

# DELIVERABLE

## **FAIR integrated ontology network - v.1**

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Lead partner	LIU
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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 Haftungsbeschränkt	CON	Germany
4	+Impakt Luxembourg Sarl	POS	Luxembourg
5	Circularise Bv	CIRC	The Netherlands
6	Universitaet Hamburg	UHAM	Germany
7	Circular.Fashion Ug (Haftungsbeschränkt)	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



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0.1	2023-03-31	Text updated to reflect the final state of the actual deliverable, i.e. the ontology network.	Eva Blomqvist	

### Document Approval

Version	Date	Name	Role in the project	Beneficiary
0.05	2023-03-23	Gertjan DeMulder	Reviewer of the GitHub repository	IMEC
0.1	2023-03-31	Eva Blomqvist	PC	LIU

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## 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 consists of a first prototype of the Onto-DEISDE ontology network, earlier introduced and motivated in D3.1. The deliverable itself is the online ontology network<sup>1</sup>, however, this short report summarises the main content, and contains the documentation and respective files of the network (v0.1) in the appendix, for archival and review purposes.

The ontology network prototype consists of 9 ontology modules, i.e. small ontologies, that are connected through `owl:imports` or by referencing concepts from other modules. In this version no external alignments have been included, but such module will be added in the next steps. The modules will also be specialised to cover the domain-specific user stories of our three industry use cases, and evaluated with end-users and domain experts.

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<sup>1</sup>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 will develop 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 D3.3 (deliverable type OTHER), which is published publicly on GitHub<sup>2</sup>, and that provides the foundations of the necessary core ontologies to enable semantic interoperability. This document describes the first version of the deliverable, presenting initial prototype versions of the ontologies, that will be evaluated and tested in the remainder of the first project iteration, while the following version (D3.4, and further releases) will present changes, updates and extensions to this initial ontology network. This concretely means that the deliverable reports ongoing work in our first project iteration, and that both ontology requirements and ontology modules themselves are to be considered as preliminary, since they are not fully validated by end-users and domain experts yet. The focus is also primarily on the core modules, i.e. general cross-domain concepts, rather than on concrete concepts for our use cases. The latter will be developed in the context of WP6 in the next period.

## 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, 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 will 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 [5] and other requirements, and thereafter formally represented in an ontology language, in our case OWL<sup>3</sup>. 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, 4] is used to here denote small, highly generic, ontology modules, that will be reusable across all industry domain, 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 subsequent versions of that deliverable.

### 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 can also be generalised, and we note that there are many parallels between the three project use cases. Consider that all

<sup>2</sup>With the permanent URI <https://w3id.org/CEON/>

<sup>3</sup><https://www.w3.org/OWL/>



these requirements still have to be validated with the end-user partners of the project, e.g. in the context of WP6, hence also the set of requirements is to be considered preliminary.

In the first project iteration we have therefore focused on identifying the core topics that need to be covered by ontology modules, using this set of initial requirements. An overview of such topics (refined version of the initial image in D3.1), 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 dark blue boxes represent the 9 modules that are included in this release (i.e. D3.3), in some form. 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. The light blue box with the text "location" represents an important notion that is present in many of the requirement stories, namely spatial locations of things, e.g., resources or actors. However, for this specific topic, we do not release our own module, but rather rely on reusing standard geographical ontologies, such as W3C standards and the OGC standard GeoSPARQL (but what to use is left open in this version of the network).

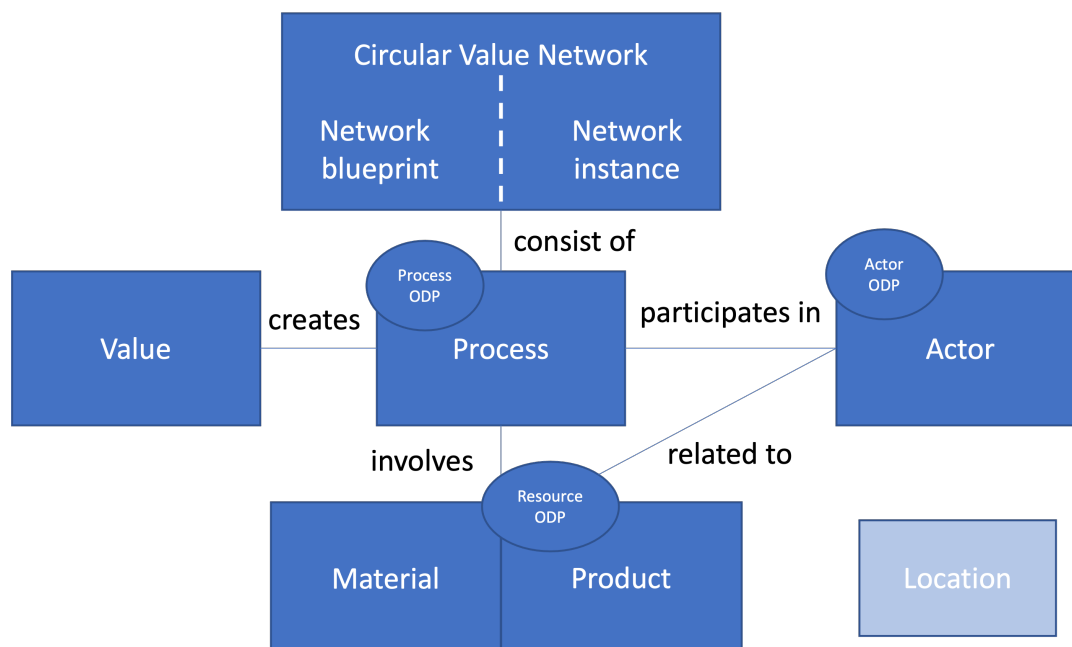


Figure 1: Informal illustration of the core topics of the ontology network.

## 2.3 Core Cross-Domain Topics

In this section we provide a brief description of the set of core modules 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<sup>4</sup> and in the appendix of this document. The topics include:

- Circular Value Network
- Value
- Actor
- Process
- Resource

<sup>4</sup><http://w3id.org/CEON>



### 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, with needed functions in the network possible to fill by certain actor types, types of circular strategies targeted (e.g. refurbishment of a product), and relations 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, c.f. 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 and D2.1. The CVN module refers to concepts both in the actor, process and resources modules.

### 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. Following the discussions on the value concept that is currently ongoing in other fora, e.g. including standardisation bodies, the concept will for now be left as a "stub" for further definition and extension in later versions of our ontology network. Hence, we reserve a specific module for this concept, but it is not further detailed in this initial version of the ontology network.

### 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 modeling of this topic is done at two levels for the first version of 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.

### 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 processes and sub-processes. Each step may then also have inputs and outputs, 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 value network, since they are the things that are needed as input and output of each step. 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, the work and investments needed. Similarly to the case of processes, much work already exist in modelling both products and materials, and their relations, hence this topic again mainly acts as a small set of general bridge modules, to be able to properly align to other ontologies in the future.

This part of the network is realised through a generic resource ODP, which is then specialised into two modules, i.e. one modelling materials and one modelling products and components. 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 a concrete alignments module (this is still future work).

## 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 [9]. The ontologies developed by the project will be published according to the FAIR principles. However, recent analyses by several researchers and projects [8, 7, 3, 6] 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:

- URI:s – 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, including `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 envisioned ontology network will entail multiple inter-dependent ontologies, several of which will go through multiple development iterations. In order to keep track of such changes, we are using a GitHub<sup>5</sup> 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 accessed 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<sup>6</sup> for generating web-friendly documentation directly from the ontology files, thus removing the need for manually creating such content. Additionally, we employ OWL2VOWL<sup>7</sup> and WebVOWL<sup>8</sup> 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 will be combined into a pipeline that allows ontology documentation to be generated automatically, ensuring that the documentation always remains up to date.

## 4 Concluding Remarks and Future Work

The current state of the repository, constituting the deliverable 3.3, consists of 9 ontology modules (where three of them are considered to be generic ODPs). All are published online in our ontology catalogue, including human-friendly documentation generated automatically from the ontology files, and versioned through GitHub. This first release constitutes the starting point for further ontology development in the context of WP6, i.e. specialising these ontology modules for the three domain-specific use cases respectively, and for describing the data to be included in the research dataset of WP6.

However, both the ontological requirements, and their realisation as ontology modules, have not yet been evaluated properly by end-users and domain-experts. One part of such evaluation is their use in WP6, which will result in feedback on their suitability, coverage and usability. However, in addition, we will specifically evaluate the set of ontology stories together with end-user partners in the project, primarily with FAS who are directly involved in WP3. In this way, the next version of both this deliverable and D3.1, will also consist of evaluation results and the indicated changes needed. Consequently, any use of the ontologies that are published currently should be done with care, since breaking changes may occur in the next version of the ontology network. Stable and production-ready versions of the ontologies are not envisioned until the final release at the end of the project.

<sup>5</sup><https://github.com/LiUSemWeb/CEON/>

<sup>6</sup><https://github.com/RDFLib/pyLODE>

<sup>7</sup><https://github.com/VisualDataWeb/OWL2VOWL>

<sup>8</sup><https://github.com/VisualDataWeb/WebVOWL>

Further next steps include to develop alignment modules, consisting of alignments to the most prominent ontologies discovered in the ontology survey presented in D3.1. 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.

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# Appendices

In this appendix we first provide 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 version 0.1 of each ODP and ontology module.

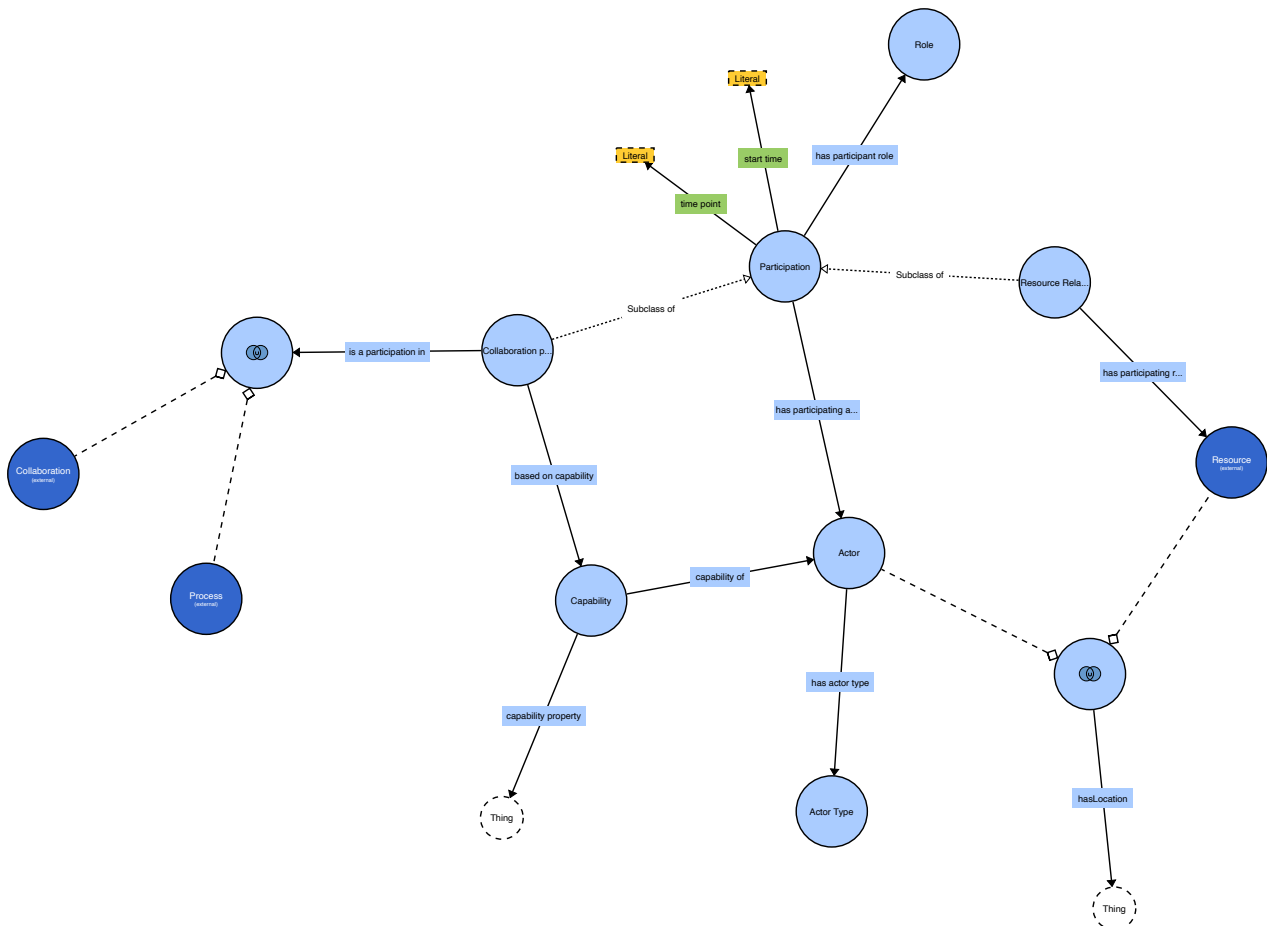


Figure 2: VOWL visualisation of the actor ODP.

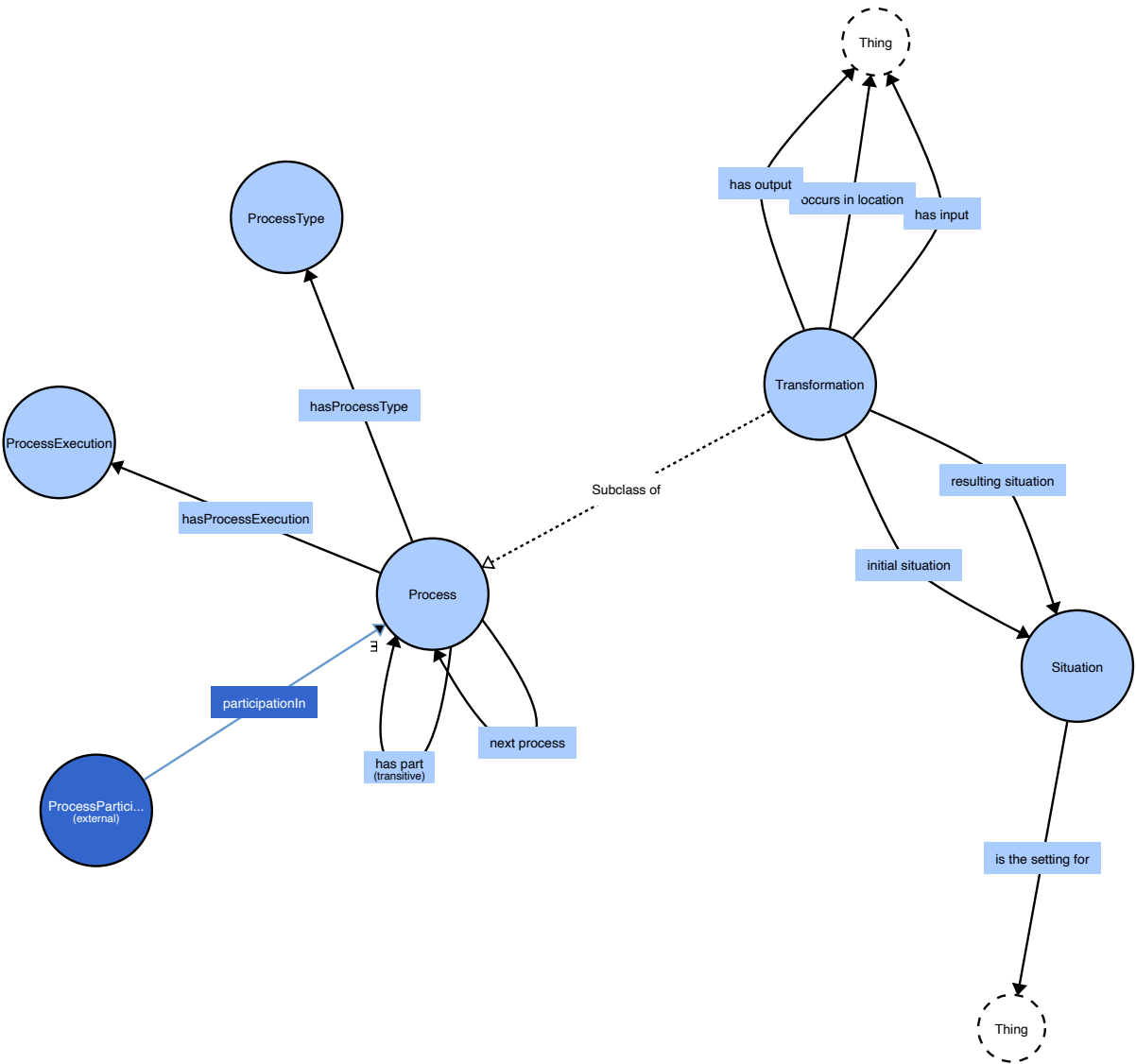


Figure 3: VOWL visualisation of the process ODP.



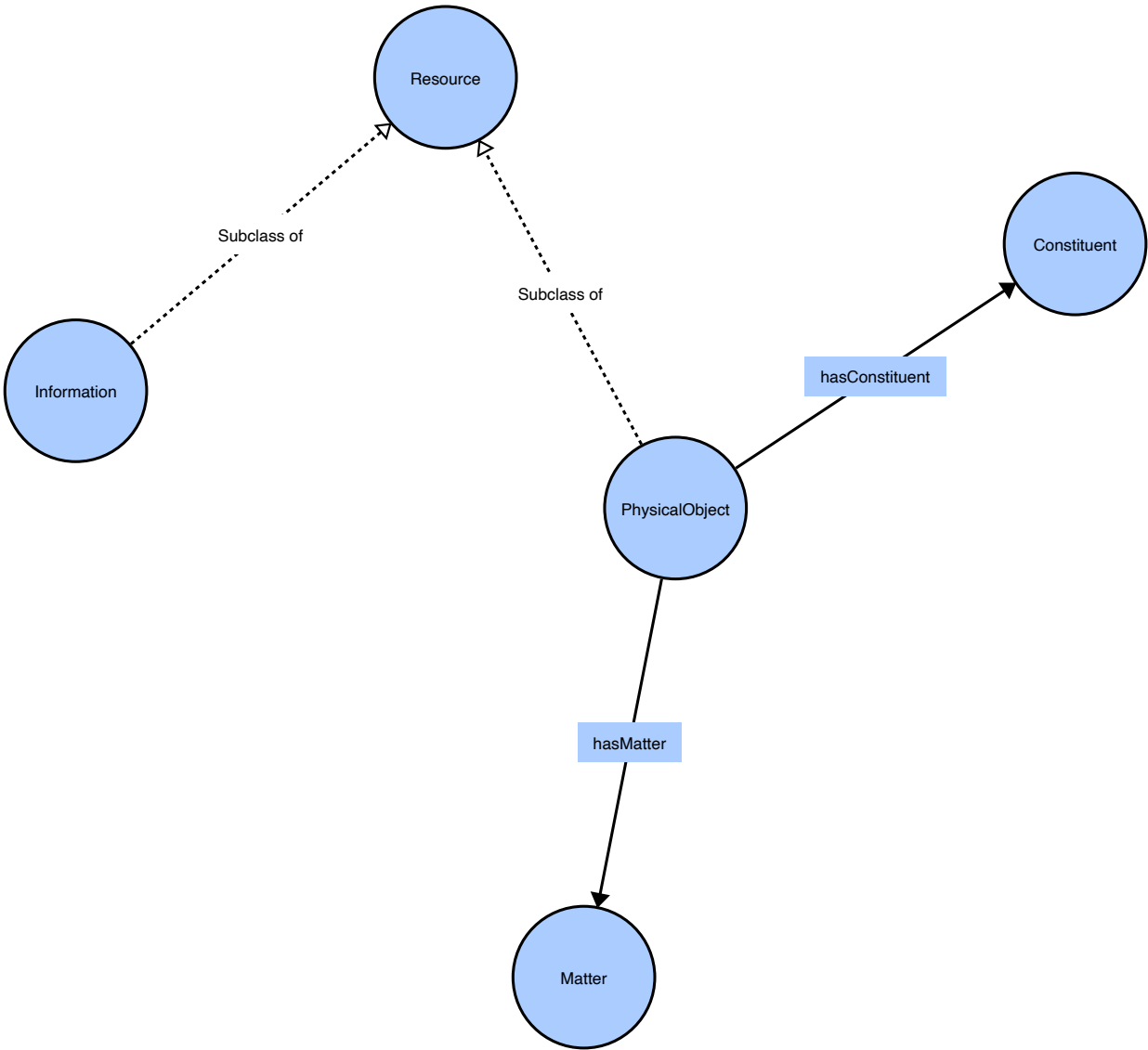


Figure 4: VOWL visualisation of the resource ODP.

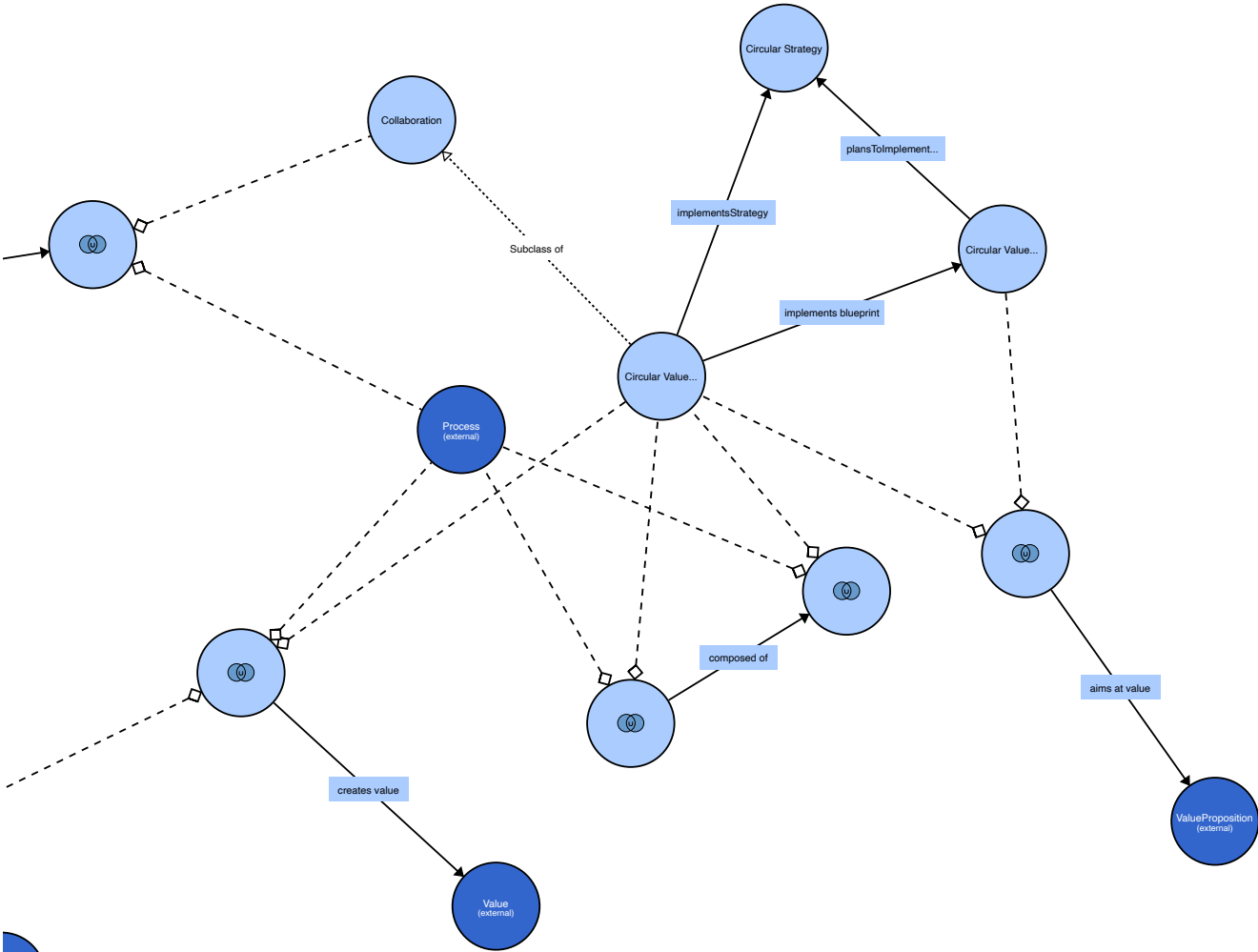


Figure 5: VOWL visualisation of the core part of the CVN module.

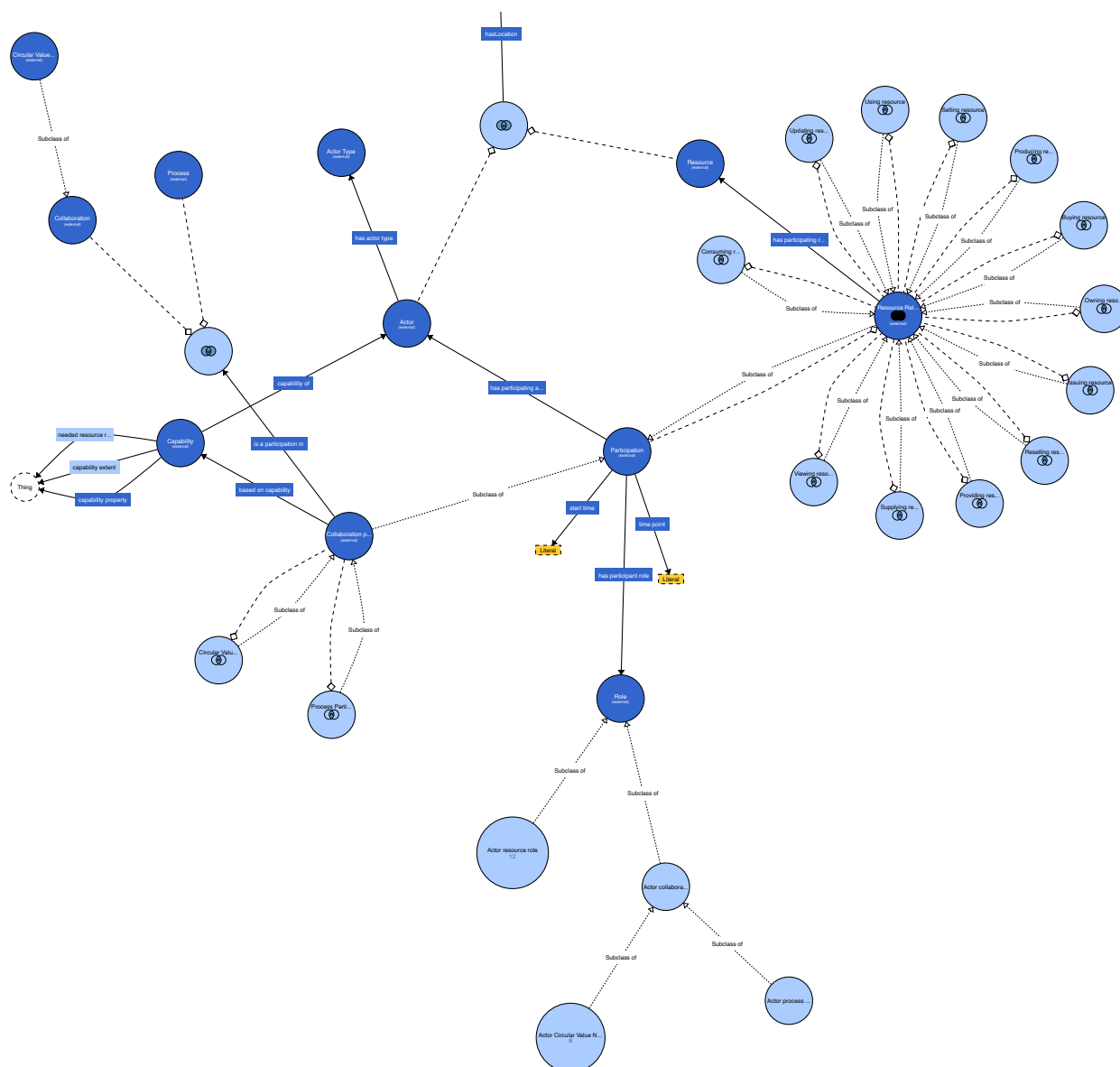


Figure 6: VOWL visualisation of the actor module, specialising the actor ODP.

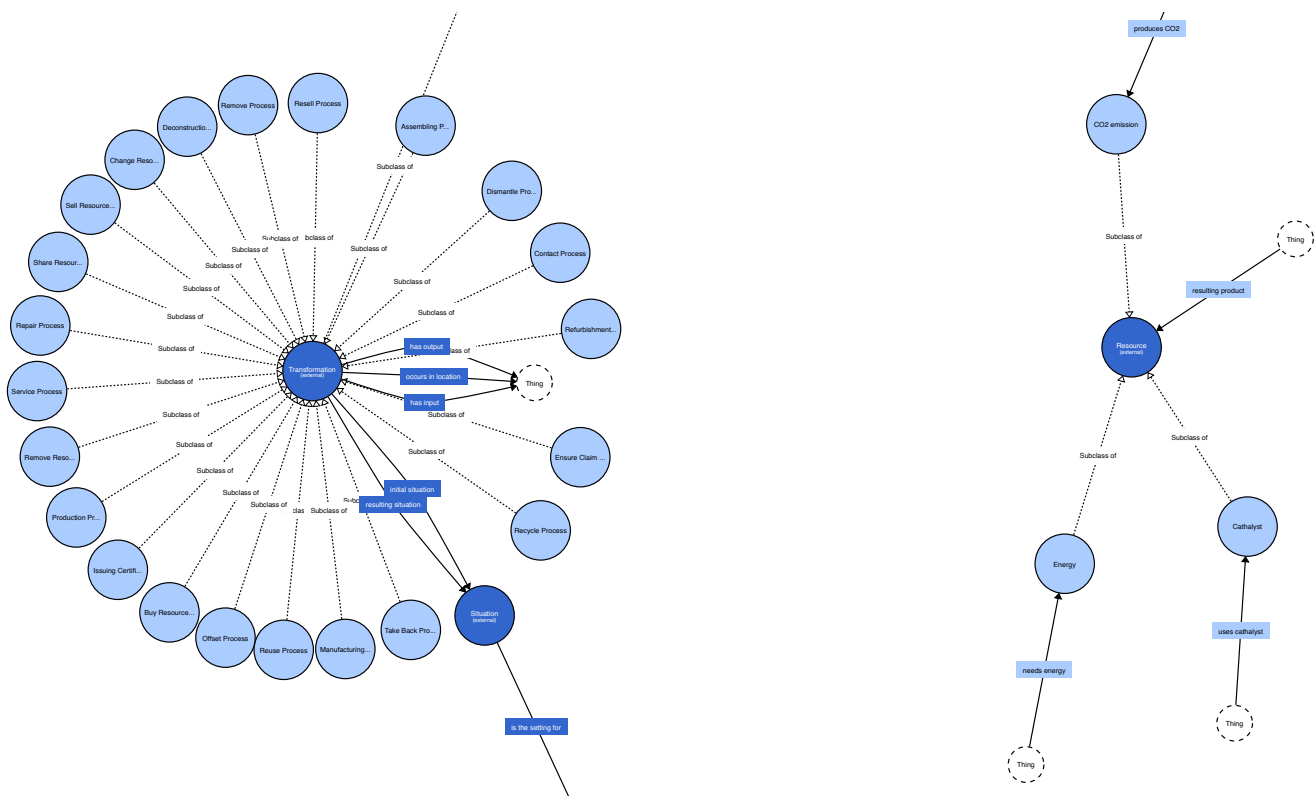


Figure 7: VOWL visualisation of the process module, specialising the process ODP.

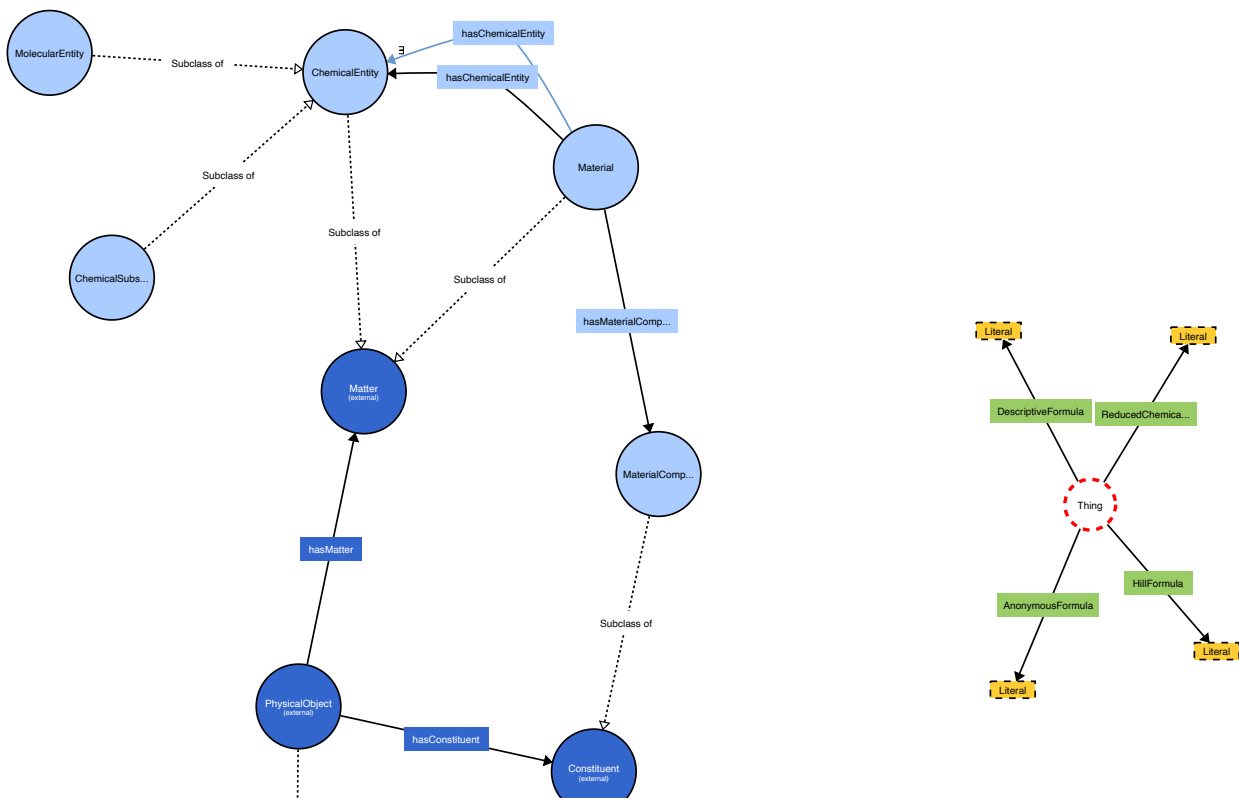


Figure 8: VOWL visualisation of the material module, specialising the resource ODP.

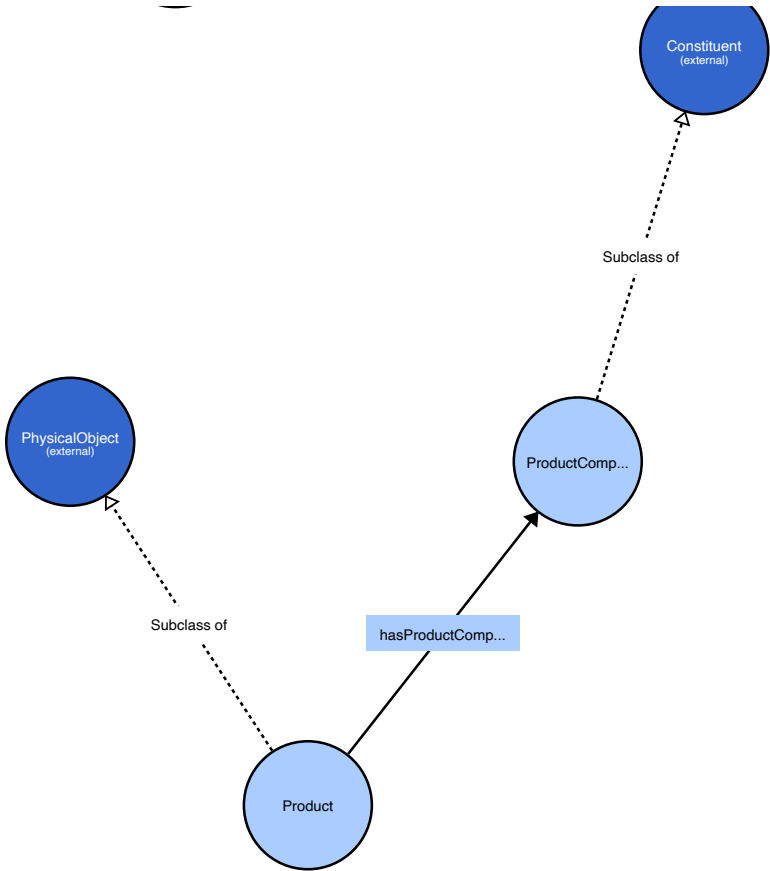


Figure 9: VOWL visualisation of the product module, specialising the resource ODP.



Figure 10: VOWL visualisation of the stub for the value module.

# 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

### Version Iri

<http://w3id.org/CEON/ontology/actorODP/0.1/>

### Version Info

0.1

### Preferred Namespace Prefix

actorODP

### Preferred Namespace Uri

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

## Classes

Actor <sup>c</sup>	
IRI	<a href="http://w3id.org/CEON/ontology/actorODP/Actor">http://w3id.org/CEON/ontology/actorODP/Actor</a>
Description	An agent able to act in the context of a circular value network, e.g. an organisation, person.
In Domain Of	<a href="#">has actor type</a> <sup>op</sup>
In Range Of	<a href="#">Relates to the actor holding the capability.</a> <sup>op</sup> <a href="#">has participating actor</a> <sup>op</sup>

## Actor Type<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/ActorType">http://w3id.org/CEON/ontology/actorODP/ActorType</a>
<b>Description</b>	The type of an actor, e.g. the type of company, or a specific subtype based on the organisations capabilities.
<b>In Range Of</b>	<a href="#">has actor type</a> <sup>op</sup>

## Capability<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/Capability">http://w3id.org/CEON/ontology/actorODP/Capability</a>
<b>Description</b>	Something that the actor is capable of doing, e.g. performing a certain role in a process, based on some properties, such as access to infrastructure, resources and know-how.
<b>In Domain Of</b>	<a href="#">Relates to the actor holding the capability.</a> <sup>op</sup> <a href="#">capability property</a> <sup>op</sup>
<b>In Range Of</b>	<a href="#">based on capability</a> <sup>op</sup>

## Collaboration participation<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/CollaborationParticipation">http://w3id.org/CEON/ontology/actorODP/CollaborationParticipation</a>
<b>Description</b>	The relation involving the role of a certain actor with respect to a value network or a process in such a network, e.g. an organisation (actor) acting as the recycler (role) in a glass recycling value network (network) at a specific point or period in time. Or an organisation (actor) acting as the dismantler (role) in a dismantling step of a building deconstruction process (process step) at a specific point or period in time.
<b>Sub Class Of</b>	<a href="#">Participation</a> <sup>C</sup>
<b>In Domain Of</b>	<a href="#">based on capability</a> <sup>op</sup> <a href="#">is a participation in</a> <sup>op</sup>



## Participation<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/Participation>

**Sub Class Of** [start time](#)<sup>dp</sup> *exactly 1* [1](#)<sup>c</sup> *or* [time point](#)<sup>dp</sup> *exactly 1* [1](#)<sup>c</sup>

**In Domain Of** [has participant role](#)<sup>op</sup>  
[has participating actor](#)<sup>op</sup>  
[start time](#)<sup>dp</sup>  
[time point](#)<sup>dp</sup>

**Super Class Of** [Collaboration participation](#)<sup>c</sup>  
[Resource Relation](#)<sup>c</sup>

## Resource Relation<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/ResourceRelation>

**Description** The relation involving the role of a certain actor with respect to a certain resource, e.g. an organisation or individual (actor) owning (role) a specific product (resource) at a specific point or period in time.

**Sub Class Of** [Participation](#)<sup>c</sup>

**In Domain Of** [has participating resource](#)<sup>op</sup>

## Role<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/Role>

**Description** A role that an actor can take in a specific context. Applies both to roles in the context of resources, such as owner, manufacturer, reseller etc. of that resource, as well as roles in relation to a circular value network, such as recycler, dismantler, transporter etc., in relation to a material flow.

**In Range Of** [has participant role](#)<sup>op</sup>

## Collaboration<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/cvn/Collaboration>

**Description** A collaboration between a set of actors.

## Process<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/process/Process>

## Resource<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Resource>

**In Range Of** [has participating resource<sup>op</sup>](#)

## Object Properties

### has actor type<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/actorType>

**Description** The type of the actor.

**Domain** [Actor<sup>c</sup>](#)

**Range** [Actor Type<sup>c</sup>](#)

### based on capability<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/basedOnCapability>

**Description** An actor participates in a collaboration based on that it has some capability that is useful for the collaboration.

**Domain** [Collaboration participation<sup>c</sup>](#)

**Range** [Capability<sup>c</sup>](#)

### Relates to the actor holding the capability.capability of<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/capabilityOf>

**Domain** [Capability<sup>c</sup>](#)

**Range** [Actor<sup>c</sup>](#)

## capability property<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/capabilityProperty">http://w3id.org/CEON/ontology/actorODP/capabilityProperty</a>
<b>Description</b>	Relates some properties to the capability, such as the parameters of it, or the needed resources.
<b>Domain</b>	<a href="#">Capability</a> <sup>c</sup>

## has location<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/hasLocation">http://w3id.org/CEON/ontology/actorODP/hasLocation</a>
<b>Domain</b>	<a href="#">Actor</a> <sup>c</sup> or <a href="#">resourceODP:Resource</a> <sup>c</sup>

## has participant role<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/participantRole">http://w3id.org/CEON/ontology/actorODP/participantRole</a>
<b>Description</b>	Holds the value of the role of the participant in this participation relation.
<b>Domain</b>	<a href="#">Participation</a> <sup>c</sup>
<b>Range</b>	<a href="#">Role</a> <sup>c</sup>

## has participating actor<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/participatingActor">http://w3id.org/CEON/ontology/actorODP/participatingActor</a>
<b>Description</b>	Holds the value of the actor involved in this participation relation.
<b>Domain</b>	<a href="#">Participation</a> <sup>c</sup>
<b>Range</b>	<a href="#">Actor</a> <sup>c</sup>

## has participating resource<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/participatingResource">http://w3id.org/CEON/ontology/actorODP/participatingResource</a>
<b>Description</b>	The resource that this participation relation relates to, i.e. for which the actor holds the specified role.
<b>Domain</b>	<a href="#">Resource Relation</a> <sup>c</sup>
<b>Range</b>	<a href="#">resourceODP:Resource</a> <sup>c</sup>

## is a participation in<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/participationIn">http://w3id.org/CEON/ontology/actorODP/participationIn</a>
<b>Description</b>	The collaboration or process that this participation relates to.
<b>Domain</b>	<a href="#">Collaboration participation</a> <sup>c</sup>
<b>Range</b>	<a href="#">Collaboration</a> <sup>c</sup> or <a href="#">process:Process</a> <sup>c</sup>

## Datatype Properties

### end time<sup>dp</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/participationEndTime">http://w3id.org/CEON/ontology/actorODP/participationEndTime</a>
<b>Description</b>	The end of a time interval.
<b>Range</b>	<a href="#">xsd:date</a> <sup>c</sup> or <a href="#">xsd:gMonthYear</a> <sup>c</sup> or <a href="#">xsd:dateTime</a> <sup>c</sup> or <a href="#">xsd:gYear</a> <sup>c</sup>

### start time<sup>dp</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/participationStartTime">http://w3id.org/CEON/ontology/actorODP/participationStartTime</a>
<b>Description</b>	The start of a time interval.
<b>Domain</b>	<a href="#">Participation</a> <sup>c</sup>
<b>Range</b>	<a href="#">xsd:gYear</a> <sup>c</sup> or <a href="#">xsd:dateTime</a> <sup>c</sup> or <a href="#">xsd:gMonthYear</a> <sup>c</sup> or <a href="#">xsd:date</a> <sup>c</sup>

time point<sup>dp</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/participationTimePoint>

**Description** The point in time when something took place or was valid.

**Domain** [Participation](#)<sup>c</sup>

**Range** [xsd:gYear](#)<sup>c</sup> or [xsd:date](#)<sup>c</sup> or [xsd:gMonthYear](#)<sup>c</sup> or [xsd:dateTime](#)<sup>c</sup>

## Annotation Properties

contributor<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/contributor>

creator<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/creator>

description<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/description>

title<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/title>

preferred namespace prefix<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespacePrefix>

preferred namespace uri<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespaceUri>

covers requirements<sup>ap</sup>

<b>IRI</b>	<a href="http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements">http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements</a>
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## Namespaces

:

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

**cvn**

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

**dcterms**

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

**odp**

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

**owl**

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

**process**

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

**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

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# Circular Economy Ontology Network (CEON) - Process ODP

## Metadata

### IRI

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

### Title

Circular Economy Ontology Network (CEON) - Process ODP

### Creator

Huanyu Li

### Contributor

Eva Blomqvist

Mikael Lindecrantz

Robin Keskisärkkä

### Date Created

2023-03-23

### License

<https://github.com/LiUSemWeb/CEON/blob/master/LICENSE>

### Version Iri

<http://w3id.org/CEON/ontology/processODP/0.1/>

### Version Info

0.1

### 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, CVN-Input/Output-1,3,4, C3-1, C4-2, C4-5, C4-7, C4-9, C13-2, E2-6

## Classes

### Process Participation<sup>c</sup>

#### IRI

<http://w3id.org/CEON/ontology/actor/ProcessParticipation>

#### Restriction

[actorODP:participationIn](#)<sup>op</sup> some [actor:ProcessParticipation](#)<sup>c</sup>



## Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/processODP/Process>

**Description** An activity in the context of a circular value network, handling resources.

**In Domain Of** [has part](#)<sup>op</sup>  
[hasProcessExecution](#)<sup>op</sup>  
[hasProcessType](#)<sup>op</sup>  
[next process](#)<sup>op</sup>

**In Range Of** [has part](#)<sup>op</sup>  
[next process](#)<sup>op</sup>

**Super Class Of** [Transformation](#)<sup>C</sup>

## ProcessExecution<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/processODP/ProcessExecution>

**Description** An execution of a specific process.

**In Range Of** [hasProcessExecution](#)<sup>op</sup>

## ProcessType<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/processODP/ProcessType>

**Description** The type of a process.

**In Range Of** [hasProcessType](#)<sup>op</sup>

## Situation<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/processODP/Situation>

**Description** A situation that may involve some resources and actors, i.e. a state of affairs at a certain point in time.

**In Domain Of** [is the setting for](#)<sup>op</sup>

**In Range Of** [initial situation](#)<sup>op</sup>  
[resulting situation](#)<sup>op</sup>

## Transformation<sup>c</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/Transformation">http://w3id.org/CEON/ontology/processODP/Transformation</a>
<b>Description</b>	A process that transforms some situation into another situation, i.e. changes the state of affairs of some actor, resource etc.
<b>Sub Class Of</b>	<a href="#">Process<sup>c</sup></a>
<b>In Domain Of</b>	<a href="#">has input<sup>op</sup></a> <a href="#">has output<sup>op</sup></a> <a href="#">initial situation<sup>op</sup></a> <a href="#">occurs in location<sup>op</sup></a> <a href="#">resulting situation<sup>op</sup></a>

## Resource<sup>c</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/resourceODP/Resource">http://w3id.org/CEON/ontology/resourceODP/Resource</a>
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## Object Properties

### participation in<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/participationIn">http://w3id.org/CEON/ontology/actorODP/participationIn</a>
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### has input<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/hasInput">http://w3id.org/CEON/ontology/processODP/hasInput</a>
<b>Description</b>	The situation before the transformation takes place, i.e. the state of affairs before the process takes places, such as the set of components before they are assembled into a product.
<b>Domain</b>	<a href="#">Transformation<sup>c</sup></a>

### has output<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/hasOutput">http://w3id.org/CEON/ontology/processODP/hasOutput</a>
<b>Description</b>	The output situation of a transformation, i.e. the state of affairs after the transformation took place.
<b>Domain</b>	<a href="#">Transformation<sup>c</sup></a>

## has part<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/hasPart">http://w3id.org/CEON/ontology/processODP/hasPart</a>
<b><u>Description</u></b>	A process can consists of several part, which are sub-processes.
<b><u>Domain</u></b>	<a href="#">Process</a> <sup>c</sup>
<b><u>Range</u></b>	<a href="#">Process</a> <sup>c</sup>

## hasProcessExecution<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/hasProcessExecution">http://w3id.org/CEON/ontology/processODP/hasProcessExecution</a>
<b><u>Description</u></b>	A process can have specific executions.
<b><u>Domain</u></b>	<a href="#">Process</a> <sup>c</sup>
<b><u>Range</u></b>	<a href="#">ProcessExecution</a> <sup>c</sup>

## hasProcessType<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/hasProcessType">http://w3id.org/CEON/ontology/processODP/hasProcessType</a>
<b><u>Description</u></b>	The type of the process.
<b><u>Domain</u></b>	<a href="#">Process</a> <sup>c</sup>
<b><u>Range</u></b>	<a href="#">ProcessType</a> <sup>c</sup>

## initial situation<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/initialSituation">http://w3id.org/CEON/ontology/processODP/initialSituation</a>
<b><u>Description</u></b>	The situation before executing a process.
<b><u>Domain</u></b>	<a href="#">Transformation</a> <sup>c</sup>
<b><u>Range</u></b>	<a href="#">Situation</a> <sup>c</sup>

## is the setting for<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/isSettingFor">http://w3id.org/CEON/ontology/processODP/isSettingFor</a>
<b>Description</b>	The thing(s) that this situation is the setting for, e.g. a resource that is in a certain state.
<b>Domain</b>	<a href="#">Situation</a> <sup>c</sup>

## next process<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/nextProcess">http://w3id.org/CEON/ontology/processODP/nextProcess</a>
<b>Description</b>	A relation between one process and the next one following it in some sequence of processes, e.g. a sequence of transformations in a material flow.
<b>Domain</b>	<a href="#">Process</a> <sup>c</sup>
<b>Range</b>	<a href="#">Process</a> <sup>c</sup>

## occurs in location<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/occursInLocation">http://w3id.org/CEON/ontology/processODP/occursInLocation</a>
<b>Description</b>	The location in which a transformation takes place, e.g. the factory location where something is manufactured.
<b>Domain</b>	<a href="#">Transformation</a> <sup>c</sup>

## resulting situation<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/processODP/resultingSituation">http://w3id.org/CEON/ontology/processODP/resultingSituation</a>
<b>Description</b>	The situation after the execution of a process.
<b>Domain</b>	<a href="#">Transformation</a> <sup>c</sup>
<b>Range</b>	<a href="#">Situation</a> <sup>c</sup>

## Annotation Properties

contributor<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/contributor>

created<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/created>

creator<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/creator>

description<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/description>

license<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/license>

title<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/title>

preferred namespace prefix<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespacePrefix>

preferred namespace uri<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespaceUri>

covers requirements<sup>ap</sup>

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

## Namespaces

:

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

**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#>

**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

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Object Properties

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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

2023-03-16

### License

<https://github.com/LiUSemWeb/CEON/blob/master/LICENSE>

### Version Iri

<http://w3id.org/CEON/ontology/resourceODP/0.1/>

### Version Info

0.1

### 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-ResourceType-4, C7-3, E2-2, E4-6, E5-1, E6-3, T3-1.

## Classes

Constituent <sup>c</sup>	
IRI	<a href="http://w3id.org/CEON/ontology/resourceODP/Constituent">http://w3id.org/CEON/ontology/resourceODP/Constituent</a>
Description	A constituent is a component of object.
In Range Of	<a href="#">hasConstituent<sup>op</sup></a>



## Information<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Information>

**Sub Class Of** [Resource<sup>c</sup>](#)

## Matter<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Matter>

**Description** A matter is a physical substance.

**In Range Of** [hasMatter<sup>op</sup>](#)

## PhysicalObject<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/PhysicalObject>

**Description** A physical object is a collection of matter.

**Sub Class Of** [Resource<sup>c</sup>](#)  
[hasConstituent<sup>op</sup>](#) only [Constituent<sup>c</sup>](#) and [hasConstituent<sup>op</sup>](#) some [Constituent<sup>c</sup>](#)  
[hasMatter<sup>op</sup>](#) only [Matter<sup>c</sup>](#) and [hasMatter<sup>op</sup>](#) some [Matter<sup>c</sup>](#)

**In Domain Of** [hasConstituent<sup>op</sup>](#)  
[hasMatter<sup>op</sup>](#)

## Resource<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Resource>

**Description** A resource able to be handled in the context of a circular value network, e.g. data generated by software systems in the CVN, materials or products as physical objects handled in the CVN.

**Super Class Of** [Information<sup>c</sup>](#)  
[PhysicalObject<sup>c</sup>](#)

## Object Properties

### hasConstituent<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/resourceODP/hasConstituent">http://w3id.org/CEON/ontology/resourceODP/hasConstituent</a>
<b>Description</b>	hasConstituent intends to represent that a physical object can have a collection of composing components.
<b>Domain</b>	<a href="#">PhysicalObject</a> <sup>c</sup>
<b>Range</b>	<a href="#">Constituent</a> <sup>c</sup>

### hasMatter<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/resourceODP/hasMatter">http://w3id.org/CEON/ontology/resourceODP/hasMatter</a>
<b>Description</b>	hasMatter intends to represent that a physical object can have a collection of matter.
<b>Domain</b>	<a href="#">PhysicalObject</a> <sup>c</sup>
<b>Range</b>	<a href="#">Matter</a> <sup>c</sup>

## Annotation Properties

### description<sup>ap</sup>

<b>IRI</b>	<a href="http://purl.org/dc/elements/1.1/description">http://purl.org/dc/elements/1.1/description</a>
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### contributor<sup>ap</sup>

<b>IRI</b>	<a href="http://purl.org/dc/terms/contributor">http://purl.org/dc/terms/contributor</a>
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### created<sup>ap</sup>

<b>IRI</b>	<a href="http://purl.org/dc/terms/created">http://purl.org/dc/terms/created</a>
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### creator<sup>ap</sup>

<b>IRI</b>	<a href="http://purl.org/dc/terms/creator">http://purl.org/dc/terms/creator</a>
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description <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/description">http://purl.org/dc/terms/description</a>
license <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/license">http://purl.org/dc/terms/license</a>
title <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/title">http://purl.org/dc/terms/title</a>
preferred namespace prefix <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespacePrefix">http://purl.org/vocab/vann/preferredNamespacePrefix</a>
preferred namespace uri <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespaceUri">http://purl.org/vocab/vann/preferredNamespaceUri</a>
covers requirements <sup>ap</sup>	
IRI	<a href="http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements">http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements</a>

## Namespaces

:

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

**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#>

**vann**

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

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# 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

### Version Iri

<http://w3id.org/CEON/ontology/cvn/0.1/>

### Version Info

0.1

### Preferred Namespace Prefix

cvn

### Preferred Namespace Uri

<http://w3id.org/CEON/ontology/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-1,6, CVN-Process-1,6, CVN-VP-1,3, CVN-Type-3, C0-1.

## Classes

Participation <sup>c</sup>	
IRI	<a href="http://w3id.org/CEON/ontology/actorODP/Participation">http://w3id.org/CEON/ontology/actorODP/Participation</a>

## Circular Value Network<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/CVN">http://w3id.org/CEON/ontology/cvn/CVN</a>
<b>Description</b>	An instantiation of a circular value network, i.e. a concrete network of different actors collaborating to achieve some goal.
<b>Sub Class Of</b>	<a href="#">Collaboration<sup>C</sup></a>
<b>In Domain Of</b>	<a href="#">implements blueprint<sup>op</sup></a> <a href="#">implementsStrategy<sup>op</sup></a>

## Circular Value Network Blueprint<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/CVNBlueprint">http://w3id.org/CEON/ontology/cvn/CVNBlueprint</a>
<b>Description</b>	A plan or a pattern of a CVN configuration that can then be filled with actual actors and processes. The blueprint can be used to capture a desired setup of a network, or for reusing patterns of CVNs.
<b>In Domain Of</b>	<a href="#">plansToImplementStrategy<sup>op</sup></a>
<b>In Range Of</b>	<a href="#">implements blueprint<sup>op</sup></a>

## Circular Strategy<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/CircularStrategy">http://w3id.org/CEON/ontology/cvn/CircularStrategy</a>
<b>Description</b>	A circular strategy, such as to recycle, reuse or refurbish something.
<b>In Range Of</b>	<a href="#">implementsStrategy<sup>op</sup></a> <a href="#">plansToImplementStrategy<sup>op</sup></a>

## Collaboration<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/Collaboration">http://w3id.org/CEON/ontology/cvn/Collaboration</a>
<b>Description</b>	Collaboration Some collaboration to achieve a goal.
<b>Super Class Of</b>	<a href="#">Circular Value Network<sup>C</sup></a>

## Process<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/process/Process>

## Resource<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Resource>

## Value<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/value/Value>

**In Range Of** [creates value](#)<sup>op</sup>

## Value Proposition<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/value/ValueProposition>

**In Range Of** [aims at value](#)<sup>op</sup>

## Object Properties

### [aims at value](#)<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/cvn/aimsAtValue>

**Description** The value proposition that the planned abstract CVN configuration, or concrete network wants to achieve.

**Domain** [Circular Value Network Blueprint](#)<sup>c</sup> or [Circular Value Network](#)<sup>c</sup>

**Range** [value:ValueProposition](#)<sup>c</sup>

### [composed of](#)<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/cvn/composedOf>

**Description** Both a CVN and a process can be composed of other CVNs or processes.

**Domain** [Circular Value Network](#)<sup>c</sup> or [process:Process](#)<sup>c</sup>

**Range** [process:Process](#)<sup>c</sup> or [Circular Value Network](#)<sup>c</sup>

## creates value<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/createsValue">http://w3id.org/CEON/ontology/cvn/createsValue</a>
<b>Description</b>	Value creation can be captured at the actor level, i.e. value created by an actor's participation in a collaboration, or at the process or complete CVN level.
<b>Domain</b>	<a href="#">Circular Value Network</a> <sup>C</sup> <i>or</i> <a href="#">actorODP:Participation</a> <sup>C</sup> <i>or</i> <a href="#">process:Process</a> <sup>C</sup>
<b>Range</b>	<a href="#">value:Value</a> <sup>C</sup>

## implements blueprint<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/implementsBlueprint">http://w3id.org/CEON/ontology/cvn/implementsBlueprint</a>
<b>Description</b>	The blueprint (or plan) that this concrete CVN is an instance of.
<b>Domain</b>	<a href="#">Circular Value Network</a> <sup>C</sup>
<b>Range</b>	<a href="#">Circular Value Network Blueprint</a> <sup>C</sup>

## implements strategy<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/implementsStrategy">http://w3id.org/CEON/ontology/cvn/implementsStrategy</a>
<b>Sub Property Of</b>	<a href="#">related strategy</a> <sup>op</sup>
<b>Domain</b>	<a href="#">Circular Value Network</a> <sup>C</sup>
<b>Range</b>	<a href="#">Circular Strategy</a> <sup>C</sup>

## plans to implement strategy<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/cvn/plansToImplementStrategy">http://w3id.org/CEON/ontology/cvn/plansToImplementStrategy</a>
<b>Sub Property Of</b>	<a href="#">related strategy</a> <sup>op</sup>
<b>Domain</b>	<a href="#">Circular Value Network Blueprint</a> <sup>C</sup>
<b>Range</b>	<a href="#">Circular Strategy</a> <sup>C</sup>



related strategy<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/cvn/relatedStrategy>

**Description** A strategy that is targeted by this CVN or CVN blueprint.

**Super Property Of**

- [implementsStrategy<sup>op</sup>](#)
- [plansToImplementStrategy<sup>op</sup>](#)

## Annotation Properties

contributor<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/contributor>

creator<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/creator>

description<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/description>

title<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/title>

preferred namespace prefix<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespacePrefix>

preferred namespace uri<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespaceUri>

## Namespaces

:

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

**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#>

**process**

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

**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

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ap

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Annotation Properties

# Circular Economy Ontology Network (CEON) - Actor Module

## Metadata

### IRI

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

### Title

Circular Economy Ontology Network (CEON) - Actor Module

### Creator

Eva Blomqvist

### Contributor

Huanyu Li

Mikael Lindecrantz

Robin Keskisärkkä

### Date Created

2023-03-16

### License

<https://github.com/LiUSemWeb/CEON/blob/master/LICENSE>

### Version Iri

<http://w3id.org/CEON/ontology/actor/0.1/>

### Version Info

0.1

### 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

## Classes

## Actor Circular Value Network role<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/ActorCVNRole>

**Description** The role(s) of an actor in a Circular Value Network, which is a specific type of collaboration.

**Sub Class Of** [Actor collaboration role<sup>C</sup>](#)

**Named Individuals**

- [collector<sup>ni</sup>](#)
- [dismantler<sup>ni</sup>](#)
- [manufacturer<sup>ni</sup>](#)
- [recycler<sup>ni</sup>](#)
- [reseller<sup>ni</sup>](#)
- [seller<sup>ni</sup>](#)
- [supplier<sup>ni</sup>](#)
- [user<sup>ni</sup>](#)

## Actor collaboration role<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/ActorCollaborationRole>

**Description** The roles of an actor involved in a collaboration.

**Sub Class Of** [actorODP:Role<sup>C</sup>](#)

**Super Class Of**

- [Actor Circular Value Network role<sup>C</sup>](#)
- [Actor process role<sup>C</sup>](#)

## Actor process role<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/ActorProcessRole>

**Description** The role(s) of an actor involved in a process.

**Sub Class Of** [Actor collaboration role<sup>C</sup>](#)

## Actor resource role<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/ActorResourceRole>

**Description** The role(s) of an actor in relation to a resource.

**Sub Class Of** [actorODP:Role<sup>C</sup>](#)

**Named Individuals** [buyer<sup>ni</sup>](#)  
[consumer<sup>ni</sup>](#)  
[issuer<sup>ni</sup>](#)  
[owner<sup>ni</sup>](#)  
[producer<sup>ni</sup>](#)  
[provider<sup>ni</sup>](#)  
[reseller<sup>ni</sup>](#)  
[seller<sup>ni</sup>](#)  
[supplier<sup>ni</sup>](#)  
[updater<sup>ni</sup>](#)  
[user<sup>ni</sup>](#)  
[viewer<sup>ni</sup>](#)

## Buying resource<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/BuyingResource>

**Description** The relation where the role of the actor is the buyer of a certain resource.

**Sub Class Of** [Resource Relation<sup>C</sup>](#)

**Equivalentclass** [actorODP:participantRole<sup>op</sup>](#) value [buyer<sup>C</sup>](#) and [Resource Relation<sup>C</sup>](#)

## Circular Value Network Participation<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/CVNPParticipation>

**Description** A participation-relation, that represents the participation of an actor in a CVN with a certain role. For instance, a specific company playing the role of recycler in a certain flow of a CVN. The participation may also be related to a certain time (or time interval).

**Sub Class Of** [actorODP:CollaborationParticipation<sup>C</sup>](#)  
[actorODP:CollaborationParticipation<sup>C</sup>](#) and [actorODP:participantRole<sup>op</sup>](#) some [Actor Circular Value Network role<sup>C</sup>](#) and [actorODP:participatingActor<sup>op</sup>](#) some [actorODP:Actor<sup>C</sup>](#) and [actorODP:participationIn<sup>op</sup>](#) some [Circular Value Network<sup>C</sup>](#)

## Consuming resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/ConsumingResource">http://w3id.org/CEON/ontology/actor/ConsumingResource</a>
<b>Description</b>	The relation where the role of the actor is the consumer of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation</a> <sup>C</sup>
<b>Equivalentclass</b>	<a href="#">actorODP:participantRole</a> <sup>op</sup> value <a href="#">consumer</a> <sup>C</sup> and <a href="#">Resource Relation</a> <sup>C</sup>

## Issuing resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/IssuingResource">http://w3id.org/CEON/ontology/actor/IssuingResource</a>
<b>Description</b>	The relation where the role of the actor is the issuer of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation</a> <sup>C</sup>
<b>Equivalentclass</b>	<a href="#">Resource Relation</a> <sup>C</sup> and <a href="#">actorODP:participantRole</a> <sup>op</sup> value <a href="#">issuer</a> <sup>C</sup>

## Owning resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/OwningResource">http://w3id.org/CEON/ontology/actor/OwningResource</a>
<b>Description</b>	The relation where the role of the actor is the owner of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation</a> <sup>C</sup>
<b>Equivalentclass</b>	<a href="#">Resource Relation</a> <sup>C</sup> and <a href="#">actorODP:participantRole</a> <sup>op</sup> value <a href="#">owner</a> <sup>C</sup>

## Process Participation<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/ProcessParticipation">http://w3id.org/CEON/ontology/actor/ProcessParticipation</a>
<b>Description</b>	Participation of a certain actor in a certain process, with a certain role. For instance, a certain department of a recycling company having the role of quality controllant, or material sorter, in a certain recycling process. The participation may also be given a time, e.g. a start and end time.
<b>Sub Class Of</b>	<a href="#">actorODP:CollaborationParticipation</a> <sup>C</sup> <a href="#">actorODP:CollaborationParticipation</a> <sup>C</sup> and <a href="#">actorODP:participationIn</a> <sup>op</sup> some <a href="#">http://w3id.org/CEON/ontology/process/Process</a> <sup>C</sup> and <a href="#">actorODP:participatingActor</a> <sup>op</sup> some <a href="#">actorODP:Actor</a> <sup>C</sup> and <a href="#">actorODP:participantRole</a> <sup>op</sup> some <a href="#">Actor Circular Value Network role</a> <sup>C</sup>

## Producing resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/ProducingResource">http://w3id.org/CEON/ontology/actor/ProducingResource</a>
<b>Description</b>	The relation where the role of the actor is the producer of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation</a> <sup>C</sup>
<b>Equivalentclass</b>	<a href="#">actorODP:participantRole</a> <sup>op</sup> value <a href="#">producer</a> <sup>C</sup> <i>and</i> <a href="#">Resource Relation</a> <sup>C</sup>

## Providing resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/ProvidingResource">http://w3id.org/CEON/ontology/actor/ProvidingResource</a>
<b>Description</b>	The relation where the role of the actor is the provider of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation</a> <sup>C</sup>
<b>Equivalentclass</b>	<a href="#">actorODP:participantRole</a> <sup>op</sup> value <a href="#">provider</a> <sup>C</sup> <i>and</i> <a href="#">Resource Relation</a> <sup>C</sup>

## Reselling resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/ResellingResource">http://w3id.org/CEON/ontology/actor/ResellingResource</a>
<b>Description</b>	The relation where the role of the actor is the reseller of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation</a> <sup>C</sup>
<b>Equivalentclass</b>	<a href="#">Resource Relation</a> <sup>C</sup> <i>and</i> <a href="#">actorODP:participantRole</a> <sup>op</sup> value <a href="#">reseller</a> <sup>C</sup>

## Selling resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/SellingResource">http://w3id.org/CEON/ontology/actor/SellingResource</a>
<b>Description</b>	The relation where the role of the actor is the seller of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation</a> <sup>C</sup>
<b>Equivalentclass</b>	<a href="#">actorODP:participantRole</a> <sup>op</sup> value <a href="#">seller</a> <sup>C</sup> <i>and</i> <a href="#">Resource Relation</a> <sup>C</sup>

## Supplying resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/SupplyingResource">http://w3id.org/CEON/ontology/actor/SupplyingResource</a>
<b>Description</b>	The relation where the role of the actor is the supplier of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation<sup>C</sup></a>
<b>Equivalentclass</b>	<a href="#">Resource Relation<sup>C</sup></a> and <a href="#">actorODP:participantRole<sup>OP</sup></a> value <a href="#">supplier<sup>C</sup></a>

## Updating resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/UpdatingResource">http://w3id.org/CEON/ontology/actor/UpdatingResource</a>
<b>Description</b>	The relation where the role of the actor is the updater of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation<sup>C</sup></a>
<b>Equivalentclass</b>	<a href="#">Resource Relation<sup>C</sup></a> and <a href="#">actorODP:participantRole<sup>OP</sup></a> value <a href="#">updater<sup>C</sup></a>

## Using resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/UsingResource">http://w3id.org/CEON/ontology/actor/UsingResource</a>
<b>Description</b>	The relation where the role of the actor is the user of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation<sup>C</sup></a>
<b>Equivalentclass</b>	<a href="#">actorODP:participantRole<sup>OP</sup></a> value <a href="#">user<sup>C</sup></a> and <a href="#">Resource Relation<sup>C</sup></a>

## Viewing resource<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actor/ViewingResource">http://w3id.org/CEON/ontology/actor/ViewingResource</a>
<b>Description</b>	The relation where the role of the actor is the viewer of a certain resource.
<b>Sub Class Of</b>	<a href="#">Resource Relation<sup>C</sup></a>
<b>Equivalentclass</b>	<a href="#">Resource Relation<sup>C</sup></a> and <a href="#">actorODP:participantRole<sup>OP</sup></a> value <a href="#">viewer<sup>C</sup></a>

## Actor<sup>C</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/actorODP/Actor">http://w3id.org/CEON/ontology/actorODP/Actor</a>
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## Capability<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/Capability>

**In Domain Of** [capability extent](#)<sup>op</sup>  
[needed resource relations](#)<sup>op</sup>

## Collaboration Participation<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/CollaborationParticipation>

**Super Class Of** [Circular Value Network Participation](#)<sup>c</sup>  
[Process Participation](#)<sup>c</sup>

## Participation<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/Participation>

## Resource Relation<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/ResourceRelation>

**Description** A relation between a resource, an actor, and the role the actor has in relation to the resource. For instance, the role of owner that a certain actor takes for a certain resource for a certain period of time. Or the seller of a certain resource, until that resource has been sold, and the actor no longer has that role in relation to the resource.

**Sub Class Of** [actorODP:participantRole](#)<sup>op</sup> some [Actor resource role](#)<sup>c</sup> and [actorODP:participatingResource](#)<sup>op</sup> some <http://w3id.org/CEON/ontology/resourceODP/Resource><sup>c</sup> and [actorODP:participatingActor](#)<sup>op</sup> some [actorODP:Actor](#)<sup>c</sup> and [actorODP:Participation](#)<sup>c</sup>

**Super Class Of** [Buying resource](#)<sup>c</sup>  
[Consuming resource](#)<sup>c</sup>  
[Issuing resource](#)<sup>c</sup>  
[Owning resource](#)<sup>c</sup>  
[Producing resource](#)<sup>c</sup>  
[Providing resource](#)<sup>c</sup>  
[Reselling resource](#)<sup>c</sup>  
[Selling resource](#)<sup>c</sup>  
[Supplying resource](#)<sup>c</sup>  
[Updating resource](#)<sup>c</sup>  
[Using resource](#)<sup>c</sup>  
[Viewing resource](#)<sup>c</sup>

## Role<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/Role>

**Super Class Of** [Actor collaboration role<sup>c</sup>](#)  
[Actor resource role<sup>c</sup>](#)

## Circular Value Network<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/cvn/CVN>

**Description** A collaboration between actors that constitute a Circular Value Newtworks, implicitly or explicitly set up.

**Sub Class Of** [http://w3id.org/CEON/ontology/cvn/Collaboration<sup>c</sup>](http://w3id.org/CEON/ontology/cvn/Collaboration)

## Collaboration<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/cvn/Collaboration>

**Super Class Of** [Circular Value Network<sup>c</sup>](#)

## Process<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/processODP/Process>

## Resource<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Resource>

## Object Properties

## capability extent<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/capabilityExtent>

**Description**

The extent of this capability, e.g. stating whether there are limits to the capability, such as a maximum amount or size of something.

**Sub Property Of** [actorODP:capabilityProperty<sup>op</sup>](#)

**Domain** [actorODP:Capability<sup>c</sup>](#)

## needed resource relations<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actor/neededResourceRelation>

**Description**

In order for an actor to have a capability, it needs to have certain resources, e.g. materials, infrastructure, know-how, information etc.

**Sub Property Of** [actorODP:capabilityProperty<sup>op</sup>](#)

**Domain** [actorODP:Capability<sup>c</sup>](#)

## capability property<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/capabilityProperty>

**Super Property Of**

- [capability extent<sup>op</sup>](#)
- [needed resource relations<sup>op</sup>](#)

## participant role<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/participantRole>

## participating actor<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/participatingActor>

## participating resource<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/participatingResource>

participation in<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/actorODP/participationIn>

## Annotation Properties

contributor<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/contributor>

created<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/created>

creator<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/creator>

description<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/description>

license<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/license>

title<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/title>

preferred namespace prefix<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespacePrefix>

preferred namespace uri<sup>ap</sup>

**IRI** <http://purl.org/vocab/vann/preferredNamespaceUri>

covers requirements<sup>ap</sup>

<b>IRI</b>	<a href="http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements">http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements</a>
------------	---

## 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

<sup>c</sup>

Classes

<sup>op</sup>

Object Properties

<sup>ap</sup>

Annotation Properties

# 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

### License

<https://github.com/LiUSemWeb/CEON/blob/master/LICENSE>

### Version Iri

<http://w3id.org/CEON/ontology/process/0.1/>

### Version Info

0.1

### 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, T10-1

## Classes

### Assembling Process<sup>C</sup>

#### IRI

<http://w3id.org/CEON/ontology/process/AssemblingProcess>

#### Sub Class Of

[processODP:Transformation](#)

### Buy Resource Process<sup>C</sup>

#### IRI

<http://w3id.org/CEON/ontology/process/BuyResourceProcess>

#### Sub Class Of

[processODP:Transformation](#)

## CO2 emission<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/CO2Emission>

**Description** An amount of CO2.

**Sub Class Of** [resourceODP:Resource](#)

**In Range Of** [produces CO2](#)<sup>op</sup>

## Cathalyst<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/Cathalyst>

**Description** A resource that is needed as a cathalyst by a process, but that is not considered the direct input or output of it.

**Sub Class Of** [resourceODP:Resource](#)

**In Range Of** [uses cathalyst](#)<sup>op</sup>

## Change Resource Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ChangeResourceProcess>

**Sub Class Of** [processODP:Transformation](#)

## Contact Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ContactProcess>

**Sub Class Of** [processODP:Transformation](#)

## Deconstruction Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/DeconstructionProcess>

**Sub Class Of** [processODP:Transformation](#)

## Dismantle Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/DismantleProcess>

**Sub Class Of** [processODP:Transformation](#)

## Energy<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/Energy>

**Description** An amount of energy.

**Sub Class Of** [resourceODP:Resource](#)

**In Range Of** [needs energy](#)<sup>op</sup>

## Ensure Claim Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/EnsureClaimProcess>

**Sub Class Of** [processODP:Transformation](#)

## Issuing Certificate Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/IssuingCertificateProcess>

**Sub Class Of** [processODP:Transformation](#)

## Manufacturing Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ManufacturingProcess>

**Sub Class Of** [processODP:Transformation](#)

## Offset Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/OffsetProcess>

**Sub Class Of** [processODP:Transformation](#)



## Production Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ProductionProcess>

**Sub Class Of** [processODP:Transformation](#)

## Recycle Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/RecycleProcess>

**Sub Class Of** [processODP:Transformation](#)

## Refurbishment Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/RefurbishmentProcess>

**Sub Class Of** [processODP:Transformation](#)

## Remove Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/RemoveProcess>

**Sub Class Of** [processODP:Transformation](#)

## Remove Resource Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/RemoveResourceProcess>

**Sub Class Of** [processODP:Transformation](#)

## Repair Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/RepairProcess>

**Sub Class Of** [processODP:Transformation](#)

## Resell Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ResellProcess>

**Sub Class Of** [processODP:Transformation](#)

## Reuse Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ReuseProcess>

**Sub Class Of** [processODP:Transformation](#)

## Sell Resource Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/SellResourceProcess>

**Sub Class Of** [processODP:Transformation](#)

## Service Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ServiceProcess>

**Sub Class Of** [processODP:Transformation](#)

## Share Resource Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/ShareResourceProcess>

**Sub Class Of** [processODP:Transformation](#)

## Take Back Process<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/process/TakeBackProcess>

**Sub Class Of** [processODP:Transformation](#)

## Object Properties

### needs energy<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/process/needsEnergy>

**Description** The energy needed to perform a certain process.

**Sub Property Of** [processODP:hasInput](#)

**Range** [Energy<sup>C</sup>](#)

produces CO2<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/process/producesCO2>

**Description** The CO2 released or produced by the process.

**Sub Property Of** [processODP:hasOutput](#)

**Range** [CO2 emission](#)<sup>c</sup>

resulting product<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/process/resultingProduct>

**Description** The resource that is the output (product, i.e. what is produced) from a certain process.

**Sub Property Of** [processODP:hasOutput](#)

**Range** [resourceODP:Resource](#)

uses cathalyst<sup>op</sup>

**IRI** <http://w3id.org/CEON/ontology/process/usesCathalyst>

**Description** The cathalyst used in a process.

**Sub Property Of** [processODP:hasInput](#)

**Range** [Cathalyst](#)<sup>c</sup>

## Annotation Properties

contributor<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/contributor>

creator<sup>ap</sup>

**IRI** <http://purl.org/dc/terms/creator>

description <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/description">http://purl.org/dc/terms/description</a>
license <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/license">http://purl.org/dc/terms/license</a>
title <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/title">http://purl.org/dc/terms/title</a>
preferred namespace prefix <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespacePrefix">http://purl.org/vocab/vann/preferredNamespacePrefix</a>
preferred namespace uri <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespaceUri">http://purl.org/vocab/vann/preferredNamespaceUri</a>

## 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**

## Legend

c

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ap

Classes

Object Properties

Annotation Properties

# 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

2023-03-16

### License

<https://github.com/LiUSemWeb/CEON/blob/master/LICENSE>

### Version Iri

<http://w3id.org/CEON/ontology/material/0.1/>

### Version Info

0.1

### 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, E1-1, E1-3, E2-4, E5-2, T1-1, T10-2.

## Classes

## ChemicalEntity<sup>C</sup>

**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<sup>C</sup>](#)

**In Range Of** [hasChemicalEntity<sup>op</sup>](#)

**Super Class Of**  
[ChemicalSubstance<sup>C</sup>](#)  
[MolecularEntity<sup>C</sup>](#)

## ChemicalSubstance<sup>C</sup>

**IRI** <http://w3id.org/CEON/ontology/material/ChemicalSubstance>

**Description**

A chemical substance is made up of a collection of molecular entities.

**Sub Class Of** [ChemicalEntity<sup>C</sup>](#)

## Material<sup>C</sup>

**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<sup>C</sup>](#)

**In Domain Of**  
[hasChemicalEntity<sup>op</sup>](#)  
[hasMaterialComponent<sup>op</sup>](#)

**Restriction** [hasChemicalEntity<sup>op</sup>](#) some [Material<sup>C</sup>](#)

## MaterialComponent<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/material/MaterialComponent>

**Description** A material component is a part of a material.

**Sub Class Of** [resourceODP:Constituent<sup>c</sup>](#)

**In Range Of** [hasMaterialComponent<sup>op</sup>](#)

## MolecularEntity<sup>c</sup>

**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** [ChemicalEntity<sup>c</sup>](#)

## Constituent<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Constituent>

**Super Class Of** [MaterialComponent<sup>c</sup>](#)

## Matter<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Matter>

**Super Class Of** [ChemicalEntity<sup>c</sup>](#)  
[Material<sup>c</sup>](#)

## Physical Object<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/PhysicalObject>

## Resource<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Resource>



## Object Properties

### hasChemicalEntity<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/material/hasChemicalEntity">http://w3id.org/CEON/ontology/material/hasChemicalEntity</a>
<b>Description</b>	hasChemicalEntity intends to represent that a material can have a collection of chemical entities.
<b>Domain</b>	<a href="#">Material</a> <sup>c</sup>
<b>Range</b>	<a href="#">ChemicalEntity</a> <sup>c</sup>

### hasMaterialComponent<sup>op</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/material/hasMaterialComponent">http://w3id.org/CEON/ontology/material/hasMaterialComponent</a>
<b>Description</b>	hasMaterialComponent intends to represent that a material can have a collection of components.
<b>Domain</b>	<a href="#">Material</a> <sup>c</sup>
<b>Range</b>	<a href="#">MaterialComponent</a> <sup>c</sup>

## Datatype Properties

### Anonymous Formula<sup>dp</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/material/AnonymousFormula">http://w3id.org/CEON/ontology/material/AnonymousFormula</a>
<b>Description</b>	AnonymousFormula represents that a molecular entity has the anonymous formula in a string.

### Descriptive Formula<sup>dp</sup>

<b>IRI</b>	<a href="http://w3id.org/CEON/ontology/material/DescriptiveFormula">http://w3id.org/CEON/ontology/material/DescriptiveFormula</a>
<b>Description</b>	DescriptiveFormula represents that a molecular entity has the descriptive formula in a string.

## Hill Formula<sup>dp</sup>

**IRI** <http://w3id.org/CEON/ontology/material/HillFormula>

### Description

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

## Reduced Chemical Formula<sup>dp</sup>

**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<sup>ap</sup>

**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

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dp

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Classes

Object Properties

Datatype Properties

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

<https://github.com/LiUSemWeb/CEON/blob/master/LICENSE>

### Version Iri

<http://w3id.org/CEON/ontology/product/0.1/>

### Version Info

0.1

### 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-ResourceType-4, C11-2, C12-1, C13-3, E2-1, T8-3.

## Classes

## Product<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/product/Product>

### Description

A product is a physical object put into a market for sale. The product can be a thing that grows naturally or produced through some chemical or manufacturing processes.

### Sub Class Of

[resourceODP:PhysicalObject<sup>c</sup>](#)  
[hasProductComponent<sup>op</sup>](#) only [ProductComponent<sup>c</sup>](#) *and* [hasProductComponent<sup>op</sup>](#) some [ProductComponent<sup>c</sup>](#)

### In Domain Of

[hasProductComponent<sup>op</sup>](#)

## ProductComponent<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/product/ProductComponent>

### Description

A product component is a part of a product.

### Sub Class Of

[resourceODP:Constituent<sup>c</sup>](#)

### In Range Of

[hasProductComponent<sup>op</sup>](#)

## Constituent<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Constituent>

### Super Class Of

[ProductComponent<sup>c</sup>](#)

## Matter<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/Matter>

## Physical Object<sup>c</sup>

**IRI** <http://w3id.org/CEON/ontology/resourceODP/PhysicalObject>

### Super Class Of

[Product<sup>c</sup>](#)

## Resource<sup>c</sup>

IRI	<a href="http://w3id.org/CEON/ontology/resourceODP/Resource">http://w3id.org/CEON/ontology/resourceODP/Resource</a>
-----	---

## Object Properties

### hasProductComponent<sup>op</sup>

IRI	<a href="http://w3id.org/CEON/ontology/product/hasProductComponent">http://w3id.org/CEON/ontology/product/hasProductComponent</a>
-----	---

<u>Description</u>	hasProductComponent intends to represent that a product can have a collection of components.
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<u>Domain</u>	<a href="#">Product<sup>c</sup></a>
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<u>Range</u>	<a href="#">ProductComponent<sup>c</sup></a>
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## Annotation Properties

### contributor<sup>ap</sup>

IRI	<a href="http://purl.org/dc/terms/contributor">http://purl.org/dc/terms/contributor</a>
-----	---

### created<sup>ap</sup>

IRI	<a href="http://purl.org/dc/terms/created">http://purl.org/dc/terms/created</a>
-----	---

### creator<sup>ap</sup>

IRI	<a href="http://purl.org/dc/terms/creator">http://purl.org/dc/terms/creator</a>
-----	---

### description<sup>ap</sup>

IRI	<a href="http://purl.org/dc/terms/description">http://purl.org/dc/terms/description</a>
-----	---

### license<sup>ap</sup>

IRI	<a href="http://purl.org/dc/terms/license">http://purl.org/dc/terms/license</a>
-----	---

title <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/title">http://purl.org/dc/terms/title</a>
preferred namespace prefix <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespacePrefix">http://purl.org/vocab/vann/preferredNamespacePrefix</a>
preferred namespace uri <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespaceUri">http://purl.org/vocab/vann/preferredNamespaceUri</a>
covers requirements <sup>ap</sup>	
IRI	<a href="http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements">http://www.ontologydesignpatterns.org/schemas/cpannotationschema.owl#coversRequirements</a>

## Namespaces

:

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

**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

c

Classes

op

Object 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

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### Version Iri

<http://w3id.org/CEON/ontology/value/0.1/>

### Version Info

0.1

### Preferred Namespace Prefix

value

### Preferred Namespace Uri

<https://w3id.org/CEON/ontology/value/>

### Description

A core ODP of the CEON ontology network, defining aspects of the value concept. Currently a "stub" for future extension.

## Classes

### Value<sup>c</sup>

#### IRI

<http://w3id.org/CEON/ontology/value/Value>

#### Description

Some notion of value.

### Value proposition<sup>c</sup>

#### IRI

<http://w3id.org/CEON/ontology/value/ValueProposition>

#### Description

Proposed or intended value outcome of some process, action or collaboration.

## Annotation Properties

contributor <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/contributor">http://purl.org/dc/terms/contributor</a>
creator <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/creator">http://purl.org/dc/terms/creator</a>
description <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/description">http://purl.org/dc/terms/description</a>
title <sup>ap</sup>	
IRI	<a href="http://purl.org/dc/terms/title">http://purl.org/dc/terms/title</a>
preferred namespace prefix <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespacePrefix">http://purl.org/vocab/vann/preferredNamespacePrefix</a>
preferred namespace uri <sup>ap</sup>	
IRI	<a href="http://purl.org/vocab/vann/preferredNamespaceUri">http://purl.org/vocab/vann/preferredNamespaceUri</a>

## Namespaces

:

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

**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#>

**vann**

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

**xsd**

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

## Legend

c

Classes

ap

Annotation Properties