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ONTO-DESIDE

DELIVERABLE

FAIR integrated ontology network - v.3

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PROJECT INFORMATION

Project summary

Circular economy aims at reducing value loss and avoiding waste, by circulating materials or product parts before they become waste. Today, lack of support for sharing data in a secure, quality assured, and automated way is one of the main obstacles that industry actors point to when creating new circular value networks. Together with using different terminologies and not having explicit definitions of the concepts that appear in data, this makes it very difficult to create new ecosystems of actors in Europe today. This project will address the core challenges of making decentralized data and information understandable and usable for humans as well as machines. The project will leverage open standards for semantic data interoperability in establishing a shared vocabulary (ontology network) for data documentation, as well as a decentralized digital platform that enables collaboration in a secure and privacy-preserving manner.

The project addresses several open research problems, including the development of ontologies that need to model a wide range of different materials and products, not only providing vertical interoperability but also horizontal interoperability, for cross-industry value networks. As well as transdisciplinary research on methods to find, analyze and assess new circular value chain configurations opened by considering resource, information, value and energy flows as an integral part of the same complex system. Three industry use cases, from radically different industry domains, act as drivers for the research and development activities, as well as test beds and demonstrators for the cross-industry applicability of the results. The developed solutions will allow for automation of planning, management, and execution of circular value networks, at a European scale, and beyond. The project thereby supports acceleration of the digital and green transitions, automating the discovery and formation of new collaborations in the circular economy.

Project start date and duration

1st of June 2022, 36 months

Project consortium

No	Partner	Abbreviation	Country
1	Linköping University	LIU	Sweden
2	Interuniversitair Micro-Electronica Centrum	IMEC	Belgium
3	Concular Ug Haftungsbeschrankt	CON	Germany
4	+Impakt Luxembourg Sarl	POS	Luxembourg
5	Circularise Bv	CIRC	The Netherlands
6	Universitaet Hamburg	UHAM	Germany
7	Circular.Fashion Ug (Haftungsbeschrankt)	FAS	Germany
8	Lindner Group Kg	LIN	Germany
9	Ragn-Sells Recycling Ab	RS	Sweden
10	Texon Italia Srl	TEXON	Italy
11	Rare Earths Industry Association	REIA	Belgium
12	Prague University of Economics and Business	VSE	Czech Republic

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Contents

Abbreviations

Abbreviation	Explanation
CE	Circular Economy
CVN	Circular Value Network
Dx.x	Deliverable x.x
EMMO	Elementary Multiperspective Material Ontology
FAIR	Findability, Accessibility, Interoperability, and Reusability
ODP	Ontology Design Pattern
OGC	Open Geospatial Consortium
OWL	Web Ontology Language
URI	Uniform Resource Identifier
WP	Work Package
W3C	World Wide Web Consortium
XD	eXtreme Design Methodology

Summary

This deliverable describes the third prototype of the Onto-DESIDE ontology network, earlier introduced and motivated in D3.1 and D3.2, then first released in D3.3 with an updated version released in D3.4. The deliverable itself is the online ontology network[1], however, this short report summarises the main content, and contains the documentation of the respective files of the network (release v0.3.0, for any updated modules - note that this release number is different from the version numbers of the individual modules) in the appendix, for archival and review purposes.

The ontology network prototype consists of 13 ontology modules, i.e. small ontologies, that are connected through `owl:imports` or by referencing concepts from other modules. The work on preparing external alignments has been started, and in this release we include some initial alignments to provide an overview of the landscape and alignment opportunities, while curated reusable alignments will be included in the final release. For testing the core ontology network the modules have also been specialised to cover the domain-specific user stories of our three industry use cases, and evaluated with end-users and domain experts, which is the basis of some of the updates in release v0.3.0.

[1] Available at https://w3id.org/CEON/

1 Introduction

Ontologies are a key enabler for semantic interoperability since they can provide formal definitions of concepts and their relations, for describing the data to be exchanged. The Onto-DESIDE project develops a technology for allowing data sharing about materials, components, and products, as well as actors, capabilities and processes, as part of circular value networks (CVNs), at a global scale and across industry domains. Metadata and structures for transforming data into information (semantic descriptions, vocabularies) will be open, and comply with FAIR principles (Findability, Accessibility, Interoperability, and Reusability), to enable the highest possible degree of semantic interoperability and automation in data sharing.

This document describes the ontology deliverable D3.5 (deliverable type OTHER, third version of D3.3), which is published publicly on GitHub[2], and that provides the foundations of the necessary core ontologies to enable semantic interoperability. This document describes the third version of the deliverable, presenting the third prototype versions of the ontologies, that will be updated in a final release and then evaluated and tested in the evaluation phase of the third project iteration. This concretely means that the deliverable reports ongoing work in our third and final project iteration, and that both ontology requirements and ontology modules themselves still are to be considered as preliminary, since they are not fully validated by end-users and domain experts yet, and not fully aligned with standards and external ontologies. The focus is also primarily on the core modules, i.e. general cross-domain concepts, rather than on concrete concepts for our industry use cases. The latter is developed in the context of WP6, but are to be seen only as test cases for verifying the usability and applicability of the ontology network.

2 Ontology Network

The main content of this deliverable is the ontology network itself, but here we give a brief textual overview of the outline and content of the network.

2.1 Methodology

As presented in D3.1 and 3.2, we rely on an agile ontology development methodology, inspired by eXtreme Design (XD) [1]. This methodology supports an agile work process, suitable for the three iterations of the project, where requirements and solutions evolve and emerge incrementally. The basis of the ontology development, is a set of stories, exemplifying and detailing the intended use of the ontologies. These are then transformed into ontology requirements, e.g. Competency Questions (CQs) [7] and other requirements, and thereafter formally represented in an ontology language, in our case OWL[3]. This methodology emphasizes highly modular ontologies, i.e. both for separation of concerns but also as a way to allow for modelling certain aspects without having the full picture of the requirements at hand, which is the case in our project. Further, the notion of Ontology Design Patterns (ODP) [2, 5] is used to here denote small, highly generic, ontology modules, that will be reusable across all industry domains, and which constitute the shared core design decisions of the ontology network. For further methodological details, and the full list of requirements, see D3.1 and 3.2.

2.2 Outline of the Ontology Network

The requirements analysis presented in D3.1 resulted in a quite extensive set of ontological requirements, i.e. 55 ontology stories resulting from the analysis of D2.1 (and D6.1) and 17 stories resulting from the analysis of the circular value network (CVN) concept itself and its definitions in standards and usage in D6.1 and D2.1. Many of them are use case-specific, in terms of involving specific concepts of an industry domain. Still, many of them

[2]With the permanent URI https://w3id.org/CEON/
[3]https://www.w3.org/OWL/

can also be generalised, and we note that there are many parallels between the three project use cases. Consider that these requirements were preliminary, and have now been updated and consolidated in D2.3. However, explicit references to the updated set of requirements have not been included in this release, but will be part of the final release in D3.6.

In the first and second project iteration we focused on identifying the core topics that need to be covered by ontology modules, using the set of initial requirements, and updating the models based on initial feedback from the use cases. In the third iteration, we have focused on extending the coverage, and aligning to standards and existing ontologies. An overview of the included topics (refined version of the initial image in D3.1 and included in D3.4), in the form of an informal conceptual model is displayed in Figure 1. Note that the boxes do not represent single concepts in an ontology, but rather areas, i.e. topics, that should be covered by some ontology module. The blue boxes and ovals represent the 13 modules that are included in this release (i.e. D3.5), in some form. This is an increase from the 9 previous modules in D3.4. The three boxes at the bottom represent cross-cutting notions that are used in many of the other modules. The lines between the boxes represent some common sense relations between the topics, and are in the actual implementation of the ontology network replaced by formal relations between modules, e.g. in some cases `owl:imports`, as well as some other alignments, reuse of concepts between modules, or specific object properties connecting concepts inside the modules.

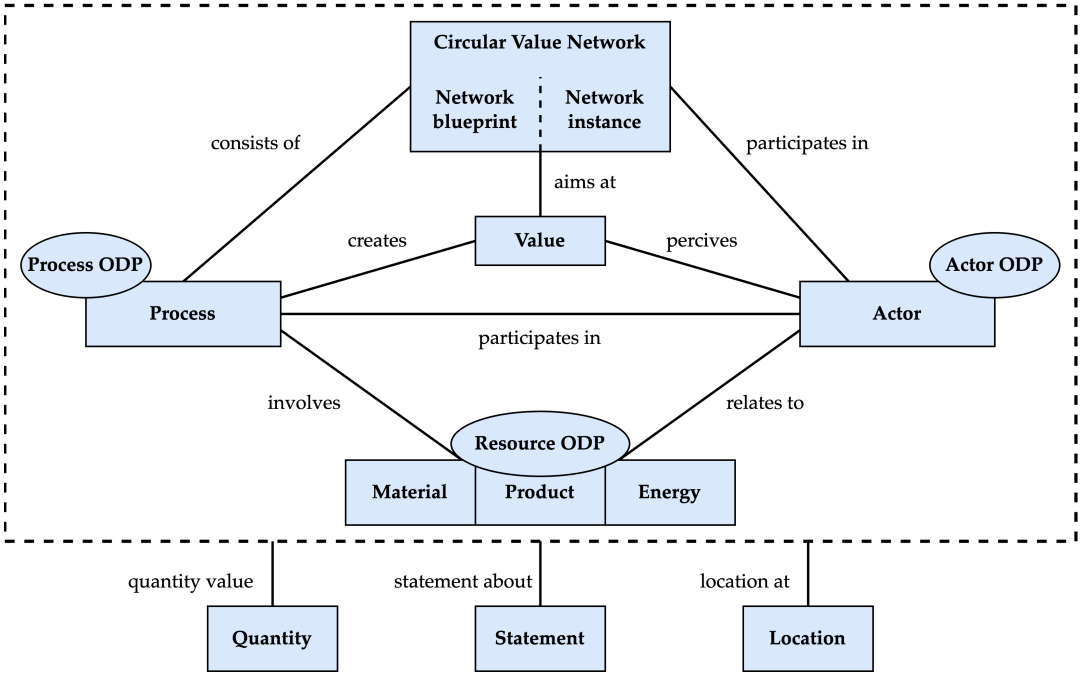

Figure 1: Informal illustration of the core topics of the ontology network.

2.3 Core Cross-Domain Topics

In this section we provide a brief description of the set of core modules, 9 of which were already identified for D3.3 and D3.4 while 4 are new for D3.5, that have been created, as generic reusable ontology building blocks, as illustrated in Figure 1. The actual modules can be found in our GitHub repository[4] and in the appendix of this document. The topics that underlie the modules, include:

- Circular Value Network
- Value

[4] https://github.com/LiUSemWeb/CEON/tree/main

- Actor
- Process
- Resource
- Quantity
- Statement
- Location

2.3.1 Circular Value Network

This topic is in the current version of the network represented by one module, which details the core concept of the ontology network, i.e. the Circular Value Network (CVN) itself. The value network works according to a blueprint, which describes the planned setup. A planned setup usually (1): specifies how resources are transformed or operated by actors of certain types, (2): follows or targets certain types of circular strategies (e.g. refurbishment of a product) and (3): relates to typical value propositions and goals.However, we also want to be able to model the concrete instance of the blueprint, i.e. an actual value network where the roles are filled by various actors of the appropriate types, with a specific goal, and specific value proposition (and value created) in mind.

Our starting point for this module was an analysis of several terminologies, ontologies, and emerging standards, cf. D3.1, including the emerging standards in ISO 59004, the Circularity Thinking methodology, as well as a generalisation over the project use cases and requirements in D6.1-3 and D2.1-3. The CVN module refers to concepts both in the actor, process and resources modules, since a CVN is something that connects actors and resources through processes. The terminology of the value network concept is aligned with the ISO 59004:2024 term glossary (3.5.3 value network).

2.3.2 Value

Although value is a very central concept in the Circular Economy (CE), and closely related to the circular value network through its value proposition, value is also a very hard concept to define and capture in data.

Following the discussions on the value concept that is currently ongoing in other fora, e.g. standardisation bodies and our work in WP5, we model the basic concepts and relationships to represent values, value propositions, value perceptions, etc. In addition, we model the connections between value module and CVN value basically through defining that specific CVNs or their blueprints can aim at specific values therefore stating some value propositions. Additionally, we capture the fact that value is contextual, e.g. that a resource has some value in relation to a specific actor, or in a specific context. The terminology of the value module is aligned with the ISO 59004:2024 term glossary (3.1.7 value).

2.3.3 Actor

A circular value network is in essence composed of a set of actors filling certain roles in different phases of the network's flows, and in relation to certain resources. Hence, the actors are the ones that actually realise the value network, and perform the work to transform materials, components, and products in the various steps in the value network phases. Similar to the value network itself, also actors can be modelled at two levels, i.e. as actor types that can fill certain typical roles in a network, such as a "recycler" or "manufacturer", and the concrete actors, that are usually organisations, that take on those roles in a specific network instantiation. Actors are also related to their capabilities and competencies, which determines if they are able to fulfil a certain role in a network or not. Further, actors take on various roles in relation to resources, e.g. holding certain resources, owning them, selling them, buying them etc.

The modelling of this topic is done at two levels in the ontology network, i.e. one actor ODP, which holds the most general concepts that are essentially independent of any industry domain or circular strategy, and an actor module that specialises that ODP and includes CVN-specific concepts, as well as specific roles in relation to circular strategies. These modules refer to concepts in the process and resource ODPs. The terminology of the actor module is aligned with the ISO 59004:2024 term glossary (3.4.1 organization, 3.4.2 interested party, stakeholder).

2.3.4 Process

Each circular value network realises one or more circular value flows, which can be seen as a process of transforming some resource, e.g. from materials, to components, into products, and then potentially back again. Such processes have different phases, e.g. the phase that takes something from materials to components, or the phase of deconstructing a product into its material composition, and each phase can further be subdivided into smaller steps (pieces of work), which can be performed by different actors. However, at this point we chose to simply model all this at the level of executions and sub-executions. This is done by specialising a process can transform some situation into another situation, such as changing the state of affairs (situations of actors or resources). Then each situation is supposed to satisfy a plan which has a plan execution. Each step may then also have inputs and outputs, with respect to the situation of its corresponding process, both in terms of resources, but also work, energy, and information, for instance, and may result in some waste, i.e. transforming something for a certain state of affairs (situation) to another state of affairs (situation). Steps can be performed by actors, i.e. participants in the value network, with the right capabilities. For these aspects, many existing ontologies exist, and the module(s) for this topic will mainly act as a bridge, for in the future aligning to such existing models for allowing their integration into the network.

The current realisation of this topic consists of one process ODP, specifying the generic concepts involved in process modelling, and a process module as a specialisation of that, for including the CVN-specific processes that are targeted in the project. The process modules refer to concepts in the actor and resource ODPs.

2.3.5 Resource

Resources are at the core of the circular economy, since they constitute the physical flows that are circulated, and the things which are needed as input and output of each process. Most prominently the resources are the materials, components, and products that the network aims to manage circularly, but resources can also include the additional materials needed for processing, such as consumables or catalysts, and energy needed in different processes. We introduced the energy module in the latest release to satisfy the requirements related to energy that emerged in the latest version of the project requirements (D2.3).

This part of the network is realised through a generic resource ODP, which is then specialised into three modules, i.e. one modelling materials, one modelling products and components and one modelling energies. The materials module is modelled in the same style as the EMMO core ontology for materials modelling, although at the moment we do not provide alignments as a module in our network (this will be included in the final release, but see also Section 5 of this report concerning the current alignment results). The terminology of the resource ODP and the product module is aligned with the ISO 59004:2024 term glossary (3.1.5 resource, 3.2.1 solution, 3.2.2 product).

2.3.6 Quantity

A cross cutting notion when sharing data in the circular economy is to be able to represent actual quantities, e.g. quantities of materials or products, but also quantities of energy use, or quantification of value aspects. To represent such more detailed quantity information of resources or processes, we modeled the quantity module which can be used to represent quantity values, for instance values that are associated with processes such as dismantling costs or transport costs. In detail, we reuse the QUDT [8] (Quantities, Units, Dimensions, and Types) ontology by specialising its quantity value concept and its related relationships.

2.3.7 Statement

From our requirements it is also clear that we need to be able to express facts about facts, i.e. metadata about the information shared in the circular value network. The most obvious case is to keep the traceability of what actor has made a certain claim, e.g. about a product or its components, or any resource in general. Thus we need to model the general concept of a statement. To further detail the kinds of statements required in the data we have modelled two more specific kinds of statements: Quantity and Participation. A quantity expresses a relation between some thing and a literal value, commonly with an associated unit of measure, e.g., the weight of a product in grams. The participation viewed as a statement is used to represent the role of an actor in relation to a resource, e.g. this could represent statements about who has issued a data sheet, or who is the manufacturer of the product the data sheet is about.

2.3.8 Location

Location appears in many places in the overall list of requirements (e.g. D3.1-D3.2). Resources are associated with a specific location at a given point in time, but they may also have an origin point and a traceable history of places they have been. Similarly for actors, information etc. Different use cases demand varying levels of granularity in location information. For example, a construction-related use case might require precise details, such as specifying that an object is on the second floor of a building. In contrast, a take-back system may necessitate exact coordinates for a crate of products awaiting pick-up. While in other cases location information such as the country of origin of a certain product or material may suffice. Hence, we need both a generic notion of location, but also a "pluggable" structure where more specific models can be added for specific use cases.

In this release, we propose a dedicated module for the relevant concepts and relationships of location. This module integrates existing standard ontologies (e.g. the OGC standard GeoSPARQL) and introduces new concepts and relationships relevant to our ontology network. Notably, the concept of “location at" in Figure 1 serves as a generic relationship linking diverse entities to the location concept.

3 FAIR Ontology Publishing

Once ontologies have been modelled, they also need to be shared with the community. In order to actually be useful, they need to be both findable, accessible, interpretable and interoperable with standards and other ontologies, as well as highly reusable. In general, this holds for all scientific results and artefacts, but perhaps specifically for ontologies, that are supposed to act as mediators and provide semantic interoperability in a domain. To guide and support the sharing of scientific results in general, and artefacts in particular, the FAIR principles were proposed [17]. The ontologies developed by the project are published according to the FAIR principles. However, recent analyses by several researchers and projects [14, 12, 3, 9] come to the conclusion that there are different ways to fulfil the FAIR principles, and it is not always clear exactly what is the best solution. Still, many of the principles are quite naturally fulfilled simply by the fact that we rely on Web technologies, e.g. the ontology language OWL which is based on Web standards, and use URIs as unique identifiers. In this section we therefore discuss what aspects are important to take into account, as well as outline some specific methodological practices for the project.

3.1 Ontology Design Guidelines

In order to allow for a good design and representation of our ontologies, we have set up a number of concrete design guidelines for the project. These include:

- URIs – Each ontology should have a unique and resolvable URI, using the stable URI namespace of the project. Ontology modules are collected under the sub-path `https://w3id.org/CEON/ontology/`.

- Versioning – Each ontology module has a version IRI that includes a version number, but the ontology URI always leads to the latest version.
- Naming conventions – Local names (in terms of URI suffixes) are created using the camel notation, where classes start with a capital letter, and properties with a lower case letter.
- Labels – Every entity in the ontology modules should have a label (using `rdfs:label`), at least in English.
- Documentation – The ontology modules themselves are documented using a set of annotation properties, e.g. `dc:creator` etc., and `rdfs:comment` is used to document all the elements inside the ontology (in terms of natural language definitions and explanations in English).

Changes to the ontologies are managed through issues and branching in the underlying GitHub repository where the ontologies are stored.

3.2 Publishing Pipeline

The development of the ontology network will entail multiple interdependent ontologies, several of which will go though multiple development iterations. In order to keep track of such changes, we are using a GitHub[5] repository to handle versioning and to create new releases. Proper ontology versioning ensures both consistency and predictability over time, since any reference to a specific version of the ontology will remain valid.

The w3id service is used to provide permanent identifiers for the ontologies, all of which are aligned with the ontology releases. This provides a way of decoupling the identifiers used from any specific domain name or publishing platform, thus providing resilience in the long term, and the identifiers can be redirected as needed. Additionally, the w3id service can be used to support some aspects of content negotiation, allowing the ontologies to be made available according to the requirements of the user (e.g. Turtle files when access by an application, human-readable documentation when accessed via a browser).

Documentation is an important aspect when it comes to making ontologies both accessible and understandable. However, creating such documentation can be both labor intensive and time-consuming. In order to streamline this process, the project leverages pyLODE[6] for generating web-friendly documentation directly from the ontology files, thus removing the need for manually creating such content. Additionally, we employ OWL2VOWL[7] and WebVOWL[8] to generate interactive visualizations, providing an easy to understand overview of each ontology. These tools are all available open-source under the MIT licence and are combined into a pipeline that allows ontology documentation to be generated automatically, ensuring that the documentation always remains up to date.

4 Ontology Evaluation Summary

In this section, we briefly summarise the findings from the ontology evaluation conducted during the project evaluation phase, and reported in D6.8. In addition, we comment on how the areas of improvement have been addressed, and what is left for future work, or in some cases deliberately left undefined for flexibility reasons.

4.1 Ontology Evaluation Method

First of all, applying an ontology in a concrete use case is often the best evaluation method, where both errors and misconceptions can be found, and the effectiveness of the ontology assessed. Hence the main evaluation of

[5] https://github.com/LiUSemWeb/CEON/
[6] https://github.com/RDFLib/pyLODE
[7] https://github.com/VisualDataWeb/OWL2VOWL
[8] https://github.com/VisualDataWeb/WebVOWL

the ontology network constitutes applying it in our project use cases, together with the data sharing platform, and gathering feedback and observations from there. When it comes to the ontologies, applying them in the use cases mainly involves modelling the concrete use case-specific data (e.g. from D6.4-5), being able to formulate appropriate queries on the data, supporting the user stories and other requirements. For this purpose, a set of use case-specific ontologies were built, i.e. one per use case[9], as test cases for ontology application. While building these ontologies in the first project iteration, a number of minor issues and missing concepts were identified in the core ontology modules, which were added to, or modified in, the core modules. In addition, a set of intermediate modules, mainly with reused concepts from other generic ontologies were also added to the network[10], to connect the highly generic core modules presented here, to use case specific concepts. In the second iteration, no further missing core concepts were identified when modelling the use case data, but the demonstrator ontologies, and the intermediate modules were extended to cover the more extensive evaluation scenarios (see D6.5).

More in detail, for the evaluation in the second iteration (as mentioned in D6.8), two additional dimensions were introduced to conduct the evaluation of our ontology network, which are (1): Coverage and suitability to describe the evaluation scenarios in the second project iteration; (2): Assessment of the suitability of specific concepts and modelling solutions in release v0.2.0, from the perspective of domain experts. For the first dimension, ontology engineers noted missing, ambiguous, incompatible or insufficient elements in the ontologies when using them to create data mappings for the use case scenarios. Identified issues were documented via the GitHub issue tracking system. For the second dimension, online meetings were organized including ontology engineers (from WP3 and WP4) and domain experts from the three use cases in which PowerPoint slides and ontology sketches were used for illustrating modelling solutions. In these meetings specific notions were discussed in-depth, such as the distinction between a product, batch and item, which could then be introduced with appropriate terminology and restrictions in the ontology.

After testing the ability to specialise the ontologies for the use case data and requirements, we also conducted a more technical evaluation, including requirements validation and verification. As described in D6.8, ontology characteristics and consistency was assessed using Protégé, reasoner plugins (such as the HermiT reasoner), and manual inspection of inferred axioms. The purpose was to identify inconsistencies in the ontologies, and to provide input for updates to the ontology.

Next, the OOPS! [15] and FOOPS! [6] validators were used to detect potential violations of best practices in ontology modelling and publishing. The generated reports provided feedback on a range of design aspects. In some scenarios, however, a conscious design decision can lead to an error or warning being reported, such as when the domain or range of a property is deliberately left undefined, or when inverse relations and disjointess is deliberately left out in order to increase flexibility and reduce computational complexity of reasoning. Hence, the results from these validators are to be used mainly as guidance, rather than as an absolute list of issues to correct.

Another (non-user focused) evaluation was the verification of ontological requirements using SPARQL queries. That is, formulating the CQs presented in D3.2 (which are updates of those in D3.1) related to each ontology module as a SPARQL query using the ontology vocabulary. When the modules were developed a set of CQs were intended to be covered by each one, and they were included as annotations into the module itself. During the first evaluation, we tested each module by trying to formulate a SPARQL query for each of the CQs claimed to be covered by the modules. In the second iteration we tested the full set of CQs from D3.2. We also document what CQs are (partially or fully) covered in each module by using the annotation property `odp:coverRequirements`.

4.2 Ontology Evaluation Results

Here we briefly summarise the evaluation results, both some general observations from building the use case specific ontologies and the technical and user-based evaluations already presented in detail in D6.8, to remind the reader of the starting point of the work on this new version of the ontology network.

[9] See the table at the bottom of the CEON landing page at w3id.org/CEON/

[10] See the middle table on the CEON landing page at w3id.org/CEON/, named “Other modules”.

When specialising the ontology network to represent the concrete data outlined in D6.4, i.e. in the first project iteration, a few notions were identified that were missing (or modeled without sufficient details) in the first release. Also in the second release of the core ontology modules a few notions were not considered sufficiently modelled. Such notions include energy, value and locations. Therefore, we include new modules in the core ontology network, or extend previous ones, since these three topics are generic. Moreover, we refactor the provenance module (not part of the core network) to include a statement module in the core network. This update is due to the fact that representing statements as facts about products, components of products or any resource is generic for different industry domains. Still, the full provenance module is not warranted by our requirements, hence, the extraction of a small subset instead.

Regarding the technical evaluation, no inconsistencies nor unexpected inferences were detected when applying reasoners to the ontology modules and going through the list of inferred axioms manually. While this does not necessarily imply that there are no semantic defects in the ontology, at least they are formally correct. Hence, there were no issues from this evaluation that had to be addressed in the ontologies. The reports generated by the OOPS! validator categorizes problems as minor, important, or critical. The reports generated by FOOPS! on the other hand provide a summary of the proportion of tests passed, and lists detected errors. In the evaluation reports, all of the findings from these tools were included, regardless of whether they should be interpreted as errors or merely as observations that may need careful consideration. The reports were summarized in D6.8 but then also included in a set of GitHub issues related to the specific ontology modules in our repository. In this way, the evaluation results were used as a checklist for the ontology updates, while not all of them would be addressed in the end, since some issues are also triggered based on things that are conscious design choices. Still, quite a few issues were detected, although a lot fewer than in the first iteration, and in the next section we report on how these types of issues have been addressed.

Regarding the testing of ontology modules with SPARQL queries, a set of only partially covered CQs were detected. Mostly this is due to that the generic ODPs and core modules were annotated to solve CQs that were expressed in a more concrete way, so that the module actually did not include the specific concepts mentioned in the CQ, but where one could infer through common sense that probably those would be possible subclasses of the included concepts. For instance, such a case could be a CQ mentioning the “product” concept, while the resourceODP only includes the notion of a resource, not the concrete notion of a product, while it can be assumed that a product could be considered to be a resource. In this way we exposed an ambiguity in what is actually meant with addressing a CQ, i.e. whether the concrete terms in the CQ have to be present in the ontology module or not, for considering it to be covered. Another common reason for partial coverage was the modularisation of the ontology network, where in several cases concepts are defined in different modules, and hence a CQ that mentions one concept from one module and a second one from another module, would not be considered completely covered by either module, but using the ontology network as a whole the CQ is addressed. This raises the need for also performing integration testing, and potentially even providing an integration module for using (and testing) all modules together, which was not done in the first project iteration. In the second iteration the CQ validation was therefore done in a slightly different way, where all modules were considered together, avoiding having to connect a CQ to one module alone.

4.3 Main Changes Implemented

Here we provide a summary of the issues that have been addressed as part of the most recent version of the ontology modules (2024-12-18). We conclude the section with a brief overview of the issues that have not been addressed in the current version. A GitHub issue[11] is used to document and keep track of all the issues and their updates. These issues can be classified into two groups which are modelling issues identified through the development, where such issues needed to be further discussed among our ontology engineers and/or domain experts; and issues identified in the second evaluation including CQ verification and OOPS! and FOOPS! testing, for instance. In more detail, we have the first group of issues (which we have addressed in this release) such as adding (detailed) modules for the topics of energies and values, and moving general and common modules from the “other modules” category used for the use case demonstrations, to the core network, e.g. the statement module. Then we have the second group of

[11] https://github.com/LiUSemWeb/CEON/issues/287

issues, especially for competency question verification to see what questions can be covered, either partially or fully. While the coverage has been slightly extended, the focus has been more on correcting terminology and usability of the ontologies, e.g. by aligning them to the ISO 59004:2024 terminology.

Moving to the technical evaluation of the core ontology network. In Table 1 we summarise the reported errors from OOPS! and FOOPS! and describe how they have been addressed. Since the ontologies are still under development some of the issues cannot yet be addressed (e.g. registering the ontologies in various online catalogues will be done when a first stable version is released at the end of the project).

Table 1: Summary of errors reported by the OOPS! and FOOPS! validators and how they have been addressed.

Reported issue	**Comment**
Prefix not found in prefix.cc nor LOV registries	Not addressed (Ontology not in final release).
Ontology not found in LOV registries	Not addressed (Ontology not in final release).
Metadata not accessible in LOV registries	Not addressed (Ontology not in final release).
Missing parts of recommended metadata	Added where applicable for all ontology modules.
Missing detailed metadata	Added for all ontology modules (where applicable).
Detailed provenance metadata missing	Added where applicable, but ontology not yet in final release.
Unconnected ontology elements	Addressed for all ontology modules.
Missing domain or range in properties	Updated but some are left unspecified by design.
Missing disjointness	Commonly left out for flexibility, addressed where applicable.
Inverse relationships not explicitly declared	Commonly left out for reduced complexity.
Ambiguous namespace	Corrected for all ontology modules.
Check vocabulary reuse	Alignment addressed separately (see Section 5).

In response to the requirements verification using SPARQL queries, we manually check if new requirements will be covered when we introduce/update new modules (e.g. energy, value and, location), and address identified issues coming from previous discussions in consortium meetings/workshops and from the result of the second evaluation in terms of the first new evaluation dimension (describe evaluation scenarios for the three industry domains, e.g. some concepts in use case/demonstration ontologies could be generic and are moved to the respective core ontology modules). In Appendix A we include two lists of the total set of requirements from D3.2 and show whether they are currently covered or not by the ontology network, with comparison to the requirements (from D3.1) coverage in the previous in D3.4. While this is showing that not all requirements are covered, it is still in line with the prioritisation made by WP6, i.e. through the data delivered in D6.4-5 and the evaluation scenarios chosen for the first and second project iterations (cf. D6.7 and D6.8). Moreover, the intention is not to cover all requirements by building new modules, but rather provide bridges for alignments and integration of existing ontologies. For instance, detailed task modelling or actor role modelling is most likely out of scope of the core concepts in CEON, since either existing ontologies already cover this area or they are required in specific domain scenarios that could be included as an extension of the core of CEON in the domain ontologies.

5 Ontology Alignment Plan and Result Update

To enhance the interoperability and knowledge exchange among relevant ontologies in the Circular Economy domain, we conduct experiments of aligning relevant ontologies. These relevant ontologies cover the ones surveyed in our prior work [13], and include newcomers after the previous survey was published, and the top-level ontology, EMMO (Elementary Multiperspective Material Ontology)[12]. Therefore, we have 6 CE-related ontologies, a number

[12] https://github.com/emmo-repo/EMMO

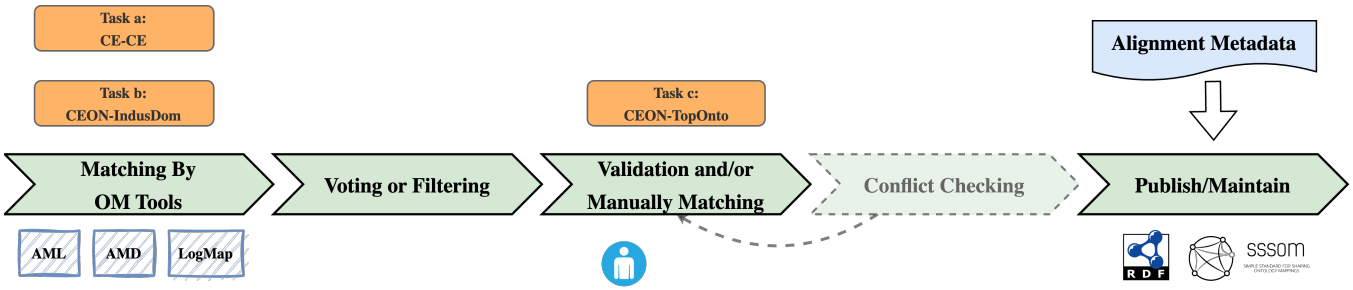

Figure 2: A pipeline of producing alignments based on the general framework outlined in [11].

of domain-specific ontologies (5 for sustainability, 13 for materials, 14 for manufacturing, 9 for products, and 8 for logistics) and 1 top-level ontology (EMMO) to include in our ontology matching tasks.

In the deliverable D3.2, we presented the ontology alignment plan and methods, as well as the initial alignment results. In this section, we mainly present the updates of the ontology alignment methods and result.

As we presented in D3.2, there are three established ontology matching tasks in our plan. They are (a): producing alignments among CE-specific ontologies, (b): producing alignments between CEON and industry domain-specific ontologies, and (c): producing alignments between CEON and top-level ontologies (e.g. EMMO). Furthermore, we set up a three-step pipeline to generate alignments. The first step is **matching** ontologies based on three existing matching systems, which are AML [4], LogMap [10], and AMD [18]. Another main step is **validation and/or manually matching** in which users validate candidate mappings or manually create new ones. While **Task a** and **Task b**, start from the first step, we use our prior experience in aligning MDO and EMMO, and start **Task c** from the manually matching step. The final step is alignments publishing and maintaining.

We remind the reader that in the previous alignment plan, there were two optional steps – **voting or filtering** and **conflict checking**, which we did not use by the time of writing D3.2, but we have now used **voting or filtering** (in this deliverable D3.5) for (1): detailing the alignment results for **Task a** in connection with proposing a new track at the OAEI (Ontology Alignment Evaluation Initiative)[13] for evaluating ontology matching systems over CE matching tasks; (2) detailing the alignment results for materials related ontologies in **Task b**. The goal of the voting or filtering step is to refine the initial set of mapping suggestions yielded in the previous step[14].

In the CE track of OAEI, we had 4 system participants for our matching sub-tasks in Task a. We conducted experiments by executing each system in its standard setting, and we compared precision, F-measure, and recall - see results in Table 2.

Table 2: The results for the circular economy track.

System	Size	Precision	F_1-measure	Recall
Matcha (0.9)	28	0.393	0.478	0.611
LogMapLt	29	0.379	0.468	0.611
LogMap (0.5)	23	0.391	0.439	0.5

The first evaluation within the track shows that matching circular economy relevant ontologies remains a challenging task for tools (F1-measure lower than 0.48). Based on a detailed analysis, it turns out that mere string matching could be misleading, and the meaning of entities should be better considered. Therefore, matching CE-related ontologies still requires domain expert validation which is a challenging task. For the more detailed alignment results in terms of **Task a** and materials-related sub-task of **Task b**, we will present the alignment in D2.8, as part of examining the standardisation landscape.

[13] https://oaei.ontologymatching.org/2024/ce/index.html
[14] E.g. voting based on the number of tools yielding the same mapping, and filtering based on similarity thresholds.

6 Concluding Remarks and Future Work

The current state of the GitHub repository, constituting the deliverable D3.5, consists of 13 core ontology modules, where three of them are considered to be generic ODPs (Process ODP, Actor ODP and Resource ODP); seven of them are considered to model CE-related domain knowledge for representing circular value networks (Circular Value Network, Value, Actor, Process, Material, Product and Energy modules); three of them are considered to be supplementary to annotate CE data (i.e. Quantity, Statement and Location modules). All are published online in our ontology repository, including human-friendly documentation generated automatically from the ontology files, and versioned through GitHub. This third release (v0.3.0) has followed the result of the second evaluation of the project, and has been subsequently updated. It should be noted that additional ontology modules have also been developed that are not part of the core ontology network. This includes modules reusing external ontologies, such as BOT (Building Topology Ontology) [16] and QUDT (Quantities, Units, Dimensions, and Types Ontology) [8], as well as modules modelling notions specific to the use case data in D6.4-5. These additional ontology modules are not included in this release since they are considered as connectors to existing ontologies and industry domains, but not part of the core concepts of CE.

One future step is to develop further alignment modules, consisting of alignments (cf., Section 5) to the most prominent ontologies discovered in the ontology survey presented in D3.1 (which has been updated in D3.2). This can be seen both as an important way of increasing the reusability of the ontologies, as well as a part of the validation of the ontologies, i.e. making sure that they are aligned with existing ontologies, but also with emerging standards etc. So far we have studied the landscape of existing ontologies and standards (cf. also D2.7, and the upcoming D2.8), and made a preliminary ontology alignment pipeline setup, that generated a set of candidate alignments that are now studied and curated, to arrive at a set of alignment modules to be released with the ontology network. Another future step is to update the additional modules and use-case demonstration ontologies, in relation to the final D6.9 evaluations.

References

[1] Eva Blomqvist, Karl Hammar, and Valentina Presutti. Engineering ontologies with patterns-the extreme design methodology. *Ontology Engineering with Ontology Design Patterns*, 25:23–50, 2016.

[2] Eva Blomqvist and Kurt Sandkuhl. Patterns in ontology engineering: Classification of ontology patterns. In *ICEIS (3)*, pages 413–416. Citeseer, 2005.

[3] G Cota et al. Best practices for implementing fair vocabularies and ontologies on the web. *Applications and practices in ontology design, extraction, and reasoning*, 49:39, 2020.

[4] Daniel Faria, Beatriz Lima, Marta Contreiras Silva, Francisco Couto, and Catia Pesquita. AML and AMLC results for OAEI 2021. In *OM 2021: The 16th International Workshop on Ontology Matching collocated with the 20th International Semantic Web Conference ISWC-2021 October 25th, 2021, Virtual conference*, volume 3063 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2021. URL: https://ceur-ws.org/Vol-3063/oaei21_paper4.pdf.

[5] Aldo Gangemi. Ontology design patterns for semantic web content. In *The Semantic Web–ISWC 2005: 4th International Semantic Web Conference, ISWC 2005, Galway, Ireland, November 6-10, 2005. Proceedings 4*, pages 262–276. Springer, 2005.

[6] Daniel Garijo, Oscar Corcho, and Maria Poveda-Villalón. Foops!: An ontology pitfall scanner for the fair principles. In *International Semantic Web Conference (ISWC) 2021: Posters, Demos, and Industry Tracks*, volume 2980 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2021. URL: http://ceur-ws.org/Vol-2980/paper321.pdf.

[7] Michael Grüninger and Mark S Fox. The role of competency questions in enterprise engineering. *Benchmarking—Theory and practice*, pages 22–31, 1995.

[8] Ralph Haas, Paul J Keller, Jack Hodges, and Jack Spivak. Quantities, units, dimensions and data types ontologies (qudt). http://qudt.org. Accessed: 2024-12-18.

[9] Krzysztof Janowicz, Pascal Hitzler, Benjamin Adams, Dave Kolas, and Charles Vardeman II. Five stars of linked data vocabulary use. *Semantic Web*, 5(3):173–176, 2014.

[10] Ernesto Jiménez-Ruiz. LogMap Family Participation in the OAEI 2023. In *OM 2023: The 18th International Workshop on Ontology Matching collocated with the 22nd International Semantic Web Conference ISWC-2023 November 7th, 2023, Athens, Greece*, volume 3591 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2023. URL: https://ceur-ws.org/Vol-3591/oaei23_paper4.pdf.

[11] Patrick Lambrix and Rajaramb Kaliyaperumal. A session-based ontology alignment approach enabling user involvement. *Semantic Web Journal*, 2017. doi:10.3233/SW-160243.

[12] Yann Le Franc, Jessica Parland-von Essen, Luiz Bonino, Heikki Lehväslaiho, Gerard Coen, and Christine Staiger. D2.2 fair semantics: First recommendations, March 2020. doi:10.5281/zenodo.5361930.

[13] Huanyu Li, Mina Abd Nikooie Pour, Ying Li, Mikael Lindecrantz, Eva Blomqvist, and Patrick Lambrix. A Survey of General Ontologies for the Cross-Industry Domain of Circular Economy. In *Companion Proc. of the ACM Web Conference 2023*. ACM, 2023. doi:10.1145/3543873.3587613.

[14] María Poveda-Villalón, Paola Espinoza-Arias, Daniel Garijo, and Oscar Corcho. Coming to terms with fair ontologies. In C. Maria Keet and Michel Dumontier, editors, *Knowledge Engineering and Knowledge Management*, pages 255–270, Cham, 2020. Springer International Publishing.

[15] María Poveda-Villalón, Asunción Gómez-Pérez, and Mari Carmen Suárez-Figueroa. OOPS! (OntOlogy Pitfall Scanner!): An On-line Tool for Ontology Evaluation. *International Journal on Semantic Web and Information Systems (IJSWIS)*, 10(2):7–34, 2014.

[16] Mads Holten Rasmussen, Maxime Lefrançois, Georg Ferdinand Schneider, and Pieter Pauwels. Bot: The building topology ontology of the w3c linked building data group. *Semantic Web*, 12(1):143–161, 2021. doi:10.3233/SW-200385.

[17] Mark D. Wilkinson, Michel Dumontier, IJsbrand Jan Aalbersberg, Gabrielle Appleton, Myles Axton, Arie Baak, Niklas Blomberg, Jan-Willem Boiten, Luiz Bonino da Silva Santos, Philip E. Bourne, Jildau Bouwman, Anthony J. Brookes, Tim Clark, Mercè Crosas, Ingrid Dillo, Olivier Dumon, Scott Edmunds, Chris T. Evelo, Richard Finkers, Alejandra Gonzalez-Beltran, Alasdair J.G. Gray, Paul Groth, Carole Goble, Jeffrey S. Grethe, Jaap Heringa, Peter A.C 't Hoen, Rob Hooft, Tobias Kuhn, Ruben Kok, Joost Kok, Scott J. Lusher, Maryann E. Martone, Albert Mons, Abel L. Packer, Bengt Persson, Philippe Rocca-Serra, Marco Roos, Rene van Schaik, Susanna-Assunta Sansone, Erik Schultes, Thierry Sengstag, Ted Slater, George Strawn, Morris A. Swertz, Mark Thompson, Johan van der Lei, Erik van Mulligen, Jan Velterop, Andra Waagmeester, Peter Wittenburg, Katherine Wolstencroft, Jun Zhao, and Barend Mons. The FAIR guiding principles for scientific data management and stewardship. *Scientific data*, 3:160018:1–9, 2016. doi:10.1038/sdata.2016.18.

[18] Wang Zhu. AMD Results for OAEI 2023. In *OM 2023: The 18th International Workshop on Ontology Matching collocated with the 22nd International Semantic Web Conference ISWC-2023 November 7th, 2023, Athens, Greece*, volume 3591 of *CEUR Workshop Proceedings*. CEUR-WS.org, 2023. URL: https://ceur-ws.org/Vol-3591/oaei23_paper2.pdf.

Appendices

In this appendix we first provide the list of requirements and their coverage in the current ontology network, then some snapshot images of the VOWL visualisations of the ODPs and ontology modules that are available online. For interactive and up-to-date visualisations we refer the reader to the respective documentation pages linked from http://w3id.org/CEON/. Further we provide the documentation for the latest version of each ODP and ontology module.

A Requirements Coverage

In Tables 3 and 4 we provide an overview of the current coverage of requirements in this release of the ontology network. Complete coverage (green) indicates that the mentioned concepts are directly modelled by the ontology network, and that the CQ can be answered, e.g., by formulating an appropriate SPARQL query. Indirect coverage (yellow) indicates that the exact concepts and relations are not present in the core modules, but that more general ones are included, thus facilitating the specialisation of those core modules to cover the concrete concepts and relations mentioned, for instance, in one of the use case-specific ontologies. Partial coverage (orange) indicates that only some aspects are currently modelled, and some parts are still missing and/or are not intended to be included in the core modules but are specific to an industry domain. White colour indicates CQs that have not yet been modelled, for instance since they may be considered out of scope of the project given the priorities set by the overall project requirements in WP2, or because they are industry specific.

Since in the 2nd iteration of the project, we updated the overall requirements in WP2. For instance, requirements are identified as **CVN-*** in the first iteration, while in the second iteration, requirements were updated based more detailed specifications and were identified as **CE*.**. In this CEON release, we make a detailed mapping between these two group of requirements. Among the updated requirements in the second iteration, we have addressed a number of requirements after the second evaluation which has been updated in Table 3. For more details, we refer readers to the GitHub issue[15].

In Table 4, we show the status of requirements coverage for the three use cases and compare evaluation result from D3.4 and D3.5. We also include an update for new addressed (partly covered or fully covered after the 2nd evaluation) in the table. For more details, we refer readers to the respective GitHub issues[16].

Table 3: Competency questions from ontological stories for general CE domain, as listed in D3.4 and D3.5. Colors indicate whether the requirements are covered (green), indirectly covered (yellow), partly covered (orange) or not covered (white), by the current ontology network.

ID (CVN)	ID (CE)						
CVN-CVN-1	CE1-1	CE2-1					
CVN-CVN-2	CE5-18	CE12-8	CE12-9				
CVN-CVN-3	CE1-1	CE11-6	CE11-7	CE12-5			
CVN-CVN-4	CE3-5	CE8-2	CE7-4				
CVN-CVN-5	CE3-5	CE10-7	CE7-5				
CVN-CVN-6	CE3-1	CE4-1					
CVN-Proc-1	CE1-1	CE3-2					
CVN-Proc-2	CE3-4	CE4-4	CE5-7				
CVN-Proc-3	CE1-1	CE12-1					
CVN-Proc-4	CE3-5	CE8-2	CE10-7	CE7-5	CE7-4		
CVN-Proc-5	CE1-1						
CVN-VP-1	CE5-16						
CVN-VP-2	CE9-4						

[15]CE requirements coverage: https://github.com/LiUSemWeb/CEON/issues/273

[16]Construction: https://github.com/LiUSemWeb/CEON/issues/274, Electronics: https://github.com/LiUSemWeb/CEON/issues/275, Textiles: https://github.com/LiUSemWeb/CEON/issues/276

CVN-VP-3	CE10-10	CE11-10					
CVN-VP-4	CE11-2						
CVN-Res-1	CE1-2	CE4-3	CE5-2	CE9-1	CE12-4	CE11-8	CE3-3
CVN-Res-2	CE5-2						
CVN-Res-3	CE1-2	CE5-2					
CVN-Res-4							
CVN-Ph-1							
CVN-Ph-2	CE1-1	CE3-4	CE4-4	CE5-7	CE12-1		
CVN-Ph-3							
CVN-Ph-4	CE3-4	CE4-4	CE5-7				
CVN-Ph-5	CE10-1	CE12-2					
CVN-Wo-1	CE3-4	CE5-17					
CVN-Wo-2							
CVN-Wo-3							
CVN-Wo-4							
CVN-Wo-5	CE3-5	CE7-4					
CVN-Wo-6	CE3-5	CE10-7	CE7-5				
CVN-Wo-7							
CVN-Wo-8	CE2-1						
CVN-Wo-9	CE3-2						
CVN-Ac-1	CE10-1						
CVN-Ac-2	CE10-4						
CVN-Ac-3							
CVN-Ac-4	CE2-2	CE10-9	CE10-4	CE6-3	CE4-2		
CVN-Ac-5	CE1-1	CE2-1					
CVN-Ac-6	CE1-1	CE2-1					
CVN-Ac-7	CE2-1						
CVN-Co-1	CE10-1	CE11-1	CE12-2				
CVN-Co-2	CE10-1	CE11-1	CE12-2				
CVN-Co-3	CE10-1	CE11-1	CE12-2				
CVN-Co-4	CE10-1	CE11-1	CE12-2				
CVN-Co-6	CE10-1	CE11-1	CE12-2				
CVN-Co-7	CE10-1	CE11-1	CE12-2				
CVN-Co-8	CE10-1	CE11-1	CE12-2				
CVN-Co-9	CE10-1	CE11-1	CE12-2				
CVN-Ty-1							
CVN-Ty-2							
CVN-Ty-3	CE3-1	CE4-1					
CVN-In-1	CE3-5	CE7-4					
CVN-In-2	CE3-5	CE7-4					
CVN-In-3	CE3-5	CE7-4					
CVN-In-4	CE3-5	CE7-4					
CVN-Out-1	CE3-5	CE10-7	CE7-5				
CVN-Out-2	CE3-5	CE10-7	CE7-5				
CVN-Out-3	CE3-5	CE10-7	CE7-5				
CVN-Out-4	CE3-5	CE10-7	CE7-5				
CVN-Inf-1	CE9-1	CE11-4					
CVN-Inf-2	CE10-2	CE11-5					
CVN-Inf-3	CE10-2	CE11-5					
CVN-Inf-4	CE11-3						
CVN-Infr-1	CE10-4						
CVN-Infr-2							
CVN-Infr-3							
CVN-Cal-1							
CVN-Cal-2							
CVN-RT-1							
CVN-RT-2							
CVN-RT-3							
CVN-RT-4							
CVN-Comp-1	CE5-2						
CVN-Comp-2	CE5-2						
CVN-VT-1	CE1-3						

CVN-VT-2 CVN-VT-3							
	New CQs or more specific CQs						
	CE5-1	CE5-3	CE5-4	CE5-5	CE5-6	CE5-8	CE5-9
	CE5-10	CE5-11	CE5-12	CE5-13	CE5-14	CE5-15	CE5-19
	CE6-1	CE6-2	CE7-1	CE7-2	CE7-3	CE7-6	CE7-7
	CE7-8	CE8-1	CE8-3	CE9-2	CE9-3	CE9-5	CE10-3
	CE10-5	CE10-6	CE10-8	CE11-9	CE11-11	CE12-3	CE12-10
	CE12-11	CE13-1	CE13-2	CE13-3	CE13-4	CE13-5	CE13-6

Table 4: Competency questions from ontological stories for three use cases, as listed in D3.*. Colors indicate whether the requirements are covered (green), indirectly covered (yellow), partly covered (orange) or not covered (white), by the current ontology network.

ID (Const.), D3.4	ID (Const.), D3.5	ID (Elec.), D3.4	ID (Elec.), D3.5	ID (Text.), D3.4	ID (Text.), D3.5
C0-1	C0-1	E1-1	E1-1	T1-1	T1-1
C0-2	C0-2	E1-2	E1-2	T1-2	T1-2
C1-1	C1-1	E1-3	E1-3	T2-1	T2-1
C1-2	C1-2	E1-4	E1-4	T2-2	T2-2
C1-3	C1-3	E1-5	E1-5	T2-3	T2-3
	C1-4	E1-6	E1-6	T2-4	T2-4
C2-1	C2-1	E1-7	E1-7	T2-5	T2-5
C2-2	C2-2	E1-8	E1-8	T3-1	T3-1
C2-3	C2-3	E1-9	E1-9	T3-2	T3-2
C2-4	C2-4	E1-10	E1-10	T3-3	T3-3
	C2-5	E1-11	E1-11	T3-4	T3-4
	C2-6	E1-12	E1-12	T3-5	T3-5
C3-1	C3-1	E1-13	E1-13	T4-1	T4-1
C3-2	C3-2	E1-14	E1-14	T4-2	T4-2
C3-3	C3-3	E1-15	E1-15	T4-3	T4-3
C3-4	C3-4		E1-16	T4-4	T4-4
C3-5	C3-5	E2-1	E2-1	T4-5	T4-5
C3-6	C3-6	E2-2	E2-2	T5-1	T5-1
C3-7	C3-7	E2-3	E2-3	T6-1	T6-1
C3-8	C3-8	E2-4	E2-4	T7-1	T7-1
C3-9	C3-9	E2-5	E2-5	T8-1	T8-1
C4-1	C4-1	E2-6	E2-6	T8-2	T8-2
C4-2	C4-2	E2-7	E2-7	T8-3	T8-3
C4-3	C4-3	E2-8	E2-8	T9-1	T9-1
C4-4	C4-4	E2-9	E2-9	T9-2	T9-2
C4-5	C4-5	E2-10	E2-10	T10-1	T10-1
C4-6	C4-6		E2-11	T10-2	T10-2
C4-7	C4-7		E2-12	T10-3	T10-3
C4-8	C4-8	E3-1	E3-1	T10-4	T10-4
C4-9	C4-9	E3-2	E3-2		T11-1
C4-10	C4-10	E3-3	E3-3		T11-2
C5-1	C5-1	E3-4	E3-4		T12-1
C5-2	C5-2	E3-5	E3-5		T13-1
	C5-3	E3-6	E3-6		T13-2
C6-1	C6-1	E3-7	E3-7	T14-1	T14-1
C6-2	C6-2	E3-8	E3-8	T15-1	T15-1
C6-3	C6-3		E3-9		T16-1
C6-4	C6-4	E4-1	E4-1		T17-1
C7-1	C7-1	E4-2	E4-2	T18-1	T18-1
C7-2	C7-2	E4-3	E4-3	T19-1	T19-1
C7-3	C7-3	E4-4	E4-4	T20-1	T20-1
C7-4	C7-4	E4-5	E4-5	T21-1	T21-1
C7-5	C7-5	E4-6	E4-6		T22-1
C7-6	C7-6	E4-7	E4-7		T22-2

C8-1	C8-1	E4-8	E4-8	T23-1	T23-1
C8-2	C8-2	E4-9	E4-9		T23-2
C8-3	C8-3	E4-10	E4-10		
C8-3	C8-4	E4-11	E4-11		
C9-1	C9-1	E5-1	E5-1		
C9-2	C9-2	E5-2	E5-2		
C9-3	C9-3	E5-3	E5-3		
C9-4	C9-4	E5-4	E5-4		
C10-1	C10-1	E5-5	E5-5		
C10-1	C10-2	E5-6	E5-6		
C10-3	C10-3	E5-7	E5-7		
C10-4	C10-4		E5-8		
C11-1	C11-1		E5-9		
C11-2	C11-2	E6-1	E6-1		
C11-3	C11-3	E6-2	E6-2		
C12-1	C12-1	E6-3	E6-3		
C12-2	C12-2	E6-4	E6-4		
C12-3	C12-3	E6-5	E6-5		
C13-1	C13-1	E6-6	E6-6		
C13-2	C13-2	E6-7	E6-7		
C13-3	C13-3		E6-8		
C13-4	C13-4				
C13-5	C13-5				
C13-6	C13-6				
C13-8	C13-8				
C13-9	C13-9				
C13-10	C13-10				
36 requirementswere updated to partly or fully covered		27 requirements were updated to partly or fully covered		5 requirements were updated to partly or fully covered; 6 requirements were updated to uncovered	

B Module Illustrations

Below, in Figures 3 to 15 we illustrate the content of the 13 core modules, using the visual notation of WebVOWL. The same illustrations are available in an interactive clickable manner from the documentation page of each module.

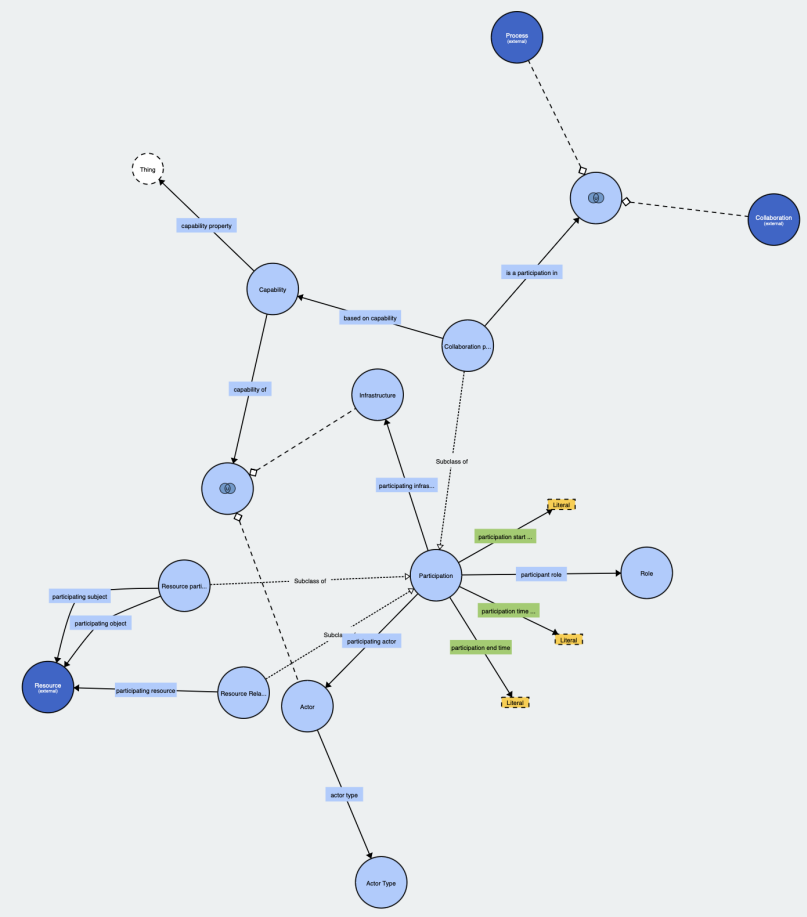

Figure 3: VOWL visualisation of the actor ODP.

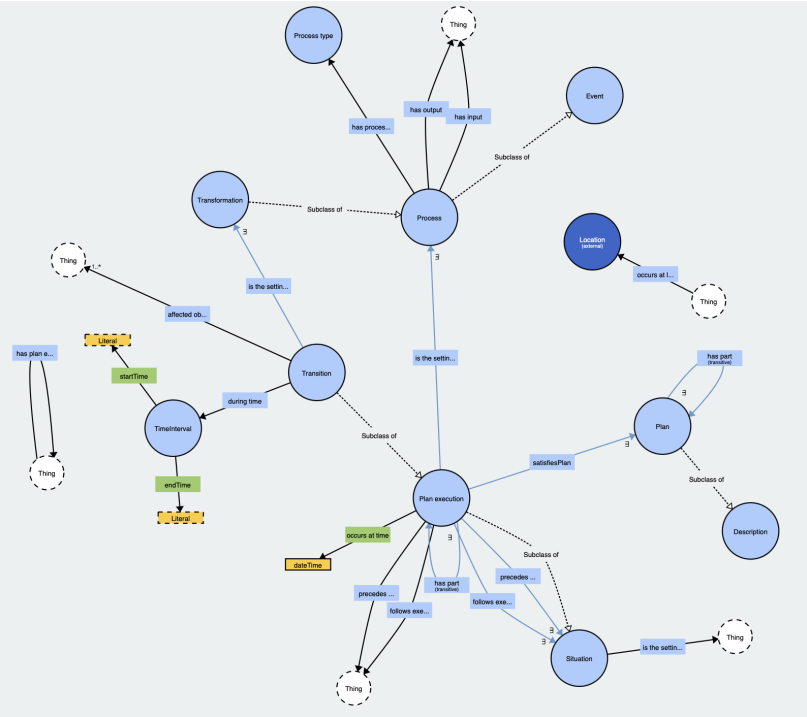

Figure 4: VOWL visualisation of the process ODP.

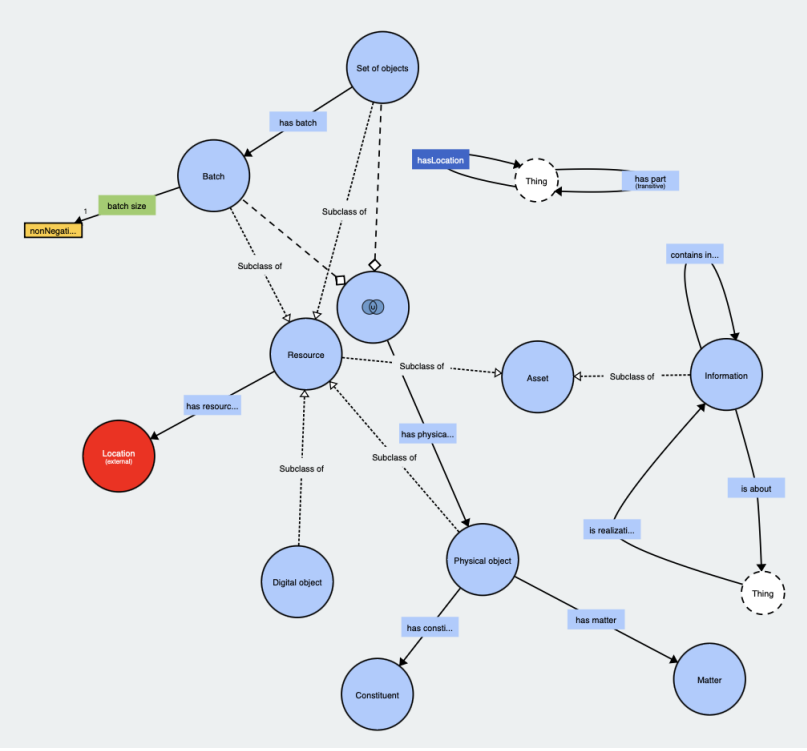

Figure 5: VOWL visualisation of the resource ODP.

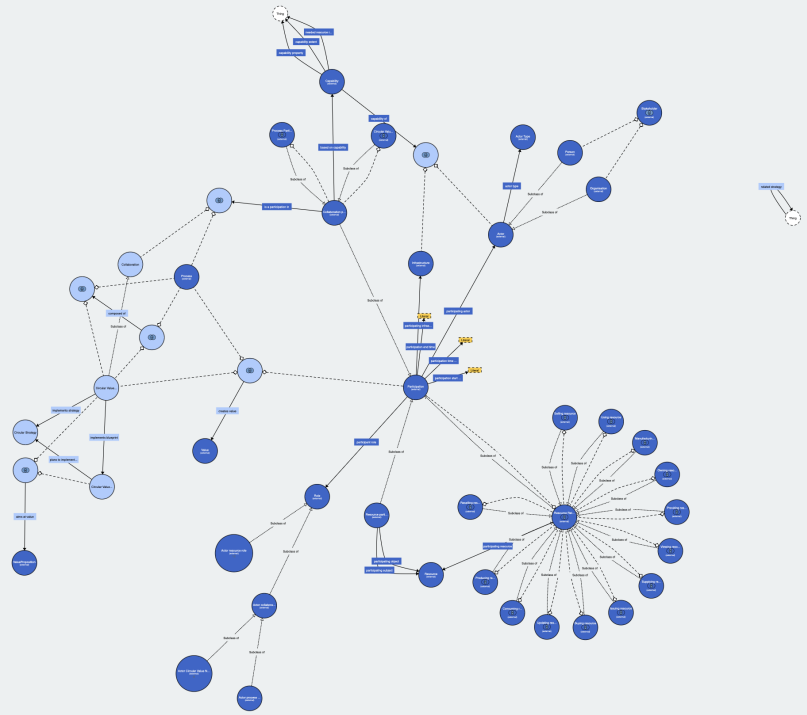

Figure 6: VOWL visualisation of the core part of the CVN module.

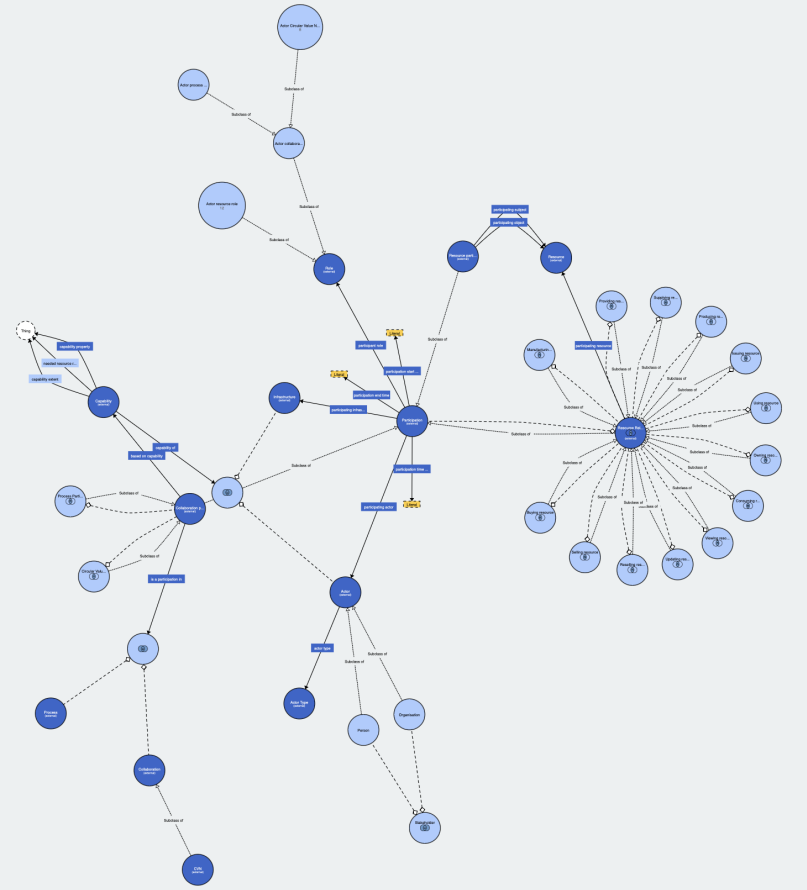

Figure 7: VOWL visualisation of the actor module, specialising the actor ODP.

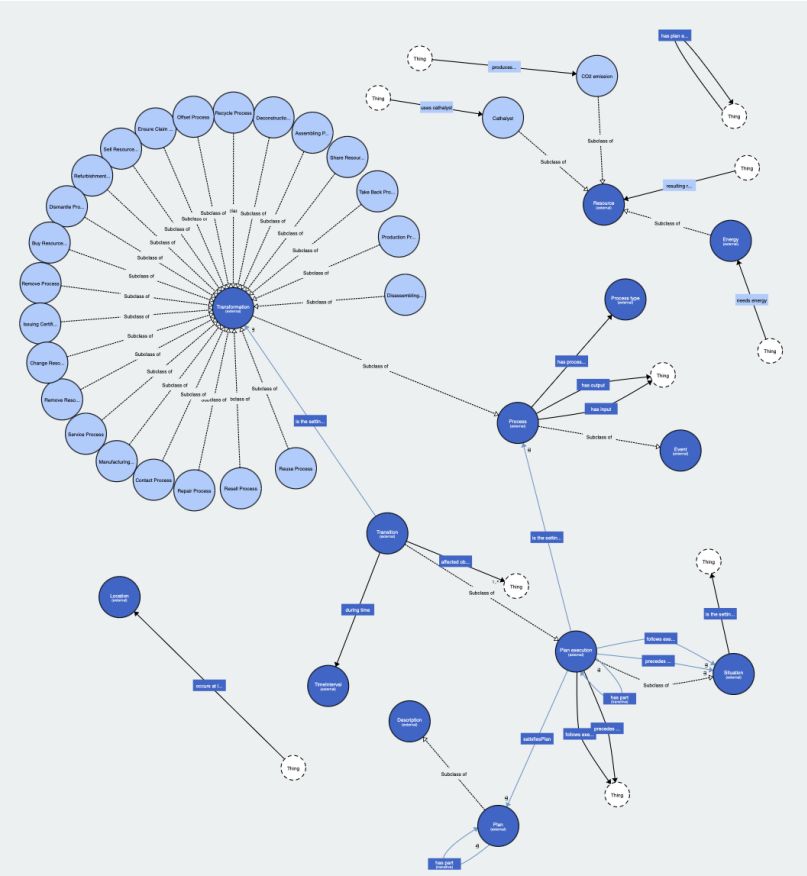

Figure 8: VOWL visualisation of the process module, specialising the process ODP.

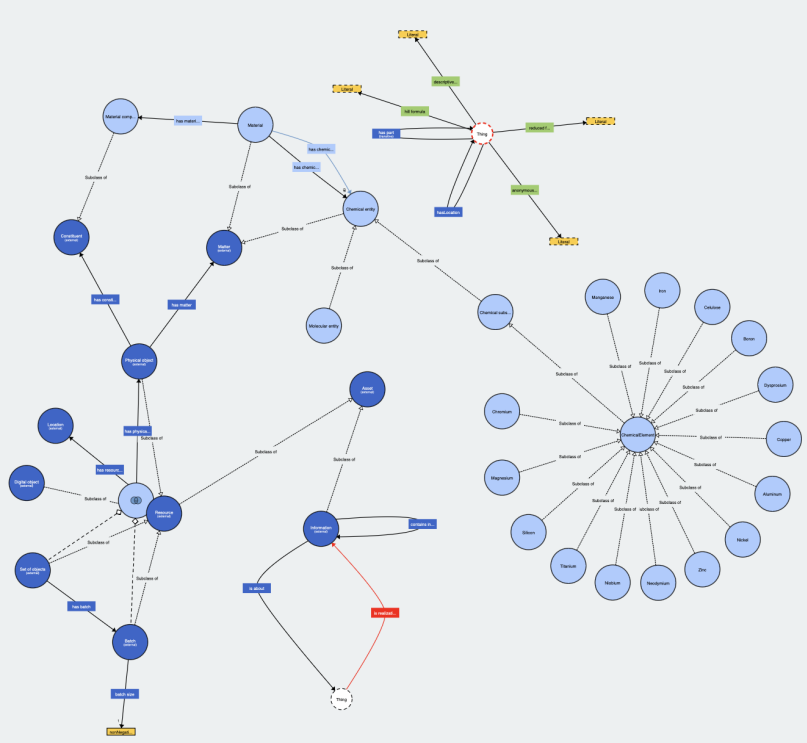

Figure 9: VOWL visualisation of the material module, specialising the resource ODP.

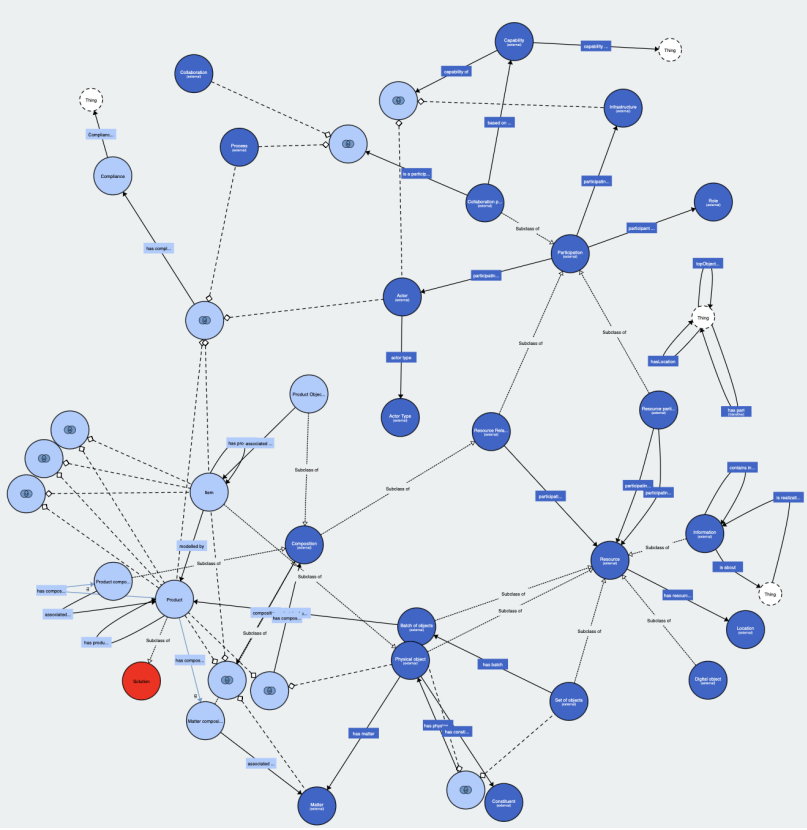

Figure 10: VOWL visualisation of the product module, specialising the resource ODP.

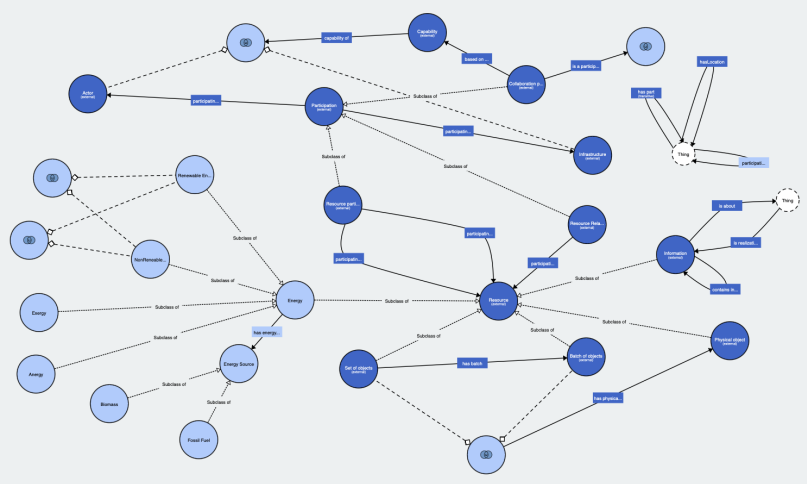

Figure 11: VOWL visualisation of the energy module, specialising the resource ODP.

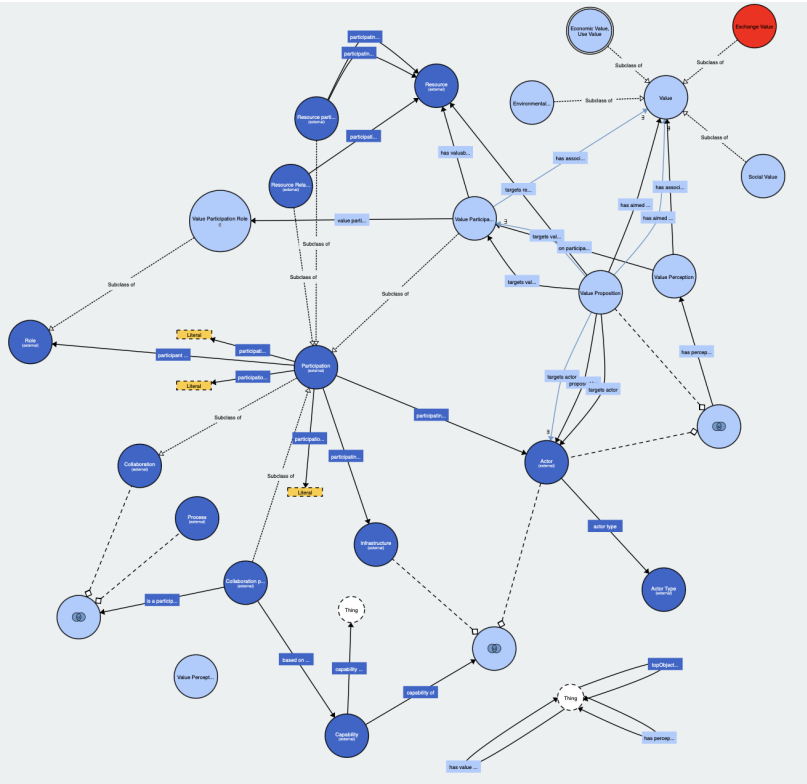

Figure 12: VOWL visualisation of the stub for the value module.

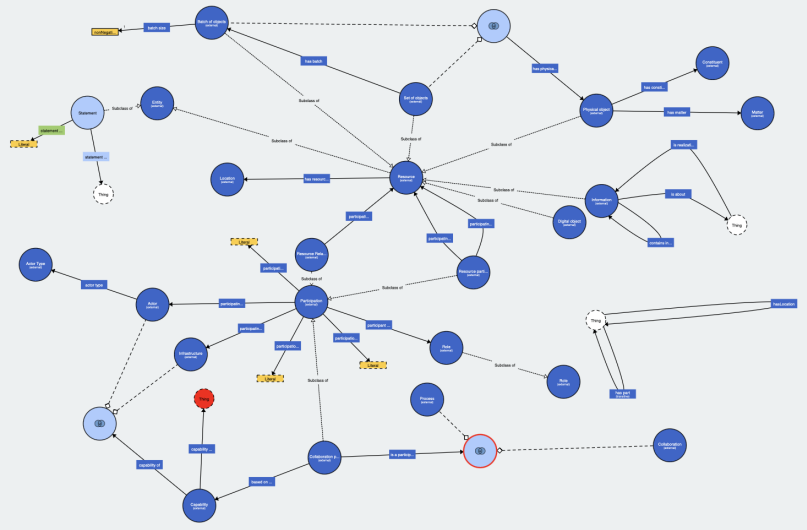

Figure 13: VOWL visualisation of the stub for the statement module.

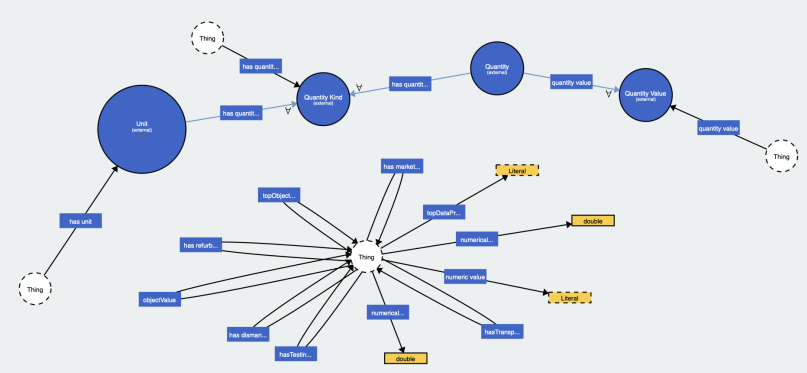

Figure 14: VOWL visualisation of the stub for the quantity module.

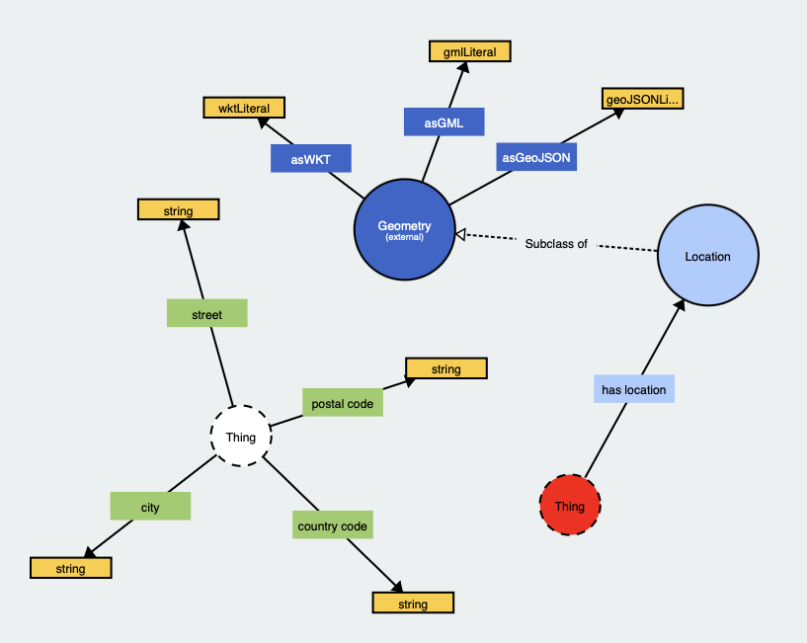

Figure 15: VOWL visualisation of the stub for the location module.

C Module Documentation

In this appendix we provide a snapshot of the documentation pages of the 13 core modules, as available online.

Circular Economy Ontology Network (CEON) - Actor Module

Metadata

IRI

http://w3id.org/CEON/ontology/actor/

Title

Circular Economy Ontology Network (CEON) - Actor Module

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-11-13

License

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Version Iri

http://w3id.org/CEON/ontology/actor/0.3/

Version Info

0.3

Preferred Namespace Prefix

actor

Preferred Namespace Uri

http://w3id.org/CEON/ontology/actor/

Description

The Actor module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: C0-1, C0-2, C3-4, T3-4

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: C0-1, C0-2, C3-4, T3-4

Classes

Actor Cvn Role [c]

IRI	http://w3id.org/CEON/ontology/actor/ActorCVNRole
Sub Class Of	ActorCollaborationRole [c]
Named Individuals	collector [ni] dismantler [ni] manufacturer [ni] recycler [ni] reseller [ni] seller [ni] supplier [ni] user [ni]

Actor Collaboration Role [c]

IRI	http://w3id.org/CEON/ontology/actor/ActorCollaborationRole
Sub Class Of	actorODP:Role [c]
Super Class Of	ActorCVNRole [c] ActorProcessRole [c]

Actor Process Role [c]

IRI	http://w3id.org/CEON/ontology/actor/ActorProcessRole
Sub Class Of	ActorCollaborationRole [c]

Actor Resource Role [c]

IRI	http://w3id.org/CEON/ontology/actor/ActorResourceRole
Sub Class Of	actorODP:Role [c]
Named Individuals	buyer [ni] consumer [ni] issuer [ni] owner [ni] producer [ni] provider [ni] reseller [ni] seller [ni] supplier [ni] updater [ni] user [ni] viewer [ni]

Buying Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/BuyingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value buyer [c] *and* actorODP:ResourceRelation [c]

Cvn Participation [c]

IRI	http://w3id.org/CEON/ontology/actor/CVNParticipation
Sub Class Of	actorODP:CollaborationParticipation [c] actorODP:participationIn [op] some http://w3id.org/CEON/ontology/cvn/CVN [c] *and* actorODP:participantRole [op] some ActorCVNRole [c] *and* actorODP:participatingActor [op] some actorODP:Actor [c] *and* actorODP:CollaborationParticipation [c]

Consuming Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ConsumingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value consumer [c]

Issuing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/IssuingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value issuer [c] *and* actorODP:ResourceRelation [c]

Manufacturing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ManufacturingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value manufacturer [c]

Organisation [c]

IRI	http://w3id.org/CEON/ontology/actor/Organisation
Is Defined By	ISO 59004:2024 - 3.4.1 organization
Description	Person or group of people that has its own functions with responsibilities, authorities, and relationships to achieve its objectives. The concept of organization includes, but is not limited to sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private (e.g. foundation, union, association, agency, municipality, region, country, intergovernmental agencies). A group of organizations can also be considered as an organization that has, alone or collectively,their own objectives.
Sub Class Of	actorODP:Actor [c]

Owning Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/OwningResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:ResourceRelation [c] *and* actorODP:participantRole [op] value owner [c]

Person [c]

IRI	http://w3id.org/CEON/ontology/actor/Person
Sub Class Of	actorODP:Actor [c]

Process Participation [c]

IRI	http://w3id.org/CEON/ontology/actor/ProcessParticipation
Sub Class Of	actorODP:CollaborationParticipation [c] actorODP:participationIn [op] some http://w3id.org/CEON/ontology/processODP/Process [c] *and* actorODP:participatingActor [op] some actorODP:Actor [c] *and* actorODP:participantRole [op] some ActorProcessRole [c] *and* actorODP:CollaborationParticipation [c]

Producing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ProducingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value producer [c] *and* actorODP:ResourceRelation [c]

Providing Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ProvidingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value provider [c] *and* actorODP:ResourceRelation [c]

Reselling Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/ResellingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value reseller [c] *and* actorODP:ResourceRelation [c]

Selling Resource [c]

IRI	http://w3id.org/CEON/ontology/actor/SellingResource
Sub Class Of	actorODP:ResourceRelation [c]
Equivalentclass	actorODP:participantRole [op] value seller [c] *and* actorODP:ResourceRelation [c]

Interested partyStakeholder[c]

IRI	http://w3id.org/CEON/ontology/actor/Stakeholder
Is Defined By	ISO 59004:2024 - 3.4.2 interested party, stakeholder
Description	Person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity. To “perceive itself to be affected” means the perception has been made known to the organization.
Sub Class Of	Organisation[c] *or* Person[c]

Supplying Resource[c]

IRI	http://w3id.org/CEON/ontology/actor/SupplyingResource
Sub Class Of	actorODP:ResourceRelation[c]
Equivalentclass	actorODP:participantRole[op] value supplier[c] *and* actorODP:ResourceRelation[c]

Updating Resource[c]

IRI	http://w3id.org/CEON/ontology/actor/UpdatingResource
Sub Class Of	actorODP:ResourceRelation[c]
Equivalentclass	actorODP:participantRole[op] value updater[c] *and* actorODP:ResourceRelation[c]

Using Resource[c]

IRI	http://w3id.org/CEON/ontology/actor/UsingResource
Sub Class Of	actorODP:ResourceRelation[c]
Equivalentclass	actorODP:participantRole[op] value user[c] *and* actorODP:ResourceRelation[c]

Viewing Resource[c]

IRI	http://w3id.org/CEON/ontology/actor/ViewingResource
Sub Class Of	actorODP:ResourceRelation[c]
Equivalentclass	actorODP:ResourceRelation[c] *and* actorODP:participantRole[op] value viewer[c]

Actor[c]

IRI	http://w3id.org/CEON/ontology/actorODP/Actor
Super Class Of	Organisation[c] Person[c]

Capability [c]

IRI http://w3id.org/CEON/ontology/actorODP/Capability

In Domain Of
capabilityExtent [op]
neededResourceRelation [op]

Collaboration Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/CollaborationParticipation

Super Class Of
CVNParticipation [c]
ProcessParticipation [c]

Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/Participation

Resource Relation [c]

IRI http://w3id.org/CEON/ontology/actorODP/ResourceRelation

Sub Class Of
actorODP:participatingActor [op] some actorODP:Actor [c] *and*
actorODP:participantRole [op] some ActorResourceRole [c] *and*
actorODP:participatingResource [op] some
http://w3id.org/CEON/ontology/resourceODP/Resource [c] *and*
actorODP:Participation [c]

Super Class Of
BuyingResource [c]
ConsumingResource [c]
IssuingResource [c]
ManufacturingResource [c]
OwningResource [c]
ProducingResource [c]
ProvidingResource [c]
ResellingResource [c]
SellingResource [c]
SupplyingResource [c]
UpdatingResource [c]
UsingResource [c]
ViewingResource [c]

Role [c]

IRI http://w3id.org/CEON/ontology/actorODP/Role

Super Class Of
ActorCollaborationRole [c]
ActorResourceRole [c]

Cvn [c]

IRI	http://w3id.org/CEON/ontology/cvn/CVN
Sub Class Of	http://w3id.org/CEON/ontology/cvn/Collaboration [c]

Collaboration [c]

IRI	http://w3id.org/CEON/ontology/cvn/Collaboration
Super Class Of	http://w3id.org/CEON/ontology/cvn/CVN [c]

Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/Process

Resource [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource

Object Properties

capability extent [op]

IRI	http://w3id.org/CEON/ontology/actor/capabilityExtent
Sub Property Of	actorODP:capabilityProperty [op]
Domain	actorODP:Capability [c]

needed resource relation [op]

IRI	http://w3id.org/CEON/ontology/actor/neededResourceRelation
Sub Property Of	actorODP:capabilityProperty [op]
Domain	actorODP:Capability [c]

capability property [op]

IRI	http://w3id.org/CEON/ontology/actorODP/capabilityProperty
Super Property Of	• capabilityExtent [op] • neededResourceRelation [op]

participant role [op]

IRI	http://w3id.org/CEON/ontology/actorODP/participantRole

participating actor [op]

IRI http://w3id.org/CEON/ontology/actorODP/participatingActor

participating resource [op]

IRI http://w3id.org/CEON/ontology/actorODP/participatingResource

participation in [op]

IRI http://w3id.org/CEON/ontology/actorODP/participationIn

Annotation Properties

contributor [ap]

IRI http://purl.org/dc/terms/contributor

created [ap]

IRI http://purl.org/dc/terms/created

creator [ap]

IRI http://purl.org/dc/terms/creator

description [ap]

IRI http://purl.org/dc/terms/description

license [ap]

IRI http://purl.org/dc/terms/license

title [ap]

IRI http://purl.org/dc/terms/title

preferred namespace prefix [ap]

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:
http://w3id.org/CEON/ontology/actor/

actorODP
http://w3id.org/CEON/ontology/actorODP/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

vann
http://purl.org/vocab/vann/

Legend

c	Classes
op	Object Properties
ap	Annotation Properties

Circular Economy Ontology Network (CEON) - Actor ODP

Metadata

IRI

http://w3id.org/CEON/ontology/actorODP/

Title

Circular Economy Ontology Network (CEON) - Actor ODP

Creator

Eva Blomqvist

Contributor

Huanyu Li

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2023-03-17

License

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Version Iri

http://w3id.org/CEON/ontology/actorODP/0.3/

Version Info

0.3

Preferred Namespace Prefix

actorODP

Preferred Namespace Uri

http://w3id.org/CEON/ontoloy/actorODP/

Description

A core ODP of the CEON ontology network, defining aspects of the actor concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.1: CVN-Process-3, CVN-Actor-1,4,6,7, CVN-Competency-3, CVN-Information-4, C11-1, C11-3, E1-6,6,6,9, E4-10

Covers the following requirements from Onto-DESIDE D3.2: CE1-1, CE2-1, CE2-2, CE4-2, CE6-3, CE12-1, CE10-1, CE10-4, CE10-9, CVN-Actor-1,4,6,7, CVN-Competency-3, C11-1, C11-3, E1-6,6,6,9, E4-10

Classes

Actor [c]

IRI	http://w3id.org/CEON/ontology/actorODP/Actor
In Domain Of	actorType [op]
In Range Of	participatingActor [op]

Actor Type [c]

IRI	http://w3id.org/CEON/ontology/actorODP/ActorType
In Range Of	actorType [op]

Capability [c]

IRI http://w3id.org/CEON/ontology/actorODP/Capability

In Domain Of
- capabilityOf [op]
- capabilityProperty [op]

In Range Of
- basedOnCapability [op]

Collaboration Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/CollaborationParticipation

Sub Class Of
- Participation [c]

In Domain Of
- basedOnCapability [op]
- participationIn [op]

Infrastructure [c]

IRI http://w3id.org/CEON/ontology/actorODP/Infrastructure

In Range Of
- participating_infrastructure [op]

Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/Participation

Sub Class Of
- participationStartTime [dp] *exactly* 1 1 [c] *or* participationTimePoint [dp] *exactly* 1 1 [c]

In Domain Of
- participantRole [op]
- participatingActor [op]
- participating_infrastructure [op]
- participationEndTime [dp]
- participationStartTime [dp]
- participationTimePoint [dp]

Super Class Of
- CollaborationParticipation [c]
- ResourceParticipation [c]
- ResourceRelation [c]

Resource Participation [c]

IRI http://w3id.org/CEON/ontology/actorODP/ResourceParticipation

Sub Class Of
- Participation [c]

In Domain Of
- participatingObject [op]
- participatingSubject [op]

Resource Relation [c]

IRI	http://w3id.org/CEON/ontology/actorODP/ResourceRelation
Sub Class Of	Participation [c]
In Domain Of	participatingResource [op]

Role [c]

IRI	http://w3id.org/CEON/ontology/actorODP/Role
In Range Of	participantRole [op]

Collaboration [c]

IRI	http://w3id.org/CEON/ontology/cvn/Collaboration

Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/Process

Resource [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource
In Range Of	participatingObject [op] participatingResource [op] participatingSubject [op]

Object Properties

actor type [op]

IRI	http://w3id.org/CEON/ontology/actorODP/actorType
Domain	Actor [c]
Range	ActorType [c]

based on capability [op]

IRI	http://w3id.org/CEON/ontology/actorODP/basedOnCapability
Domain	CollaborationParticipation [c]
Range	Capability [c]

capability of op

IRI	http://w3id.org/CEON/ontology/actorODP/capabilityOf
Domain	Capability c
Range	Infrastructure c *or* Actor c

capability property op

IRI	http://w3id.org/CEON/ontology/actorODP/capabilityProperty
Domain	Capability c

participant role op

IRI	http://w3id.org/CEON/ontology/actorODP/participantRole
Domain	Participation c
Range	Role c

participating actor op

IRI	http://w3id.org/CEON/ontology/actorODP/participatingActor
Domain	Participation c
Range	Actor c

participating object op

IRI	http://w3id.org/CEON/ontology/actorODP/participatingObject
Domain	ResourceParticipation c
Range	resourceODP:Resource c

participating resource op

IRI	http://w3id.org/CEON/ontology/actorODP/participatingResource
Domain	ResourceRelation c
Range	resourceODP:Resource c

participating subject op

IRI	http://w3id.org/CEON/ontology/actorODP/participatingSubject
Domain	ResourceParticipation c
Range	resourceODP:Resource c

participating_infrastructure op

IRI	http://w3id.org/CEON/ontology/actorODP/participating_infrastructure
Domain	Participation c
Range	Infrastructure c

participation in op

IRI	http://w3id.org/CEON/ontology/actorODP/participationIn
Domain	CollaborationParticipation c
Range	processODP:Process c *or* cvn:Collaboration c

Datatype Properties

participation end time dp

IRI	http://w3id.org/CEON/ontology/actorODP/participationEndTime
Domain	Participation c
Range	xsd:date c *or* xsd:dateTime c *or* xsd:gMonthYear c *or* xsd:gYear c

participation start time dp

IRI	http://w3id.org/CEON/ontology/actorODP/participationStartTime
Domain	Participation c
Range	xsd:dateTime c *or* xsd:gYear c *or* xsd:gMonthYear c *or* xsd:date c

participation time point dp

IRI	http://w3id.org/CEON/ontology/actorODP/participationTimePoint
Domain	Participation c
Range	xsd:gYear c *or* xsd:gMonthYear c *or* xsd:date c *or* xsd:dateTime c

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

license ap

IRI	http://purl.org/dc/terms/license

title ap

IRI	http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI	http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI	http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI	http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

definition ap

IRI	http://www.w3.org/2004/02/skos/core#definition

pref label ap

IRI	http://www.w3.org/2004/02/skos/core#prefLabel

Namespaces

:
http://w3id.org/CEON/ontology/actorODP/

cvn
http://w3id.org/CEON/ontology/cvn/

dcterms
http://purl.org/dc/terms/

geo
http://www.opengis.net/ont/geosparql#

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

processODP
http://w3id.org/CEON/ontology/processODP/

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

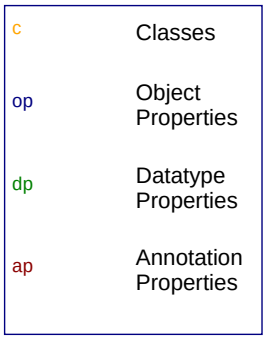
resourceODP
http://w3id.org/CEON/ontology/resourceODP/

skos
http://www.w3.org/2004/02/skos/core#

vann
http://purl.org/vocab/vann/

xsd
http://www.w3.org/2001/XMLSchema#

Legend


c
Classes
op
Object Properties
dp
Datatype Properties
ap
Annotation Properties

Circular Economy Ontology Network (CEON) - Circular Value Network Module

Metadata

IRI

http://w3id.org/CEON/ontology/cvn/

Title

Circular Economy Ontology Network (CEON) - Circular Value Network Module

Creator

Eva Blomqvist

Contributor

Huanyu Li

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2023-03-22

License

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Version Iri

http://w3id.org/CEON/ontology/cvn/0.2/

Version Info

0.2

Preferred Namespace Prefix

cvn

Preferred Namespace Uri

http://w3id.org/CEON/ontoloy/cvn/

Description

A core module of the CEON ontology network, defining aspects of the circular value network (CVN) itself.

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: CVN-CVN-1, CVN-Process-1,6, CVN-VP-1, CVN-Type-3, C0-1.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: CE1-1, CE2-1, CE3-1, CE3-2, CE4-1, CE5-16, C0-1.

Classes

Participation C

IRI http://w3id.org/CEON/ontology/actorODP/Participation

Cvn [c]

IRI	http://w3id.org/CEON/ontology/cvn/CVN
Is Defined By	ISO 59004:2024 - 3.5.3 value network
Description	A network of interlinked value chains and interested parties.
Sub Class Of	Collaboration [c]
In Domain Of	implementsBlueprint [op] implementsStrategy [op]

Cvn Blueprint [c]

IRI	http://w3id.org/CEON/ontology/cvn/CVNBlueprint
In Domain Of	plansToImplementStrategy [op]
In Range Of	implementsBlueprint [op]

Circular Strategy [c]

IRI	http://w3id.org/CEON/ontology/cvn/CircularStrategy
In Range Of	implementsStrategy [op] plansToImplementStrategy [op]

Collaboration [c]

IRI	http://w3id.org/CEON/ontology/cvn/Collaboration
Super Class Of	CVN [c]

Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/Process

Resource [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource

Value [c]

IRI	http://w3id.org/CEON/ontology/value/Value
In Range Of	createsValue [op]

Value Proposition [c]

IRI	http://w3id.org/CEON/ontology/value/ValueProposition
In Range Of	aimsAtValue [op]

Object Properties

aims at value [op]

IRI	http://w3id.org/CEON/ontology/cvn/aimsAtValue
Domain	CVNBlueprint [c] *or* CVN [c]
Range	value:ValueProposition [c]

composed of [op]

IRI	http://w3id.org/CEON/ontology/cvn/composedOf
Domain	processODP:Process [c] *or* CVN [c]
Range	CVN [c] *or* processODP:Process [c]

creates value [op]

IRI	http://w3id.org/CEON/ontology/cvn/createsValue
Domain	processODP:Process [c] *or* actorODP:Participation [c] *or* CVN [c]
Range	value:Value [c]

implements blueprint [op]

IRI	http://w3id.org/CEON/ontology/cvn/implementsBlueprint
Domain	CVN [c]
Range	CVNBlueprint [c]

implements strategy [op]

IRI	http://w3id.org/CEON/ontology/cvn/implementsStrategy
Sub Property Of	relatedStrategy [op]
Domain	CVN [c]
Range	CircularStrategy [c]

plans to implement strategy op

IRI	http://w3id.org/CEON/ontology/cvn/plansToImplementStrategy
Sub Property Of	relatedStrategy op
Domain	CVNBlueprint c
Range	CircularStrategy c

related strategy op

IRI	http://w3id.org/CEON/ontology/cvn/relatedStrategy
Super Property Of	• implementsStrategy op • plansToImplementStrategy op

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

title ap

IRI	http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI	http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI	http://purl.org/vocab/vann/preferredNamespaceUri

Namespaces

:

http://w3id.org/CEON/ontology/cvn/

actor

http://w3id.org/CEON/ontology/actor/

actorODP

http://w3id.org/CEON/ontology/actorODP/

dcterms

http://purl.org/dc/terms/

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

processODP

http://w3id.org/CEON/ontology/processODP/

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

resourceODP

http://w3id.org/CEON/ontology/resourceODP/

value

http://w3id.org/CEON/ontology/value/

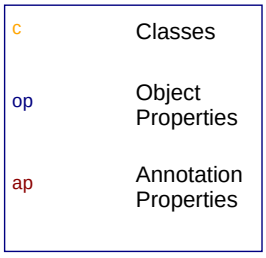
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Material Module

Metadata

IRI

http://w3id.org/CEON/ontology/material/

Title

Circular Economy Ontology Network (CEON) - Material Module

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-12-17

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Version Iri

http://w3id.org/CEON/ontology/material/0.3/

Version Info

0.3

Preferred Namespace Prefix

material

Preferred Namespace Uri

http://w3id.org/CEON/ontology/material/

Description

The Material module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: CVN-Resource-2, CVN-ResourceType-4, C3-3, E1-3, E2-4, E5-2, T1-1, T10-2.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: CE5-2, C3-3, E1-3, E2-4, E5-2, T1-1, T10-2.

Classes

Aluminum [C]

IRI	http://w3id.org/CEON/ontology/material/Aluminum
Sub Class Of	ChemicalElement [C]

Boron [C]

IRI	http://w3id.org/CEON/ontology/material/Boron
Sub Class Of	ChemicalElement [C]

Celulose [c]

IRI	http://w3id.org/CEON/ontology/material/Celulose
Sub Class Of	ChemicalElement [c]

Chemical Element [c]

IRI	http://w3id.org/CEON/ontology/material/ChemicalElement
Sub Class Of	Chemical substance [c]
Super Class Of	Aluminum [c] Boron [c] Celulose [c] Chromium [c] Copper [c] Dysprosium [c] Iron [c] Magnesium [c] Manganese [c] Neodymium [c] Nickel [c] Niobium [c] Silicon [c] Titanium [c] Zinc [c]

Chemical entity [c]

IRI	http://w3id.org/CEON/ontology/material/ChemicalEntity
Description	A chemical entity is an abstraction of entities that can compose matter. For instance, a chemical entity can be a molecular entity or a chemical substance.
Sub Class Of	resourceODP:Matter [c]
In Range Of	has chemical entity [op]
Super Class Of	Chemical substance [c] Molecular entity [c]

Chemical substance [c]

IRI	http://w3id.org/CEON/ontology/material/ChemicalSubstance
Description	A chemical substance is made up of a collection of molecular entities.
Sub Class Of	Chemical entity [c]
Super Class Of	ChemicalElement [c]

Chromium [c]

IRI	http://w3id.org/CEON/ontology/material/Chromium
Sub Class Of	ChemicalElement [c]

Copper [c]

IRI	http://w3id.org/CEON/ontology/material/Copper
Sub Class Of	ChemicalElement [c]

Dysprosium [c]

IRI	http://w3id.org/CEON/ontology/material/Dysprosium
Sub Class Of	ChemicalElement [c]

Iron [c]

IRI	http://w3id.org/CEON/ontology/material/Iron
Sub Class Of	ChemicalElement [c]

Magnesium [c]

IRI	http://w3id.org/CEON/ontology/material/Magnesium
Sub Class Of	ChemicalElement [c]

Manganese [c]

IRI	http://w3id.org/CEON/ontology/material/Manganese
Sub Class Of	ChemicalElement [c]

Material [c]

IRI	http://w3id.org/CEON/ontology/material/Material
Description	Material as a sub-concept of Matter, can be a substance or a collection of substance which a physical object is composed of.
Sub Class Of	resourceODP:Matter [c]
In Domain Of	has chemical entity [op] has material component [op]
Restriction	has chemical entity [op] some Material [c]

Material component [c]

IRI	http://w3id.org/CEON/ontology/material/MaterialComponent
Description	A material component is a part of a material.
Sub Class Of	resourceODP:Constituent [c]
In Range Of	has material component [op]

Molecular entity [c]

IRI	http://w3id.org/CEON/ontology/material/MolecularEntity
Description	A molecular entity means a singular/distinguishable entity. It can be for instance, atom, ion.
Sub Class Of	Chemical entity [c]

Neodymium [c]

IRI	http://w3id.org/CEON/ontology/material/Neodymium
Sub Class Of	ChemicalElement [c]

Nickel [c]

IRI	http://w3id.org/CEON/ontology/material/Nickel
Sub Class Of	ChemicalElement [c]

Niobium [c]

IRI	http://w3id.org/CEON/ontology/material/Niobium
Sub Class Of	ChemicalElement [c]

Silicon [c]

IRI	http://w3id.org/CEON/ontology/material/Silicon
Sub Class Of	ChemicalElement [c]

Titanium [c]

IRI	http://w3id.org/CEON/ontology/material/Titanium
Sub Class Of	ChemicalElement [c]

Zinc [c]

IRI	http://w3id.org/CEON/ontology/material/Zinc
Sub Class Of	ChemicalElement [c]

Constituent [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Constituent
Super Class Of	Material component [c]

Matter [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Matter
Super Class Of	Chemical entity [c] Material [c]

Object Properties

has chemical entity [op]

IRI	http://w3id.org/CEON/ontology/material/hasChemicalEntity
Description	hasChemicalEntity intends to represent that a material can have a collection of chemical entities.
Domain	Material [c]
Range	Chemical entity [c]

has material component [op]

IRI	http://w3id.org/CEON/ontology/material/hasMaterialComponent
Description	hasMaterialComponent intends to represent that a material can have a collection of components.
Domain	Material [c]
Range	Material component [c]

Datatype Properties

Anonymous Formula dp

IRI http://w3id.org/CEON/ontology/material/AnonymousFormula

Description AnonymousFormula represents that a molecular entity has the anonymous formula in a string.

Descriptive Formula dp

IRI http://w3id.org/CEON/ontology/material/DescriptiveFormula

Description DescriptiveFormula represents that a molecular entity has the descriptive formula in a string.

Hill Formula dp

IRI http://w3id.org/CEON/ontology/material/HillFormula

Description HillFormula represents that a composition has the hill formula in a string.

Reduced Chemical Formula dp

IRI http://w3id.org/CEON/ontology/material/ReducedChemicalFormula

Description ReducedChemicalFormula represents that a molecular entity has the reduced chemical formula in a string.

Annotation Properties

description ap

IRI http://purl.org/dc/elements/1.1/description

Namespaces

:
http://w3id.org/CEON/ontology/material/

dc
http://purl.org/dc/elements/1.1/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

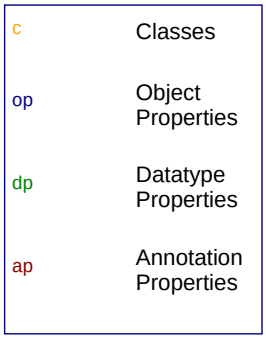
resourceODP

http://w3id.org/CEON/ontology/resourceODP/

vann

http://purl.org/vocab/vann/

Legend



Circular Economy Ontology Network (CEON) - Process Module

Metadata

IRI

http://w3id.org/CEON/ontology/process/

Title

Circular Economy Ontology Network (CEON) - Process Module

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-11-23

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Version Iri

http://w3id.org/CEON/ontology/process/0.4/

Version Info

0.4

Preferred Namespace Prefix

process

Preferred Namespace Uri

https://w3id.org/CEON/ontology/process/

Description

The Process module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: T8-2

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: T8-2

Classes

Energy [c]

IRI	http://w3id.org/CEON/ontology/energy/Energy
Sub Class Of	resourceODP:Resource [c]
In Range Of	needsEnergy [op]

Assembling Process [c]

IRI	http://w3id.org/CEON/ontology/process/AssemblingProcess
Sub Class Of	processODP:TransformationProcess [c]

Buy Resource Process [c]

IRI	http://w3id.org/CEON/ontology/process/BuyResourceProcess
Sub Class Of	processODP:TransformationProcess [c]

Co2Emission [c]

IRI	http://w3id.org/CEON/ontology/process/CO2Emission
Sub Class Of	resourceODP:Resource [c]
In Range Of	producesCO2 [op]

Cathalyst [c]

IRI	http://w3id.org/CEON/ontology/process/Cathalyst
Sub Class Of	resourceODP:Resource [c]
In Range Of	usesCathalyst [op]

Change Resource Process [c]

IRI	http://w3id.org/CEON/ontology/process/ChangeResourceProcess
Sub Class Of	processODP:TransformationProcess [c]

Contact Process [c]

IRI	http://w3id.org/CEON/ontology/process/ContactProcess
Sub Class Of	processODP:TransformationProcess [c]

Deconstruction Process [c]

IRI	http://w3id.org/CEON/ontology/process/DeconstructionProcess
Sub Class Of	processODP:TransformationProcess [c]

Disassembling Process [c]

IRI	http://w3id.org/CEON/ontology/process/DisassemblingProcess
Sub Class Of	processODP:TransformationProcess [c]

Dismantle Process [C]

IRI	http://w3id.org/CEON/ontology/process/DismantleProcess
Sub Class Of	processODP:TransformationProcess [C]

Ensure Claim Process [C]

IRI	http://w3id.org/CEON/ontology/process/EnsureClaimProcess
Sub Class Of	processODP:TransformationProcess [C]

Issuing Certificate Process [C]

IRI	http://w3id.org/CEON/ontology/process/IssuingCertificateProcess
Sub Class Of	processODP:TransformationProcess [C]

Manufacturing Process [C]

IRI	http://w3id.org/CEON/ontology/process/ManufacturingProcess
Sub Class Of	processODP:TransformationProcess [C]

Offset Process [C]

IRI	http://w3id.org/CEON/ontology/process/OffsetProcess
Sub Class Of	processODP:TransformationProcess [C]

Production Process [C]

IRI	http://w3id.org/CEON/ontology/process/ProductionProcess
Sub Class Of	processODP:TransformationProcess [C]

Recycle Process [C]

IRI	http://w3id.org/CEON/ontology/process/RecycleProcess
Sub Class Of	processODP:TransformationProcess [C]

Refurbishment Process [C]

IRI	http://w3id.org/CEON/ontology/process/RefurbishmentProcess
Sub Class Of	processODP:TransformationProcess [C]

Remove Process [C]

IRI	http://w3id.org/CEON/ontology/process/RemoveProcess
Sub Class Of	processODP:TransformationProcess [C]

Remove Resource Process [C]

IRI	http://w3id.org/CEON/ontology/process/RemoveResourceProcess
Sub Class Of	processODP:TransformationProcess [C]

Repair Process [C]

IRI	http://w3id.org/CEON/ontology/process/RepairProcess
Sub Class Of	processODP:TransformationProcess [C]

Resell Process [C]

IRI	http://w3id.org/CEON/ontology/process/ResellProcess
Sub Class Of	processODP:TransformationProcess [C]

Reuse Process [C]

IRI	http://w3id.org/CEON/ontology/process/ReuseProcess
Sub Class Of	processODP:TransformationProcess [C]

Sell Resource Process [C]

IRI	http://w3id.org/CEON/ontology/process/SellResourceProcess
Sub Class Of	processODP:TransformationProcess [C]

Service Process [C]

IRI	http://w3id.org/CEON/ontology/process/ServiceProcess
Sub Class Of	processODP:TransformationProcess [C]

Share Resource Process [C]

IRI	http://w3id.org/CEON/ontology/process/ShareResourceProcess
Sub Class Of	processODP:TransformationProcess [C]

Take Back Process [C]

IRI	http://w3id.org/CEON/ontology/process/TakeBackProcess
Sub Class Of	processODP:TransformationProcess [C]

Transformation Process [C]

IRI	http://w3id.org/CEON/ontology/processODP/TransformationProcess
Super Class Of	AssemblingProcess [C] BuyResourceProcess [C] ChangeResourceProcess [C] ContactProcess [C] DeconstructionProcess [C] DisassemblingProcess [C] DismantleProcess [C] EnsureClaimProcess [C] IssuingCertificateProcess [C] ManufacturingProcess [C] OffsetProcess [C] ProductionProcess [C] RecycleProcess [C] RefurbishmentProcess [C] RemoveProcess [C] RemoveResourceProcess [C] RepairProcess [C] ResellProcess [C] ReuseProcess [C] SellResourceProcess [C] ServiceProcess [C] ShareResourceProcess [C] TakeBackProcess [C]

Resource [C]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource
In Range Of	resultingResource [op]
Super Class Of	http://w3id.org/CEON/ontology/energy/Energy [C] CO2Emission [C] Cathalyst [C]

Object Properties

needs energy [op]

IRI	http://w3id.org/CEON/ontology/process/needsEnergy
Sub Property Of	processODP:hasInput [op]
Range	http://w3id.org/CEON/ontology/energy/Energy [c]

produces co2 [op]

IRI	http://w3id.org/CEON/ontology/process/producesCO2
Sub Property Of	processODP:hasOutput [op]
Range	CO2Emission [c]

resulting resource [op]

IRI	http://w3id.org/CEON/ontology/process/resultingResource
Sub Property Of	processODP:hasOutput [op]
Range	resourceODP:Resource [c]

uses cathalyst [op]

IRI	http://w3id.org/CEON/ontology/process/usesCathalyst
Sub Property Of	processODP:hasInput [op]
Range	Cathalyst [c]

has input [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasInput
Super Property Of	• needsEnergy [op] • usesCathalyst [op]

has output [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasOutput
Super Property Of	• producesCO2 [op] • resultingResource [op]

Annotation Properties

contributor ap

IRI http://purl.org/dc/terms/contributor

created ap

IRI http://purl.org/dc/terms/created

creator ap

IRI http://purl.org/dc/terms/creator

description ap

IRI http://purl.org/dc/terms/description

license ap

IRI http://purl.org/dc/terms/license

title ap

IRI http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:

http://w3id.org/CEON/ontology/process/

dcterms

http://purl.org/dc/terms/

odp

http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl

http://www.w3.org/2002/07/owl#

processODP

http://w3id.org/CEON/ontology/processODP/

prov

http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

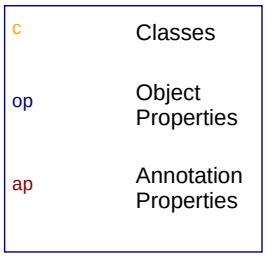
resourceODP

http://w3id.org/CEON/ontology/resourceODP/

vann

http://purl.org/vocab/vann/

Legend



Circular Economy Ontology Network (CEON) - Process ODP

Metadata

IRI

http://w3id.org/CEON/ontology/processODP/

Title

Circular Economy Ontology Network (CEON) - Process ODP

Creator

Eva Blomqvist

Contributor

Huanyu Li

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-12-17

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Version Iri

http://w3id.org/CEON/ontology/processODP/0.4/

Version Info

0.4

Preferred Namespace Prefix

processODP

Preferred Namespace Uri

http://w3id.org/CEON/ontology/processODP/

Description

A core ODP of the CEON ontology network, defining aspects of the process concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.1: CVN-Process-3,4,5, C3-1, C4-2, C4-5, C4-7, C4-9, C13-2, E2-6

Covers the following requirements from Onto-DESIDE D3.2: CE1-1, CE3-5, CE7-4, CE7-5, CE8-2, CE10-7, CE12-1, C3-1, C4-2, C4-5, C4-7, C4-9, C13-2, E2-6

Classes

Location [c]

IRI	http://w3id.org/CEON/ontology/location/Location
In Range Of	occursAtLocation [op]

Description [c]

IRI	http://w3id.org/CEON/ontology/processODP/Description
Super Class Of	Plan [c]

Event[c]

IRI	http://w3id.org/CEON/ontology/processODP/Event
Super Class Of	Process[c]

Plan[c]

IRI	http://w3id.org/CEON/ontology/processODP/Plan
Sub Class Of	Description[c]
Restriction	hasPart[op] some Plan[c]

Plan Execution[c]

IRI	http://w3id.org/CEON/ontology/processODP/PlanExecution
Sub Class Of	Situation[c] duringTime[op] some TimeInterval[c] *or* occursAtTime[dp] some xsd:dateTime[c]
In Domain Of	followsExecution[op] precedesExecution[op] occursAtTime[dp]
Restriction	followsExecution[op] some PlanExecution[c] hasPart[op] some PlanExecution[c] isSettingFor[op] some PlanExecution[c] precedesExecution[op] some PlanExecution[c] satisfiesPlan[op] some PlanExecution[c]
Super Class Of	Transition[c]

Process[c]

IRI	http://w3id.org/CEON/ontology/processODP/Process
Is Defined By	ISO 59004:2024 - 3.5.5 process
Description	Set of interrelated or interacting activities that transforms inputs into outputs.
Sub Class Of	Event[c]
In Domain Of	hasInput[op] hasOutput[op] hasProcessType[op]
Super Class Of	TransformationProcess[c]

Process Type [c]

IRI	http://w3id.org/CEON/ontology/processODP/ProcessType
In Range Of	hasProcessType [op]

Situation [c]

IRI	http://w3id.org/CEON/ontology/processODP/Situation
In Domain Of	isSettingFor [op]
Restriction	isSettingFor [op] some Situation [c]
Super Class Of	PlanExecution [c]

Time Interval [c]

IRI	http://w3id.org/CEON/ontology/processODP/TimeInterval
In Domain Of	endTime [dp] startTime [dp]
In Range Of	duringTime [op]

Transformation Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/TransformationProcess
Sub Class Of	Process [c]

Transition [c]

IRI	http://w3id.org/CEON/ontology/processODP/Transition
Sub Class Of	PlanExecution [c]
In Domain Of	affectedObject [op] duringTime [op]
Restriction	isSettingFor [op] some Transition [c] affectedObject [op] *min* 1 Transition [c]

Object Properties

affected object [op]

IRI	http://w3id.org/CEON/ontology/processODP/affectedObject
Sub Property Of	isSettingFor [op]
Domain	Transition [c]

during time [op]

IRI	http://w3id.org/CEON/ontology/processODP/duringTime
Sub Property Of	isSettingFor [op]
Domain	Transition [c]
Range	TimeInterval [c]

follows execution [op]

IRI	http://w3id.org/CEON/ontology/processODP/followsExecution
Sub Property Of	isSettingFor [op]
Domain	PlanExecution [c]

has input [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasInput
Domain	Process [c]

has output [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasOutput
Domain	Process [c]

has part [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasPart

has plan execution [op]

IRI	http://w3id.org/CEON/ontology/processODP/hasPlanExecution
Description	A plan can have specific executions.

has process type op

IRI	http://w3id.org/CEON/ontology/processODP/hasProcessType
Domain	Process c
Range	ProcessType c

is setting for op

IRI	http://w3id.org/CEON/ontology/processODP/isSettingFor
Super Property Of	• affectedObject op • duringTime op • followsExecution op • occursAtLocation op • precedesExecution op
Domain	Situation c

occurs at location op

IRI	http://w3id.org/CEON/ontology/processODP/occursAtLocation
Sub Property Of	isSettingFor op
Range	http://w3id.org/CEON/ontology/location/Location c

precedes execution op

IRI	http://w3id.org/CEON/ontology/processODP/precedesExecution
Sub Property Of	isSettingFor op
Domain	PlanExecution c

satisfies plan op

IRI	http://w3id.org/CEON/ontology/processODP/satisfiesPlan

Datatype Properties

end time dp

IRI	http://w3id.org/CEON/ontology/processODP/endTime
Domain	TimeInterval c

occurs at time dp

IRI	http://w3id.org/CEON/ontology/processODP/occursAtTime
Domain	PlanExecution c
Range	xsd:dateTime

start time dp

IRI	http://w3id.org/CEON/ontology/processODP/startTime
Domain	TimeInterval c

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

license ap

IRI	http://purl.org/dc/terms/license

title ap

IRI	http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI	http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:
http://w3id.org/CEON/ontology/processODP/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

vann
http://purl.org/vocab/vann/

xsd
http://www.w3.org/2001/XMLSchema#

Legend

c	Classes
op	Object Properties
dp	Datatype Properties
ap	Annotation Properties

Circular Economy Ontology Network (CEON) - Product Module

Metadata

IRI

http://w3id.org/CEON/ontology/product/

Title

Circular Economy Ontology Network (CEON) - Product Module

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2023-03-16

License

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Version Iri

http://w3id.org/CEON/ontology/product/0.4/

Version Info

0.4

Preferred Namespace Prefix

product

Preferred Namespace Uri

http://w3id.org/CEON/ontology/product/

Description

The Product module of CEON (Circular Economy Ontology Network).

Covers Requirements

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.1: CVN-Resource-2, CVN-ResrouceType-4, C11-2, C12-1, C13-3, E2-1, T8-3.

In addition to requirements covered by imported ODPs, covers the following requirements from Onto-DESIDE D3.2: CE5-2, C11-2, C12-1, C13-3, E2-1, T8-3.

Classes

Actor [C]

IRI http://w3id.org/CEON/ontology/actorODP/Actor

Resource Relation [C]

IRI http://w3id.org/CEON/ontology/actorODP/ResourceRelation

Super Class Of resourceODP:Composition [C]

Process [c]

IRI	http://w3id.org/CEON/ontology/processODP/Process

Compliance [c]

IRI	http://w3id.org/CEON/ontology/product/Compliance
In Domain Of	complianceWith [op] hasCertificate [dp]
In Range Of	hasCompliance [op]

Item [c]

IRI	http://w3id.org/CEON/ontology/product/Item
Description	An item is a physical object put into a market for sale, i.e. corresponding to an individual of a product. The item can be a thing that grows naturally or produced through some chemical or manufacturing processes.
Sub Class Of	resourceODP:PhysicalObject [c]
In Domain Of	hasProductObjectComponent [op] modelled by [op]
In Range Of	associatedWithProductObject [op] hasProductObjectComponent [op]
Restriction	modelled by [op] *exactly* 1 Item [c]

Matter composition [c]

IRI	http://w3id.org/CEON/ontology/product/MatterComposition
Description	A product composition is the composed information of a product in terms of a specific component, in which such a component is also a matter.
Sub Class Of	resourceODP:Composition [c]
In Domain Of	associated with matter [op]
Restriction	associated with matter [op] *exactly* 1 Matter composition [c]

Product [c]

IRI	http://w3id.org/CEON/ontology/product/Product
Is Defined By	ISO 59004:2024 -3.2.2 product
Description	Physical-based object designed for or utilized with a purpose. A product can be, for example: goods of any type; hardware (e.g. engine mechanical part, spare parts, consumables); electrical or electronic hardware devices or components (e.g. computers, communication equipment and sensors); processed materials (e.g. lubricant, cement). Represents the common sense notion of a product, i.e. the abstract notion of a product type, which is a model that is used for manufacturing items of that product.
Sub Class Of	Solution [c]
In Domain Of	has product component [op]
In Range Of	associated with product model [op] batch of products [op] has product component [op] modelled by [op]
Restriction	hasComposition [op] some Product [c] hasComposition [op] some Product [c]

Product composition [c]

IRI	http://w3id.org/CEON/ontology/product/ProductComposition
Description	A product composition is the composed information of a product in terms of a specific component, in which such a component is also a product.
Sub Class Of	resourceODP:Composition [c]
In Domain Of	associated with product model [op]
Restriction	associated with product model [op] *exactly* 1 Product composition [c]

Product Object Composition [c]

IRI	http://w3id.org/CEON/ontology/product/ProductObjectComposition
Sub Class Of	resourceODP:Composition [c]
In Domain Of	associatedWithProductObject [op]
Restriction	associatedWithProductObject [op] *exactly* 1 ProductObjectComposition [c]

Solution [c]

IRI	http://w3id.org/CEON/ontology/product/Solution
Is Defined By	ISO 59004:2024 - 3.2.1 solution
Description	Product or service, or a combination thereof, that fulfils a need of an interested party.
Super Class Of	Product [c]

Batch Of Objects [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/BatchOfObjects
In Domain Of	batch of products [op]
Restriction	batch of products [op] *exactly* 1 resourceODP:BatchOfObjects [c]

Composition [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Composition
Sub Class Of	actorODP:ResourceRelation [c]
In Domain Of	compositionOf [op] Composition quantity [dp]
In Range Of	hasComposition [op]
Super Class Of	Matter composition [c] Product composition [c] ProductObjectComposition [c]

Matter [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Matter
In Range Of	associated with matter [op]

Physical Object [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/PhysicalObject
Super Class Of	Item [c]

Object Properties

associated with matter op

IRI	http://w3id.org/CEON/ontology/product/associatedWithMatter
Description	associatedWithMatter intends to represent the matter to which a matter compopsition information regards to.
Domain	Matter composition c
Range	resourceODP:Matter c

associated with product model op

IRI	http://w3id.org/CEON/ontology/product/associatedWithProductModel
Description	associatedWithProductModel intends to represent the product model to which a product compopsition information regards to.
Domain	Product composition c
Range	Product c

associated with product object op

IRI	http://w3id.org/CEON/ontology/product/associatedWithProductObject
Sub Property Of	topObjectProperty op
Domain	ProductObjectComposition c
Range	Item c

batch of products op

IRI	http://w3id.org/CEON/ontology/product/batchOfProduct
Description	batchOfProduct intends to represent what is the model product of a batch of objects.
Domain	resourceODP:BatchOfObjects c
Range	Product c

compliance with op

IRI	http://w3id.org/CEON/ontology/product/complianceWith
Domain	Compliance c

composition of [op]

IRI	http://w3id.org/CEON/ontology/product/compositionOf
Domain	resourceODP:Composition [c]
Range	Product [c] *or* Item [c] *or* resourceODP:Matter [c]

has compliance [op]

IRI	http://w3id.org/CEON/ontology/product/hasCompliance
Domain	Item [c] *or* Product [c] *or* actorODP:Actor [c] *or* http://w3id.org/CEON/ontology/processODP/Process [c]
Range	Compliance [c]

has composition [op]

IRI	http://w3id.org/CEON/ontology/product/hasComposition
Description	hasComposition intends to represent that a product model or physical object can have compostition information.
Domain	resourceODP:PhysicalObject [c] *or* Product [c]
Range	resourceODP:Composition [c]

has product component [op]

IRI	http://w3id.org/CEON/ontology/product/hasProductComponent
Description	hasProductComponent intends to represent that a product can have other product components.
Domain	Product [c]
Range	Product [c]

has product object component [op]

IRI	http://w3id.org/CEON/ontology/product/hasProductObjectComponent
Domain	Item [c]
Range	Item [c]

modelled by op

IRI	http://w3id.org/CEON/ontology/product/modelledBy
Description	modelledBy intends to represent that product objects follow particular product models.
Domain	Item c
Range	Product c

Datatype Properties

Composition quantity dp

IRI	http://w3id.org/CEON/ontology/product/compositionQuantity
Domain	resourceODP:Composition c
Range	xsd:double

country of assembly dp

IRI	http://w3id.org/CEON/ontology/product/countryOfAssembly
Sub Property Of	locationOfAssembly dp

country of manufacture dp

IRI	http://w3id.org/CEON/ontology/product/countryOfManufacture
Sub Property Of	locationOfManufacture dp

country of origin dp

IRI	http://w3id.org/CEON/ontology/product/countryOfOrigin
Sub Property Of	locationOfOrigin dp

has certificate dp

IRI	http://w3id.org/CEON/ontology/product/hasCertificate
Domain	Compliance c

location of assembly dp

IRI	http://w3id.org/CEON/ontology/product/locationOfAssembly
Super Property Of	countryOfAssembly dp
Domain	Product c *or* Item c
Range	xsd:string

location of manufacture dp

IRI	http://w3id.org/CEON/ontology/product/locationOfManufacture
Super Property Of	countryOfManufacture dp
Domain	Item c *or* Product c
Range	xsd:string

location of origin dp

IRI	http://w3id.org/CEON/ontology/product/locationOfOrigin
Super Property Of	countryOfOrigin dp
Domain	Item c *or* Product c
Range	xsd:string

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

license [ap]

IRI http://purl.org/dc/terms/license

title [ap]

IRI http://purl.org/dc/terms/title

preferred namespace prefix [ap]

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri [ap]

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements [ap]

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

Namespaces

:
http://w3id.org/CEON/ontology/product/

actorODP
http://w3id.org/CEON/ontology/actorODP/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

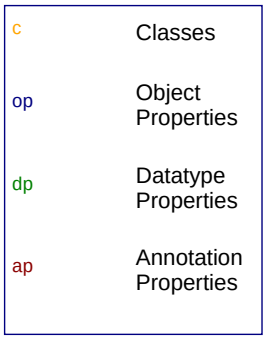
rdfs
http://www.w3.org/2000/01/rdf-schema#

resourceODP
http://w3id.org/CEON/ontology/resourceODP/

vann
http://purl.org/vocab/vann/

xsd
http://www.w3.org/2001/XMLSchema#

Legend


c
Classes
op
Object Properties
dp
Datatype Properties
ap
Annotation Properties

Circular Economy Ontology Network (CEON) - Resource ODP

Metadata

IRI

http://w3id.org/CEON/ontology/resourceODP/

Title

Circular Economy Ontology Network (CEON) - Resource ODP

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-11-12

License

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Version Iri

http://w3id.org/CEON/ontology/resourceODP/0.4/

Version Info

0.4

Preferred Namespace Prefix

resourceODP

Preferred Namespace Uri

http://w3id.org/CEON/ontology/resourceODP/

Description

A core ODP of the CEON ontology network defining aspects of the resource concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.1: CVN-Resource-1,3, CVN-Composition-1,2, CVN-ResrouceType-4, C7-3, E2-2, E4-6, E5-1, E6-3, T3-1.

Covers the following requirements from Onto-DESIDE D3.2: CE1-2, CE3-3, CE4-3, CE5-2, CE9-1, CE10-1, CE11-8, CE12-2, CE12-4, C7-3, E2-2, E4-6, E5-1, E6-3, T3-1.

Classes

Location [c]

IRI http://w3id.org/CEON/ontology/location/Location

In Range Of hasResourceLocation [op]

Asset [c]

IRI http://w3id.org/CEON/ontology/resourceODP/Asset

Super Class Of Information [c]
Resource [c]

Batch [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Batch
Description	A batch of objects is a collection of physical objects that are of the same type, e.g. a set of items (product instances) adhering to the same product model.
Sub Class Of	Resource [c] has physical object [op] some Physical object [c] *and* has physical object [op] only Physical object [c]
In Domain Of	batch size [dp]
In Range Of	has batch [op]
Restriction	batch size [dp] *exactly* 1 Batch [c]

Constituent [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Constituent
Description	A constituent is a component of object.
In Range Of	has constituent [op]

Digital object [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/DigitalObject
Sub Class Of	Resource [c]

Information [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Information
Description	Information is an abstract concept that represents any kind of interpretations. For instance, information can be data generated by software systems or data used by people for communications.
Sub Class Of	Asset [c]
In Domain Of	containsInformation [op] isAbout [op]
In Range Of	containsInformation [op] is realization of [op]

Matter [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Matter
Description	A matter is a physical substance.
In Range Of	has matter [op]

Physical object [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/PhysicalObject
Description	A physical object is a collection of matter.
Sub Class Of	Resource [c] has constituent [op] some Constituent [c] *and* has constituent [op] only Constituent [c] has matter [op] only Matter [c] *and* has matter [op] some Matter [c]
In Domain Of	has constituent [op] has matter [op]
In Range Of	has physical object [op]

Resource [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/Resource
Is Defined By	ISO 59004:2024 - 3.1.5 resource
Description	Asset from which a solution is created or implemented. Depending on the context, reference to “resource” includes “raw material”, “feedstock”, “material” or “component”. Resource includes any energy type (e.g. the energy content or energy potential of materials). Note 4 to entry: Resources can be considered concerning both stocks and flows.
Sub Class Of	Asset [c]
In Domain Of	hasResourceLocation [op]
Super Class Of	Batch [c] Digital object [c] Physical object [c] Set of objects [c]

Set of objects [c]

IRI	http://w3id.org/CEON/ontology/resourceODP/SetOfObjects
Description	A set of objects is a set of physical objects (items) that can be of different types, i.e. different kinds of items.
Sub Class Of	Resource [c] has batch [op] only Batch [c] *and* has batch [op] some Batch [c] has physical object [op] only Physical object [c] *and* has physical object [op] some Physical object [c]
In Domain Of	has batch [op]

Object Properties

has location [op]

IRI	http://w3id.org/CEON/ontology/location/hasLocation
Super Property Of	hasResourceLocation [op]

contains information [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/containsInformation
Sub Property Of	hasPart [op]
Domain	Information [c]
Range	Information [c]

has batch [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/hasBatch
Description	hasBatch intends to represent that a set of objects can be captured by a number of batches where each batch contains a number of physical objects.
Domain	Set of objects [c]
Range	Batch [c]

has constituent [op]

IRI	`http://w3id.org/CEON/ontology/resourceODP/hasConstituent`
Description	hasConstitutent intends to represent that a physical object can have a collection of composing components.
Sub Property Of	hasPart [op]
Domain	Physical object [c]
Range	Constituent [c]

has matter [op]

IRI	`http://w3id.org/CEON/ontology/resourceODP/hasMatter`
Description	hasMatter intends to represent that a physical object can have a collection of matter.
Domain	Physical object [c]
Range	Matter [c]

has part [op]

IRI	`http://w3id.org/CEON/ontology/resourceODP/hasPart`
Super Property Of	• containsInformation [op] • has constituent [op]

has physical object [op]

IRI	`http://w3id.org/CEON/ontology/resourceODP/hasPhysicalObject`
Description	hasPhysicalObject intends to represent that a batch of objects or a set of objects can have composing components of physical objects.
Domain	Batch [c] *or* Set of objects [c]
Range	Physical object [c]

has resource location [op]

IRI	`http://w3id.org/CEON/ontology/resourceODP/hasResourceLocation`
Sub Property Of	location:hasLocation [op]
Domain	Resource [c]
Range	location:Location [c]

is about [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/isAbout
Domain	Information [c]

is realization of [op]

IRI	http://w3id.org/CEON/ontology/resourceODP/isRealizationOf
Range	Information [c]

Datatype Properties

batch size [dp]

IRI	http://w3id.org/CEON/ontology/resourceODP/batchSize
Description	batchSize intends to repsent how many physical objects are belong to a batch of objects.
Domain	Batch [c]
Range	xsd:nonNegativeInteger

Annotation Properties

description [ap]

IRI	http://purl.org/dc/elements/1.1/description

contributor [ap]

IRI	http://purl.org/dc/terms/contributor

created [ap]

IRI	http://purl.org/dc/terms/created

creator [ap]

IRI	http://purl.org/dc/terms/creator

description [ap]

IRI	http://purl.org/dc/terms/description

license ap

IRI http://purl.org/dc/terms/license

title ap

IRI http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

definition ap

IRI http://www.w3.org/2004/02/skos/core#definition

pref label ap

IRI http://www.w3.org/2004/02/skos/core#prefLabel

Namespaces

:
http://w3id.org/CEON/ontology/resourceODP/

dc
http://purl.org/dc/elements/1.1/

dcterms
http://purl.org/dc/terms/

geo
http://www.opengis.net/ont/geosparql#

location
http://w3id.org/CEON/ontology/location/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

skos

http://www.w3.org/2004/02/skos/core#

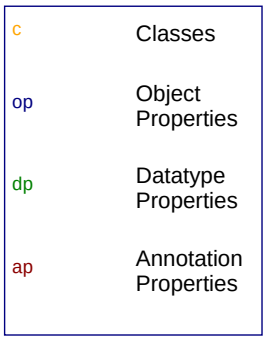
vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend



Circular Economy Ontology Network (CEON) - Energy Module

Metadata

IRI

http://w3id.org/CEON/ontology/energy/

Title

Circular Economy Ontology Network (CEON) - Energy Module

Creator

Huanyu Li

Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-11-01

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Version Iri

http://w3id.org/CEON/ontology/energy/0.1/

Version Info

0.1

Preferred Namespace Prefix

energy

Preferred Namespace Uri

http://w3id.org/CEON/ontology/energy/

Description

A module of the CEON ontology network defining aspects of the energy concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.2: CE1-2, CE4-3, CE6-3, CE7-4, CE8-2, CE10-7, CE10-9, CE11-6, CE12-5.

Classes

Anergy[c]

IRI	http://w3id.org/CEON/ontology/energy/Anergy
Sub Class Of	Energy[c]
In Range Of	hasAnergy[op]

Biofuel[c]

IRI	http://w3id.org/CEON/ontology/energy/Biofuel
Sub Class Of	Biomass[c]

Biogas [c]

IRI	http://w3id.org/CEON/ontology/energy/Biogas
Sub Class Of	Biomass [c]

Biomass [c]

IRI	http://w3id.org/CEON/ontology/energy/Biomass
Sub Class Of	EnergySource [c]
Super Class Of	Biofuel [c] Biogas [c]

Coal [c]

IRI	http://w3id.org/CEON/ontology/energy/Coal
Sub Class Of	FossilFuel [c]

Energy [c]

IRI	http://w3id.org/CEON/ontology/energy/Energy
Sub Class Of	http://w3id.org/CEON/ontology/resourceODP/Resource
In Domain Of	hasEnergySource [op]
Super Class Of	Anergy [c] Exergy [c] NonRenewableEnergy [c] RenewableEnergy [c]

Energy Composition [c]

IRI	http://w3id.org/CEON/ontology/energy/EnergyComposition
Sub Class Of	http://w3id.org/CEON/ontology/actorODP/ResourceParticipation
In Domain Of	hasEnergyComponentPercentage [dp]

Energy Conversion [c]

IRI	http://w3id.org/CEON/ontology/energy/EnergyConversion
Sub Class Of	http://w3id.org/CEON/ontology/actorODP/ResourceRelation

Energy Infrastructure [c]

IRI	http://w3id.org/CEON/ontology/energy/EnergyInfrastructure
Sub Class Of	http://w3id.org/CEON/ontology/actorODP/Infrastructure

Energy Source [c]

IRI	http://w3id.org/CEON/ontology/energy/EnergySource
In Domain Of	hasCarbonIntensity [dp] hasSustainability [dp]
In Range Of	hasEnergySource [op]
Super Class Of	Biomass [c] FossilFuel [c] GeothermalEnergySource [c] Hydropower [c] SolarEnergySource [c] Wind [c]

Exergy [c]

IRI	http://w3id.org/CEON/ontology/energy/Exergy
Sub Class Of	Energy [c]
In Range Of	hasExergy [op]

Fossil Fuel [c]

IRI	http://w3id.org/CEON/ontology/energy/FossilFuel
Sub Class Of	EnergySource [c]
Super Class Of	Coal [c] NaturalGas [c] Petroleum [c]

Geothermal Energy Source [c]

IRI	http://w3id.org/CEON/ontology/energy/GeothermalEnergySource
Sub Class Of	EnergySource [c]

Hydropower [c]

IRI	http://w3id.org/CEON/ontology/energy/Hydropower
Sub Class Of	EnergySource [c]

Natural Gas [c]

IRI	http://w3id.org/CEON/ontology/energy/NaturalGas
Sub Class Of	FossilFuel [c]

Non Renewable Energy [c]

IRI	http://w3id.org/CEON/ontology/energy/NonRenewableEnergy
Sub Class Of	Energy [c]

Petroleum [c]

IRI	http://w3id.org/CEON/ontology/energy/Petroleum
Sub Class Of	FossilFuel [c]

Renewable Energy [c]

IRI	http://w3id.org/CEON/ontology/energy/RenewableEnergy
Sub Class Of	Energy [c]

Solar Energy Source [c]

IRI	http://w3id.org/CEON/ontology/energy/SolarEnergySource
Sub Class Of	EnergySource [c]

Wind [c]

IRI	http://w3id.org/CEON/ontology/energy/Wind
Sub Class Of	EnergySource [c]

Object Properties

has anergy [op]

IRI	http://w3id.org/CEON/ontology/energy/hasAnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingObject
Range	Anergy [c]

has converted energy op

IRI	http://w3id.org/CEON/ontology/energy/hasConvertedEnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingResource
Range	RenewableEnergy c *or* NonRenewableEnergy c

has energy source op

IRI	http://w3id.org/CEON/ontology/energy/hasEnergySource
Domain	Energy c
Range	EnergySource c

has exergy op

IRI	http://w3id.org/CEON/ontology/energy/hasExergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingObject
Range	Exergy c

has original energy op

IRI	http://w3id.org/CEON/ontology/energy/hasOriginalEnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingResource
Range	RenewableEnergy c *or* NonRenewableEnergy c

participating energy op

IRI	http://w3id.org/CEON/ontology/energy/participatingEnergy
Sub Property Of	http://w3id.org/CEON/ontology/actorODP/participatingSubject

Datatype Properties

has carbon intensity dp

IRI	http://w3id.org/CEON/ontology/energy/hasCarbonIntensity
Domain	EnergySource c

has energy component percentage dp

IRI	http://w3id.org/CEON/ontology/energy/hasEnergyComponentPercentage
Domain	EnergyComposition c

has sustainability dp

IRI	http://w3id.org/CEON/ontology/energy/hasSustainability
Domain	EnergySource c

Annotation Properties

description ap

IRI	http://purl.org/dc/elements/1.1/description

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

license ap

IRI	http://purl.org/dc/terms/license

title ap

IRI	http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

definition ap

IRI http://www.w3.org/2004/02/skos/core#definition

pref label ap

IRI http://www.w3.org/2004/02/skos/core#prefLabel

Namespaces

:
http://w3id.org/CEON/ontology/energy/

dc
http://purl.org/dc/elements/1.1/

dcterms
http://purl.org/dc/terms/

geo
http://www.opengis.net/ont/geosparql#

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

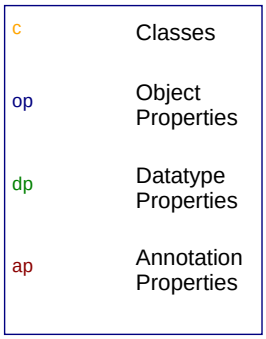
rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

skos
http://www.w3.org/2004/02/skos/core#

vann
http://purl.org/vocab/vann/

Legend


c
Classes
op
Object Properties
dp
Datatype Properties
ap
Annotation Properties

Circular Economy Ontology Network (CEON) - Value Module

Metadata

IRI

`http://w3id.org/CEON/ontology/value/`

Title

Circular Economy Ontology Network (CEON) - Value Module

Creator

Eva Blomqvist

Contributor

Huanyu Li

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2023-03-30

License

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Version Iri

http://w3id.org/CEON/ontology/value/0.2/

Version Info

0.2

Preferred Namespace Prefix

value

Preferred Namespace Uri

https://w3id.org/CEON/ontoloy/value/

Description

A core ODP of the CEON ontology network, defining aspects of the value concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.2: CE1-3, CE5-16, CE5-17.

Classes

Resource [C]

IRI	`http://w3id.org/CEON/ontology/resourceODP/Resource`
In Range Of	hasValuableResource [OP] targettingResource [OP]

Economic Value [C]

IRI	`http://w3id.org/CEON/ontology/value/EconomicValue`
Sub Class Of	Value [C]
Equivalentclass	UseValue [C]

Environmental Value [c]

IRI	http://w3id.org/CEON/ontology/value/EnvironmentalValue
Sub Class Of	Value [c]

Exchange Value [c]

IRI	http://w3id.org/CEON/ontology/value/ExchangeValue
Sub Class Of	Value [c]

Social Value [c]

IRI	http://w3id.org/CEON/ontology/value/SocialValue
Sub Class Of	Value [c]

Use Value [c]

IRI	http://w3id.org/CEON/ontology/value/UseValue
Sub Class Of	Value [c]

Value [c]

IRI	http://w3id.org/CEON/ontology/value/Value
Is Defined By	ISO 59004:2024 - 3.1.7 value
Description	Gain(s) or benefit(s) from satisfying needs and expectations, in relation to the use and conservation of resources. EXAMPLE: Revenue, savings, productivity, sustainability, satisfaction, empowerment, engagement, experience, public health, trust. Value is relative to, and determined by the perception of, those interested party(ies) able to capture it. Value can be financial or non-financial, e.g. social, environmental, other gains or benefits. Value is dynamic over time.
In Range Of	hasAimedValue [op] hasAssociatedValue [op]
Super Class Of	EconomicValue [c] EnvironmentalValue [c] ExchangeValue [c] SocialValue [c] UseValue [c]

Value Participation [c]

IRI	http://w3id.org/CEON/ontology/value/ValueParticipation
Sub Class Of	actorODP:Participation
In Domain Of	hasValuableResource [op] valueParticipantRole [op]
In Range Of	onParticipation [op] targettingValueParticipation [op]
Restriction	hasAssociatedValue [op] some ValueParticipation [c]

Value Participation Role [c]

IRI	http://w3id.org/CEON/ontology/value/ValueParticipationRole
Sub Class Of	actorODP:Role
In Range Of	valueParticipantRole [op]
Named Individuals	ValueConsumer [ni] ValueContributor [ni] ValueCreator [ni] ValueDestroyer [ni] ValueDistributor [ni] ValueEvaluator [ni]

Value Perception [c]

IRI	http://w3id.org/CEON/ontology/value/ValuePerception
In Domain Of	hasAssociatedValue [op] onParticipation [op]
In Range Of	hasPerception [op]

Value Perception Type [c]

IRI	http://w3id.org/CEON/ontology/value/ValuePerceptionType

Value Proposition [c]

IRI	http://w3id.org/CEON/ontology/value/ValueProposition
In Domain Of	hasAimedValue [op] proposedBy [op] targettingActor [op] targettingResource [op] targettingValueParticipation [op]
Restriction	hasAimedValue [op] some ValueProposition [c] targettingActor [op] some ValueProposition [c] targettingValueParticipation [op] some ValueProposition [c]

Object Properties

has aimed value [op]

IRI	http://w3id.org/CEON/ontology/value/hasAimedValue
Domain	ValueProposition [c]
Range	Value [c]

has associated value [op]

IRI	http://w3id.org/CEON/ontology/value/hasAssociatedValue
Sub Property Of	topObjectProperty [op]
Domain	ValuePerception [c]
Range	Value [c]

has perception [op]

IRI	http://w3id.org/CEON/ontology/value/hasPerception
Domain	ValueProposition [c] *or* actorODP:Actor [c]
Range	ValuePerception [c]

has perception type [op]

IRI	http://w3id.org/CEON/ontology/value/hasPerceptionType

has vp targets [op]

IRI	`http://w3id.org/CEON/ontology/value/hasVPTargets`
Super Property Of	• targettingActor [op] • targettingResource [op] • targettingValueParticipation [op]

has valuable resource [op]

IRI	`http://w3id.org/CEON/ontology/value/hasValuableResource`
Sub Property Of	topObjectProperty [op]
Domain	ValueParticipation [c]
Range	http://w3id.org/CEON/ontology/resourceODP/Resource [c]

on participation [op]

IRI	`http://w3id.org/CEON/ontology/value/onParticipation`
Domain	ValuePerception [c]
Range	ValueParticipation [c]

proposed by [op]

IRI	`http://w3id.org/CEON/ontology/value/proposedBy`
Domain	ValueProposition [c]
Range	actorODP:Actor

targetting actor [op]

IRI	`http://w3id.org/CEON/ontology/value/targettingActor`
Sub Property Of	hasVPTargets [op]
Domain	ValueProposition [c]
Range	actorODP:Actor

targetting resource [op]

IRI	`http://w3id.org/CEON/ontology/value/targettingResource`
Sub Property Of	hasVPTargets [op]
Domain	ValueProposition [c]
Range	http://w3id.org/CEON/ontology/resourceODP/Resource [c]

targetting value participation op

IRI	http://w3id.org/CEON/ontology/value/targettingValueParticipation
Sub Property Of	hasVPTargets op
Domain	ValueProposition c
Range	ValueParticipation c

value participant role op

IRI	http://w3id.org/CEON/ontology/value/valueParticipantRole
Sub Property Of	actorODP:participantRole
Domain	ValueParticipation c
Range	ValueParticipationRole c

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

license ap

IRI	http://purl.org/dc/terms/license

title ap

IRI	http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

Namespaces

:
http://w3id.org/CEON/ontology/value/

actorODP
http://w3id.org/CEON/ontology/actorODP/

dcterms
http://purl.org/dc/terms/

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

vann
http://purl.org/vocab/vann/

xsd
http://www.w3.org/2001/XMLSchema#

Legend

c	Classes
op	Object Properties
ap	Annotation Properties

Circular Economy Ontology Network (CEON) - Statement Module

Metadata

IRI

http://w3id.org/CEON/ontology/statement/

Title

Circular Economy Ontology Network (CEON) - Statement Module

Creator

Eva Blomqvist

Contributor

Huanyu Li

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2024-12-05

License

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Version Iri

http://w3id.org/CEON/ontology/statement/0.1/

Version Info

0.1

Preferred Namespace Prefix

statement

Preferred Namespace Uri

http://w3id.org/CEON/ontology/statement/

Description

A module to represent statements of CEON resources.

Classes

Statement [c]

IRI	http://w3id.org/CEON/ontology/statement/Statement
Sub Class Of	Entity [c]
In Domain Of	statementAbout [op] statementValue [dp]

Entity [c]

IRI	http://www.w3.org/ns/prov#Entity
Super Class Of	resourceODP:Resource Statement [c]

Role [c]

IRI	http://www.w3.org/ns/prov#Role
Super Class Of	http://w3id.org/CEON/ontology/actorODP/Role

Object Properties

statement about [op]

IRI	http://w3id.org/CEON/ontology/statement/statementAbout
Domain	Statement [c]

Datatype Properties

statement value [dp]

IRI	http://w3id.org/CEON/ontology/statement/statementValue
Domain	Statement [c]

Namespaces

:
http://w3id.org/CEON/ontology/statement/

dcterms
http://purl.org/dc/terms/

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

resourceODP
http://w3id.org/CEON/ontology/resourceODP/

vann
http://purl.org/vocab/vann/

Legend

c	Classes
op	Object Properties
dp	Datatype Properties

Circular Economy Ontology Network (CEON) - Quantity Module

Metadata

IRI

`http://w3id.org/CEON/ontology/quantity/`

Title

Circular Economy Ontology Network (CEON) - Quantity Module

Creator

Robin Keskisärkkä

License

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Version Iri

http://w3id.org/CEON/ontology/quantity/0.1/

Version Info

0.1

Preferred Namespace Prefix

quantity

Preferred Namespace Uri

http://w3id.org/CEON/ontology/quantity/

Description

This module defines base properties to describe quantitites with standardized units.

Object Properties

has dismantling cost op

IRI	`http://w3id.org/CEON/ontology/quantity#hasDismantlingCost`
Sub Property Of	qudt:quantityValue

has market value op

IRI	`http://w3id.org/CEON/ontology/quantity#hasMarketValue`
Sub Property Of	qudt:quantityValue

has refurbishment cost op

IRI	`http://w3id.org/CEON/ontology/quantity#hasRefurbishmentCost`
Sub Property Of	qudt:quantityValue

has testing cost op

IRI	`http://w3id.org/CEON/ontology/quantity#hasTestingCost`
Sub Property Of	qudt:quantityValue

has transport cost op

IRI	http://w3id.org/CEON/ontology/quantity#hasTransportCost
Sub Property Of	qudt:quantityValue

object value op

IRI	http://w3id.org/CEON/ontology/quantity#objectValue
Sub Property Of	topObjectProperty op

Datatype Properties

numerical max value dp

IRI	http://w3id.org/CEON/ontology/quantity#numericalMaxValue
Range	xsd:double

numerical min value dp

IRI	http://w3id.org/CEON/ontology/quantity#numericalMinValue
Sub Property Of	topDataProperty dp
Range	xsd:double

Annotation Properties

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI	http://purl.org/dc/terms/description

title ap

IRI	http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI	http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri [ap]

IRI http://purl.org/vocab/vann/preferredNamespaceUri

Namespaces

:
http://w3id.org/CEON/ontology/quantity#

dcterms
http://purl.org/dc/terms/

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

qudt
http://qudt.org/schema/qudt/

qudt-unit
http://qudt.org/vocab/unit/

rdf
http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs
http://www.w3.org/2000/01/rdf-schema#

vann
http://purl.org/vocab/vann/

xsd
http://www.w3.org/2001/XMLSchema#

Legend

op	Object Properties
dp	Datatype Properties
ap	Annotation Properties

Circular Economy Ontology Network (CEON) - Location Module

Metadata

IRI

http://w3id.org/CEON/ontology/location/

Title

Circular Economy Ontology Network (CEON) - Location Module

Creator

Eva Blomqvist

Contributor

Huanyu Li

Mikael Lindecrantz

Robin Keskisärkkä

Date Created

2023-03-17

License

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Version Iri

http://w3id.org/CEON/ontology/location/0.1/

Version Info

0.1

Preferred Namespace Prefix

location

Preferred Namespace Uri

http://w3id.org/CEON/ontoloy/location/

Description

A module the CEON ontology network, defining aspects of the location concept.

Covers Requirements

Covers the following requirements from Onto-DESIDE D3.2: CE3-3

Classes

Location [C]

IRI	http://w3id.org/CEON/ontology/location/Location
Sub Class Of	Geometry [C]
In Range Of	hasLocation [OP]

Geometry [c]

IRI	`http://www.opengis.net/ont/geosparql#Geometry`
Description	A coherent set of direct positions in space. The positions are held within a Spatial Reference System (SRS).
In Domain Of	as GML [dp] as GeoJSON [dp] as WKT [dp]
Super Class Of	Location [c]

Object Properties

has location [op]

IRI	`http://w3id.org/CEON/ontology/location/hasLocation`
Range	Location [c]

Datatype Properties

has city [dp]

IRI	`http://w3id.org/CEON/ontology/location/hasCity`
Range	xsd:string

has country code [dp]

IRI	`http://w3id.org/CEON/ontology/location/hasCountryCode`
Range	xsd:string

has postal code [dp]

IRI	`http://w3id.org/CEON/ontology/location/hasPostalCode`
Range	xsd:string

has street [dp]

IRI	`http://w3id.org/CEON/ontology/location/hasStreet`
Range	xsd:string

as GML dp

IRI	http://www.opengis.net/ont/geosparql#asGML
Is Defined By	http://www.opengis.net/spec/geosparql/1.0/req/geometry-extension/geometry-as-wkt-literal
Description	The GML serialization of a Geometry.
Domain	Geometry c
Range	geo:gmlLiteral

as GeoJSON dp

IRI	http://www.opengis.net/ont/geosparql#asGeoJSON
Is Defined By	http://www.opengis.net/spec/geosparql/1.0/req/geometry-extension/geometry-as-wkt-literal
Description	The GeoJSON serialization of a Geometry.
Domain	Geometry c
Range	geo:geoJSONLiteral

as WKT dp

IRI	http://www.opengis.net/ont/geosparql#asWKT
Is Defined By	http://www.opengis.net/spec/geosparql/1.0/req/geometry-extension/geometry-as-wkt-literal
Description	The WKT serialization of a Geometry.
Domain	Geometry c
Range	geo:wktLiteral

Annotation Properties

contributor ap

IRI	http://purl.org/dc/terms/contributor

created ap

IRI	http://purl.org/dc/terms/created

creator ap

IRI	http://purl.org/dc/terms/creator

description ap

IRI http://purl.org/dc/terms/description

license ap

IRI http://purl.org/dc/terms/license

title ap

IRI http://purl.org/dc/terms/title

preferred namespace prefix ap

IRI http://purl.org/vocab/vann/preferredNamespacePrefix

preferred namespace uri ap

IRI http://purl.org/vocab/vann/preferredNamespaceUri

covers requirements ap

IRI http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements

definition ap

IRI http://www.w3.org/2004/02/skos/core#definition

pref label ap

IRI http://www.w3.org/2004/02/skos/core#prefLabel

Namespaces

:
http://w3id.org/CEON/ontology/location/

dcterms
http://purl.org/dc/terms/

geo
http://www.opengis.net/ont/geosparql#

odp
http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#

owl
http://www.w3.org/2002/07/owl#

prov
http://www.w3.org/ns/prov#

rdf

http://www.w3.org/1999/02/22-rdf-syntax-ns#

rdfs

http://www.w3.org/2000/01/rdf-schema#

skos

http://www.w3.org/2004/02/skos/core#

vann

http://purl.org/vocab/vann/

xsd

http://www.w3.org/2001/XMLSchema#

Legend