

# Collaborative and cross-stakeholder ontology engineering

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# Motivation

## *The SC3 Ontology Platform*

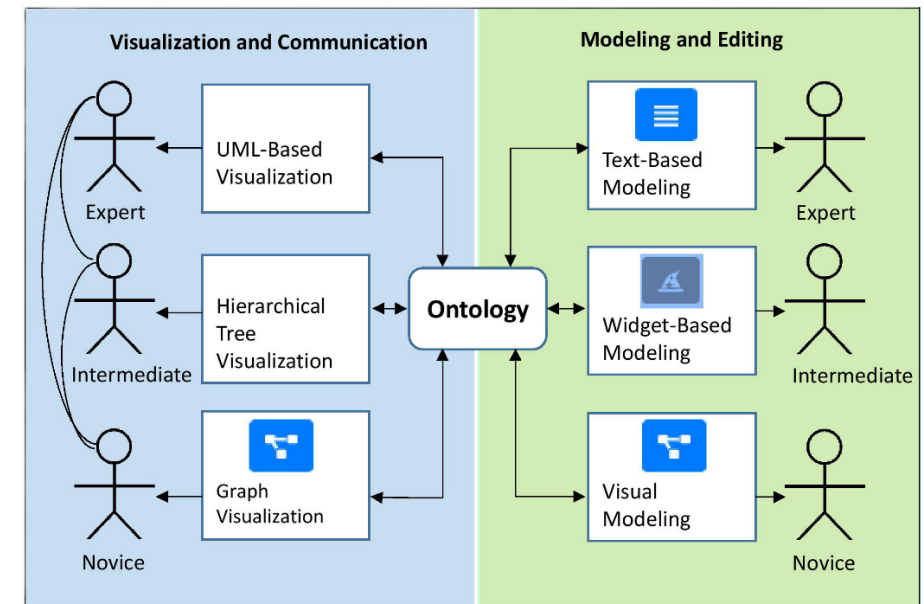
- **Semantically Connected Semiconductor Supply Chains (SC3)**
  - EC H2020, Coordination and Support Action (CSA)
  - Runtime: 01.10.2020 – 20.09.2023
- **Motivation: Semiconductor** production is a **complex industry**
  - E.g. supply chains are complicated by **short product cycles** and **strong dependencies** to further industries
  - Requires a stable generic **industrial reference communication platform**
- **Objectives:**
  - To support **collaboration of industrial and academic stakeholders** to encourage **interoperability** between semiconductor companies and further industrial domains, based on **Digital Reference (DR) Ontology**
  - To develop a framework to ensure an **agile development**, validation and refinement loop



# Motivation

## The SC3 Ontology Platform

- **Challenge**
  - An ontology is a joint work between **domain experts** and **knowledge engineers**
  - We need a tools to achieve a **common understanding** of the **domain** and its **formal representation**
    - Visualization of ontologies for different expert groups
- **Objective:** To understand the content of ontologies we need cross-stakeholder:
  - **Collaborative** ontology development platform
  - Ontology **visualization**.
- **Proficiency** levels considered: Novice, Intermediate, and Expert

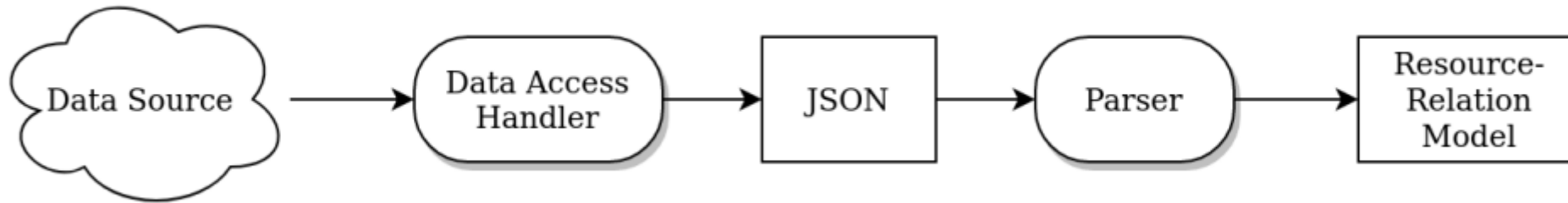


## *Pipeline Components ( @Vitalis Wiens)*

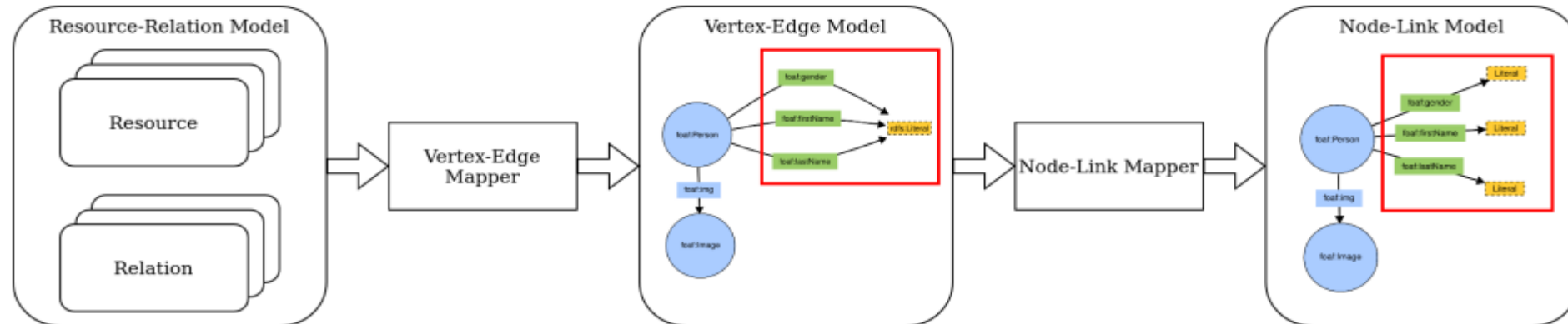
- **Data Processing Layer**
  - Pre-process data and convert to RRM
- **Resource Relation Model**
  - A data model which serves as a foundation for visualizations and synchronization between different modes of operation
  - It is a textual representation of the ontology
  - Created through pre-processing step
  - provides some re-organization of triple statements to enable different modes of operation
- **Vertex Edge Model**
  - Designed to reflect a basic graph structure using vertices and edges.
  - Vertices are derived from resources
  - Edges are derived from relations and provides source and target attributes for the connection between vertices
- **Node Link Model**
  - Modify the Graph Structure for Visualization . Merge, split and nesting mappings
  - Nodes have an id, a type, and a name.
  - Links have a source and a target node additionally to form the connections

# Mapping Pipeline

Pipeline ( @Vitalis Wiens)

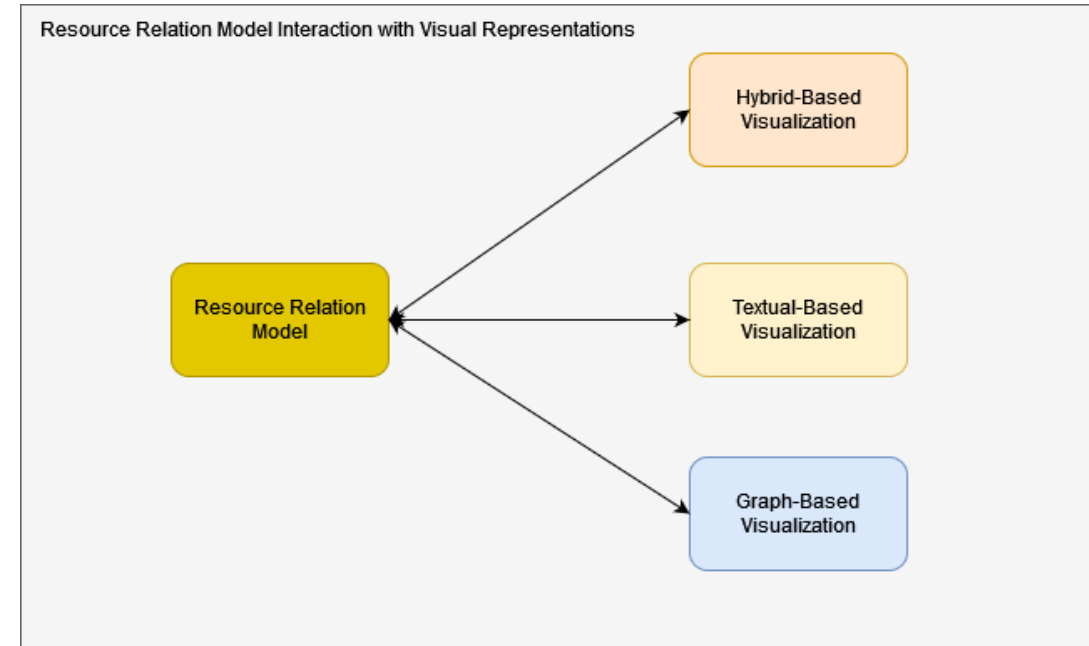
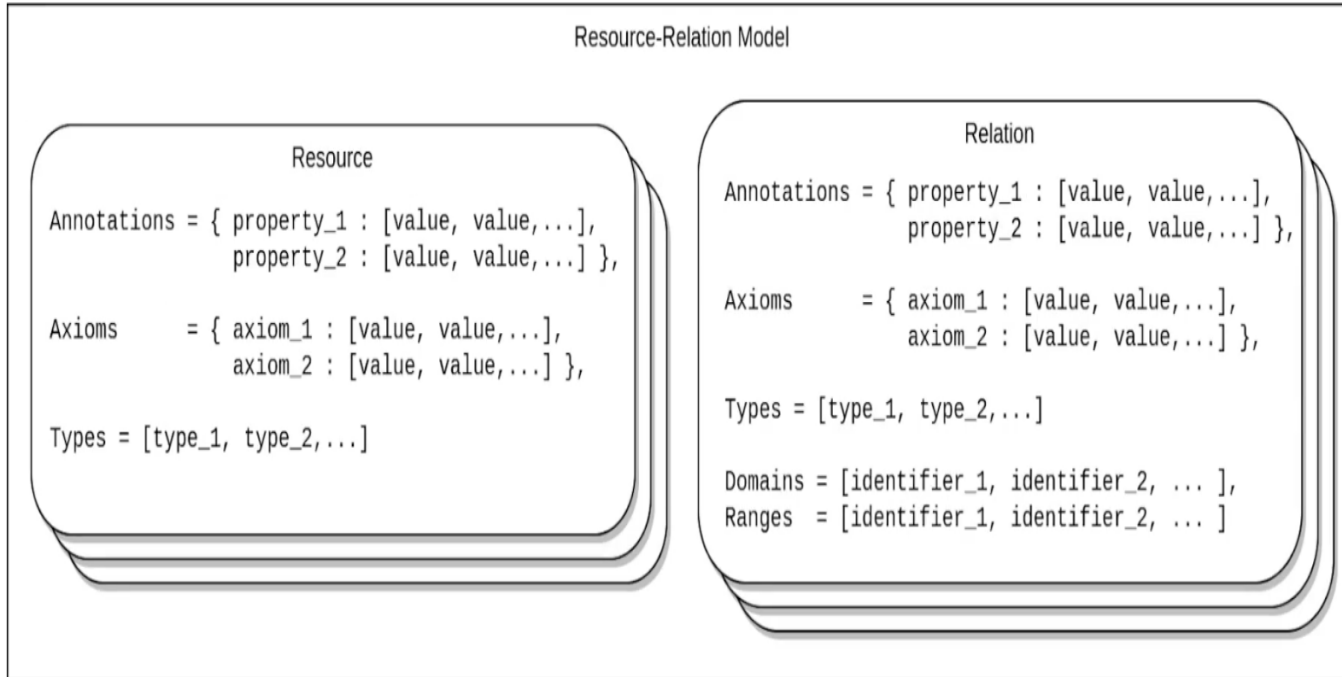


Data Processing Layer



Two-fold mappings from RRM to Node-Link Model

# Resource Relation Model



RRM model and its interaction with other views in SC3 Ontology Platform

# SC3 Platform evaluation (approach)

- *“Usability Evaluation focuses on how well users can learn and use a product to achieve their goals.”*
- **Pre-test survey** as preparation for extensive evaluation (usability + mental workload)
- **Applied methodologies**
  - Usability evaluation
    - **The System Usability Scale (SUS)**. Easy to scale, useful with small response sizes
    - 10 item questionnaire
    - **Scale:** strongly agree to strongly disagree
  - Subjective mental workload assessment
    - **NASA Task Load Index (NASA-TLX)**
    - *“a subjective workload assessment tool which allows users to perform subjective workload assessments”* [2]
    - **determine the MWL** of a participant while they are performing a task
    - **rates performance across six dimensions to determine an overall workload rating**

[1] <https://www.usability.gov/what-and-why/usability-evaluation.html#:~:text=Usability%20Evaluation%20focuses%20on%20how,related%20to%20a%20new%20site.>

[2] <https://humansystems.arc.nasa.gov/groups/tlx/>



# SC3 Platform evaluation (approach)

## The System Usability Scale (SUS)

- Consists of 6 sections
  1. About you
  2. Experience with SC3 platform
  3. Task Load
  4. About the SC3 platform approach
  5. Additional Feedback
  6. General
- radio button selections
- rating scales from 1 - 5
- Freetext fields

7 Persons took part in the pre survey

I found that various functions of the SC3 platform were well integrated \*

1      2      3      4      5

Strongly disagree                        Strongly agree

# SC3 Platform evaluation results

## The System Usability Scale (SUS) results

Participant	SUS raw score	SUS final score
1	27	67.5
2	28	70
3	26	65
4	31	77.5
5	31	77.5
6	21	52.5
7	27	67.5
<b>Average:</b>	27.29	68.21
<b>Users experience with SC3 platform</b>		

Average of all **SUS final scores** is equivalent to **68.21** that is marked as C grade (65.0 – 71.0)

1. **Users experience** with SC3 Ontology Platform
2. between **OK (51.7 – 62.6) GOOD (71.1 – 72.5)**.

Only three participants have experience with using SC3 Ontology Platform which is between C+ (good) and A (excellent)

# SC3 Platform evaluation results

The System Usability Scale (SUS) results

SC3 Ontology Platform functionalities / performances	Percentage of participants that agree and strongly agree
User interface is easily understandable	85.7
Hybrid mode for ontology modelling	71.5
The dropdown buttons in Hybrid mode	71.5
Easy to find the search/filter functionality valuable	85.7
Easy to interact with the graph based visualization	71.5
The interaction with the graph is clear	71.4
Easy to navigate between different views	71.5
Performance of the platform is fast in terms of ontology editing	71.4
The role of collapsible sidebars is clear	100%
Participants' opinion about SC3 Ontology Platform functionalities	

- Second column summarizes percentages of agreed and strongly agreed scores about **listed functionalities** in the first column.
- In total more than **71 percent** of participants agreed or strongly agreed on selected functionalities.
- **Critical points** in SC3 Ontology Platform functionalities which participants observed are **interaction** with graph and how the platform is **fast** in terms of ontology editing, that is in total 71.4 percent of votes.



# SC3 Platform evaluation results



## NASA Task Load Index (NASA-TLX) results

- amount of effort participants took to upload, visualize and modify ontology.
- **High (34.29) mental activities** is required for all users to **upload, modify and visualize** ontology when using the SC3.

Temporal results: **time pressure** that participants felt during the work with the SC3 is also **high (54.29)**

All participants **require high (41.43) amount of effort** to achieve requested level of performance when using the SC3

On individual basis, all participants, except one, needs high mental, temporal activities when using the SC3

Participant/ NASA-TLX subclasses	Mental	Physical	Temporal	Performance	Effort	Frustration	Individual score results
							Raw/Unweighted (Mean*)
1	40	-	80	90	30	10	50
2	20	-	10	100	10	10	30
3	30	-	50	80	80	100	68
4	50	-	50	50	50	50	50
5	20	-	80	100	30	20	50
6	20	-	50	50	50	80	50
7	60	-	60	70	40	40	54
<b>Group score results</b>	34.29	-	54.29	77.14	41.43	44.29	Overall: 50.29
<b>Raw/Unweighted (Mean*)</b>							

# SC3 Platform Components

## Collaboration

- **Projects List View:** Add/Delete/Edit Project, Access type
- **Ontologies List View:** Upload from Github/File system, Delete, View

**Visualization:** Hybrid, Graph, Text

**Editing:** Web protégée integration

**Documentation:** future release (widico integration)

**Roles:** Public User, Key User, Member, Project Admin, System Admin

**Projects:** Public Projects, Private Projects

The screenshot shows a web interface titled "Select Project". At the top left, there is a hamburger menu icon and a lock icon. At the top right, there is a "Sign in" button. Below the title, there is an "Add New Project" button. A list of projects follows, each with a dropdown arrow, a name, and icons for lock, edit, and delete. The projects listed are: Default, Thesis\_TTM, ListDB Onto, DIGIT RUBBER, NFDI4Ing - Nationale Forschungsdateninfrastruktur für das Ingenieurwesen, CoyPu - Cognitive Economy Intelligence Plattform für die Resilienz wirtschaftlicher Ökosysteme, SC3 - Semantically Connected Semiconductor Supply Chains (highlighted with a red box), and Sandbox. Each project has a brief description below its name.

Select Project mode



# Collaboration



**Roles:** Public User, Key User, Member, Project Admin, System Admin

**Projects:** Public Projects, Private Projects



## Select Ontology

File System [GitHub](#) Upload Ontology

Advanced Example Ontology.	
Advanced Example Ontology. Holding multiple sub ontologies	
Digital Reference	
DIGITAL REFERENCE TEST	
EXAMPLE	
EXAMPLE	

Select Ontology mode

# Visualisations

Hybrid Mode Visualization

```

@prefix dc: <http://purl.org/dc/elements/1.1/> .
@prefix exc: <http://example.com/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@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 vs: <http://www.w3.org/2003/06/sw-vocab-status/ns#> .
@prefix wot: <http://xmlns.com/wot/0.1/> .
@prefix xml: <http://www.w3.org/XML/1998/namespace> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .

#####
# Ontology
#####
<http://example.com/> rdf:type owl:Ontology ;
    dc:description "Advanced Example Ontology. Holding multiple sub ontologies ." .

#####
# Classes
#####

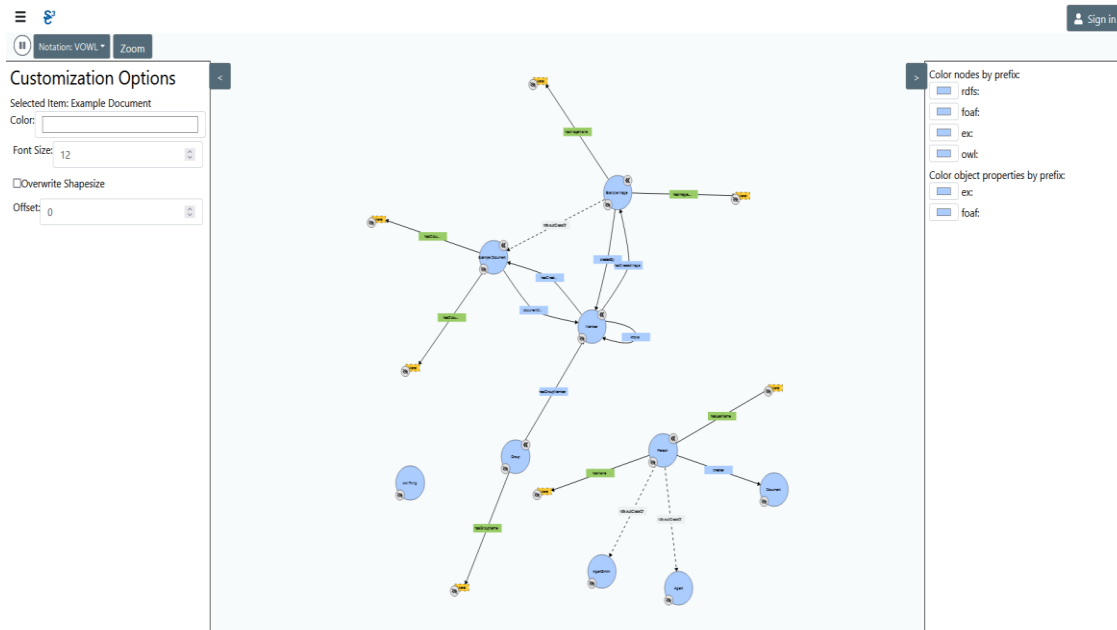
### http://xmlns.com/foaf/0.1/Agent
foaf:Agent rdf:type owl:Class .

### http://example.com/Image
exc:Image rdf:type owl:Class ;
    rdfs:label "Example Image" ;
    rdfs:subClassOf exc:Document .
    
```

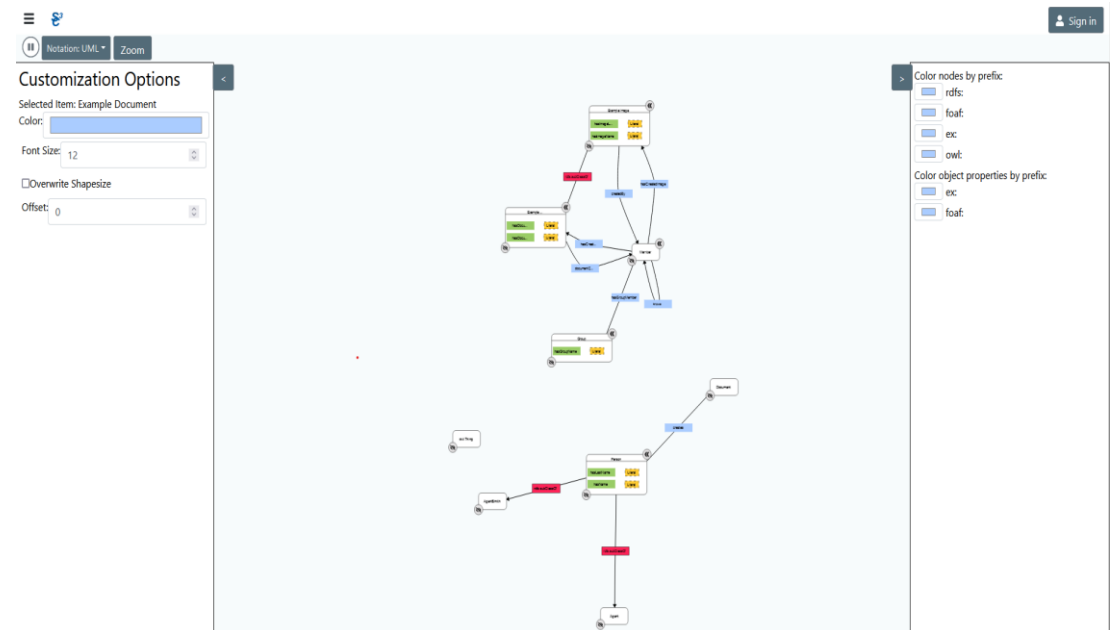
Textual-Based Visualization



# Visualisations



Graph-based Visualization with VOWL Notation



Graph-Based Visualization with UML Notation

# Visualisations

Expand all resources/relations

Home

Management & Visualization

Projects

Ontologies

Graph

Hybrid

Text

Editing & Documentation

WebProtege

Documentation

FAQ

General & About

Data Policy

Imprint

Resources

Relations

Filter... Search...

Filter... Search...

Agent

foaf:Agent rdf:type owl:Class .

Image

ex:Image rdf:type owl:Class ;

Document

ex:Document rdf:type owl:Class ;

Document

foaf:Document rdf:type owl:Class .

Member

ex:Member rdf:type owl:Class ;

Group

ex:Group rdf:type owl:Class ;

AgentSmith

foaf:AgentSmith rdf:type owl:Class .

Person

foaf:Person rdf:type owl:Class ;

Thing

owl:Thing rdf:type owl:Class .

imagLocation

ex:imagLocation rdf:type owl:DatatypeProperty ;

documentName

ex:documentName rdf:type owl:DatatypeProperty ;

imageName

ex:imageName rdf:type owl:DatatypeProperty ;

groupName

ex:groupName rdf:type owl:DatatypeProperty ;

lastName

foaf:lastName rdf:type owl:DatatypeProperty ;

documentLocation

ex:documentLocation rdf:type owl:DatatypeProperty ;

name

foaf:name rdf:type owl:DatatypeProperty ;

documentCreatedBy

ex:documentCreatedBy rdf:type owl:ObjectProperty ;

creates

foaf:creates rdf:type owl:ObjectProperty ;

knows

Metadata

Project Name: Default

Ontology Name: Advanced Example Ontology.

Github

- URL: <https://raw.githubusercontent.com/tgfawad/Ontologies/main/advanceExample.ttl>
- Version: main

Meta Information

description: Advanced Example Ontology. Holding multiple sub ontologies @en

iri: <http://example.com/>

title: Advanced Example Ontology. @en

version: Version 0.1

Ontology Prefixes

Ontology Comparison

Please choose two commits to compare

Select 1st Commit

2022-09-20T11:28:25Z

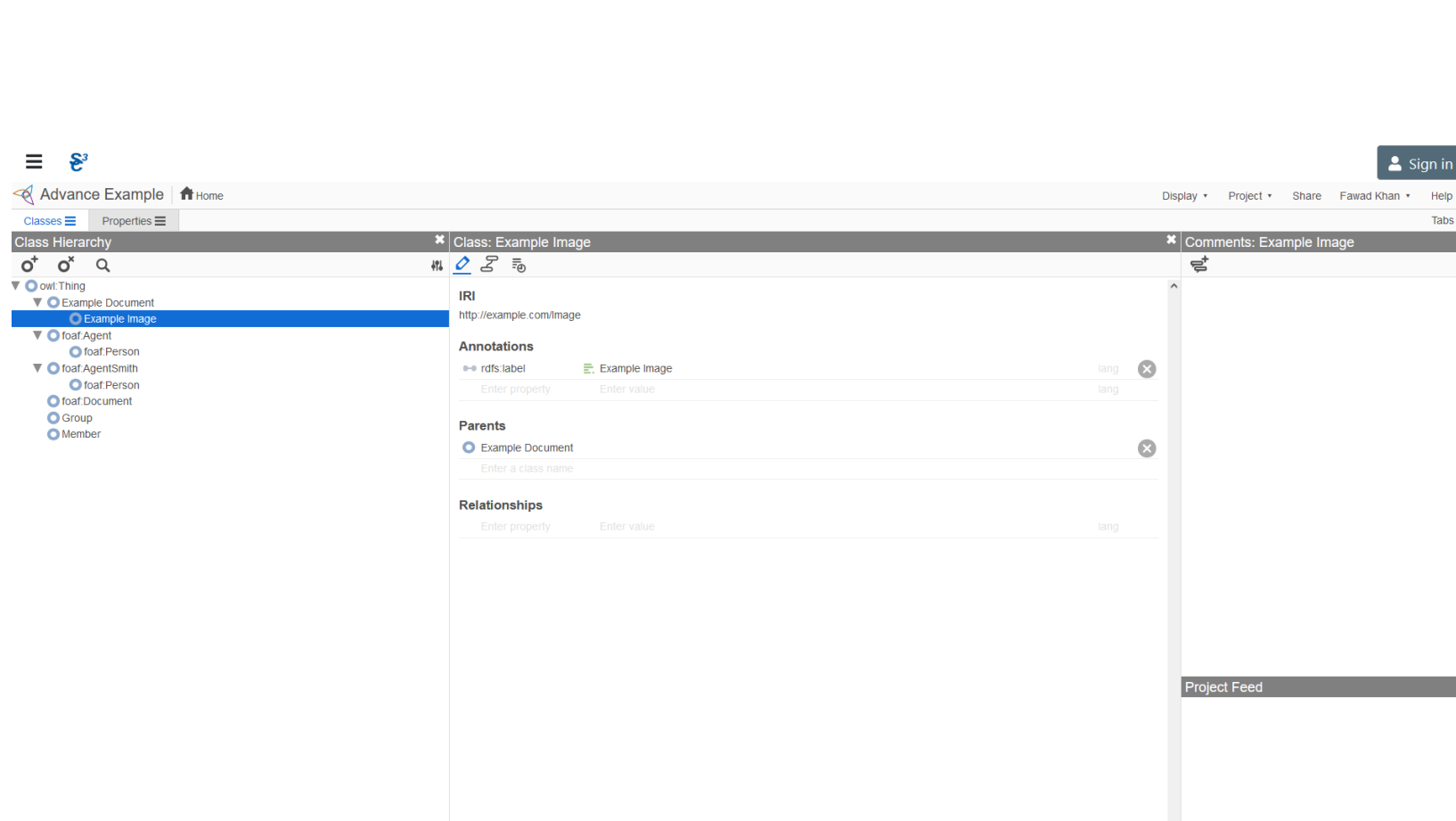
Select 2nd Commit

2021-12-20T11:24:43Z

Show Comparison

Navigation left sidebar & Metadata right sidebar

# Editing (Webprotege integration)



The screenshot displays the WebProtege web interface integrated into the SC3 environment. The interface is divided into several panes:

- Class Hierarchy:** A tree view on the left showing the ontology structure. The 'Example Image' class is selected under 'Example Document'.
- Class: Example Image:** The main editor pane showing the class's IRI (`http://example.com/Image`) and various properties for editing:
  - Annotations:** A table with columns for property, value, and language. One annotation is shown: `rdfs:label` with value `Example Image` and language `lang`.
  - Parents:** A list of parent classes, currently showing `Example Document`.
  - Relationships:** A section for defining relationships between classes.
- Comments: Example Image:** A pane on the right for adding or editing comments for the selected class.
- Project Feed:** A small pane at the bottom right for project updates.

WebProtege within SC3

**Thank you for your attention!**

**Questions!**

**<https://service.tib.eu/sc3/>**