome specific representation of a Semantic Data Set  http://www.w3.org/
2000/01/rdf-schema#comment A dome specific representation of a Semantic D
ata Set
http://dome40.eu/semantics/dome4.0_core#semantic_keyword http://www.ddmd.
io/mio/hasPart http://dome40.eu/semantics/dome4.0_core#semantic_keyword
http://dome40.eu/semantics/dome4.0_core#URI http://www.w3.org/1999/02/22-
rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#URI
http://dome40.eu/semantics/dome4.0_core#data_creator http://www.w3.org/19
99/02/22-rdf-syntax-ns#type http://dome40.eu/semantics/dome4.0_core#data_
creator
```

In [29]:
```
vis(DS99)
```

In [30]:
```
q = """
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX domeES: <http://dome40.eu/semantics/dome4.0_core#>

    SELECT ?s ?p ?o ?oLabel
    WHERE {
        ?s ?p ?o .
        ?o rdfs:label ?oLabel .
        ?o rdfs:label "medical engineering" .
        }
"""
```

In [31]:
```
r=gc.query(q)
```

In [32]:
```
for i in r:
    print(i)
```

In [ ]:

In [ ]:

In [ ]: