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ONTOLOGY-DRIVEN DATA DOCUMENTATION FOR INDUSTRY COMMONS

Bridge-Concepts

A multi-purpose tool

Online

UNIBO, CNR, GCL, ENIT, UiO, ATB, SINTEF, NUIG

27/02/2023, Online

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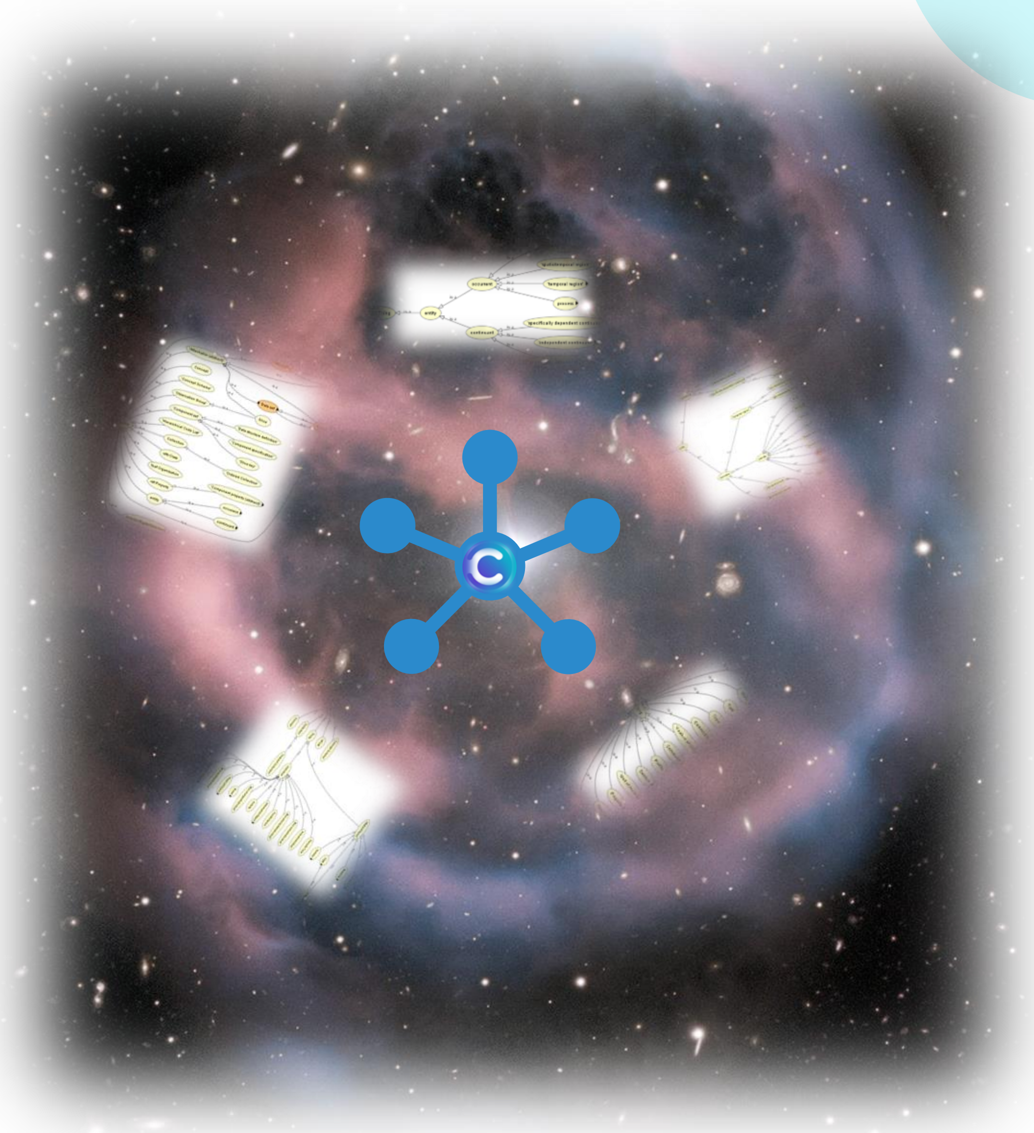
Bridge-Concepts

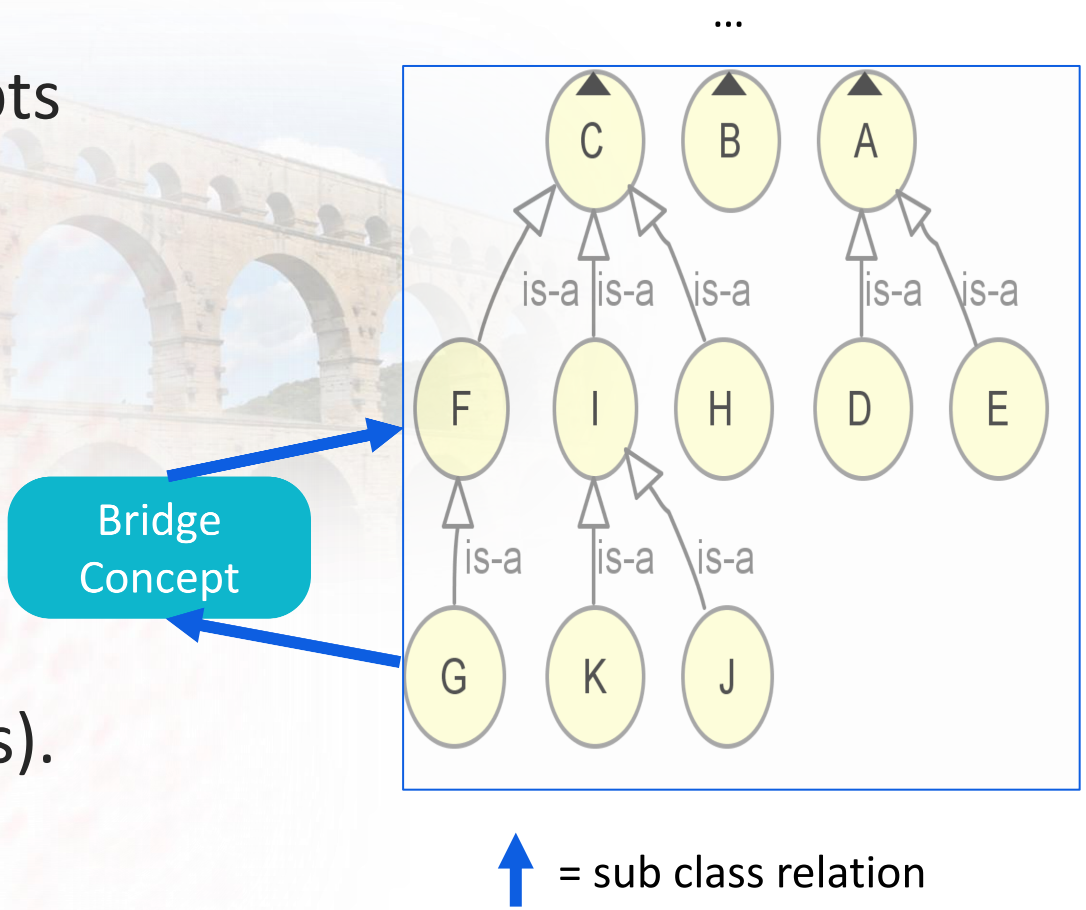
- One of the **core tools** developed in the context of the project **to establish the OCES**.
- **Standalone** [upon creation] **ontology entities** with an **extensive documentation**: a practical **dictionary** tailored for ontology-implementation.
  - Explicitly connected to the core **Knowledge Domain Resources** and **Standards**.
- They are akin to universal **adapters/converters**, supporting (and facilitating) strong **semantic alignments** among a plurality of ontologies.
  - Simple data pipelines.



Bridge-Concepts and Semantic Connections

For all practical purposes, ontologies can be seen as graphs, or networks

- **Strong Semantic Relations** are established between the Bridge-Concepts and classes from a target ontology.
- **Mediated connections** result from multiple connections.
  - **Reasoning spreads downwards** (in general from higher to lower level ontologies).
  - **(Horizontal) Data sharing is established**.

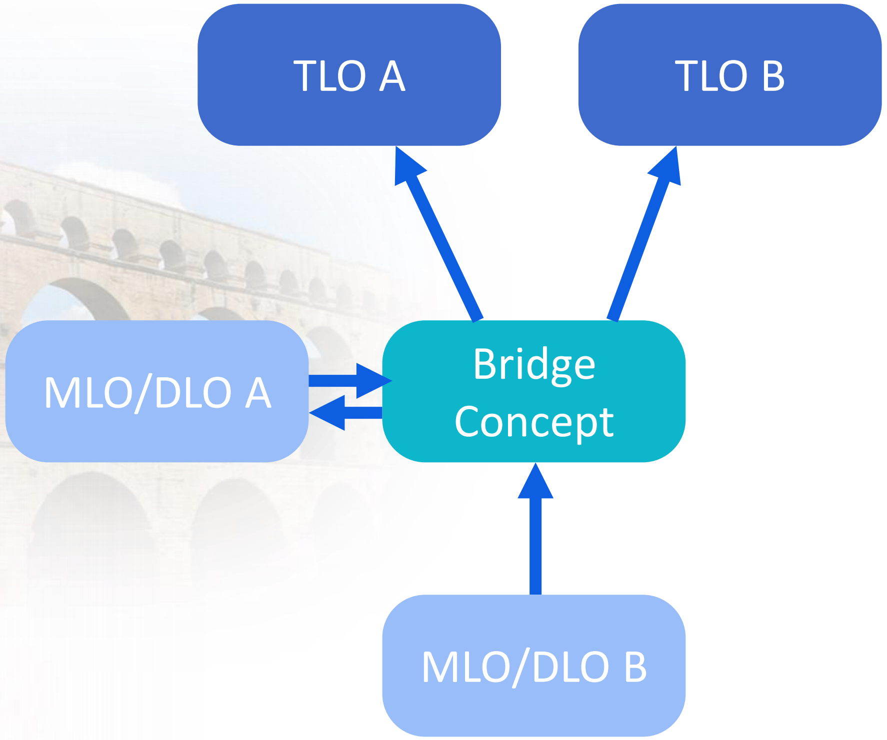


ONTO COMMONS ONTOLOGY-DRIVEN DATA DOCUMENTATION FOR INDUSTRY COMMONS

Bridge-Concepts and Mediated Connections

We'll soon touch on how they're individuated

- Tackling **Scalability** issues:
- **Data sharing** only at the **core network junctures**: simple pipelines.
    - "**Zipper effect**" with multiple Bridge-Concepts.
    - **Modular framework**.
        - The **partial mappings** among TLOs facilitate and contribute in validating alignments.
- **Hub and Spoke paradigm**: greatly reduces the number of connections to be established.
    - From exponential to linear.

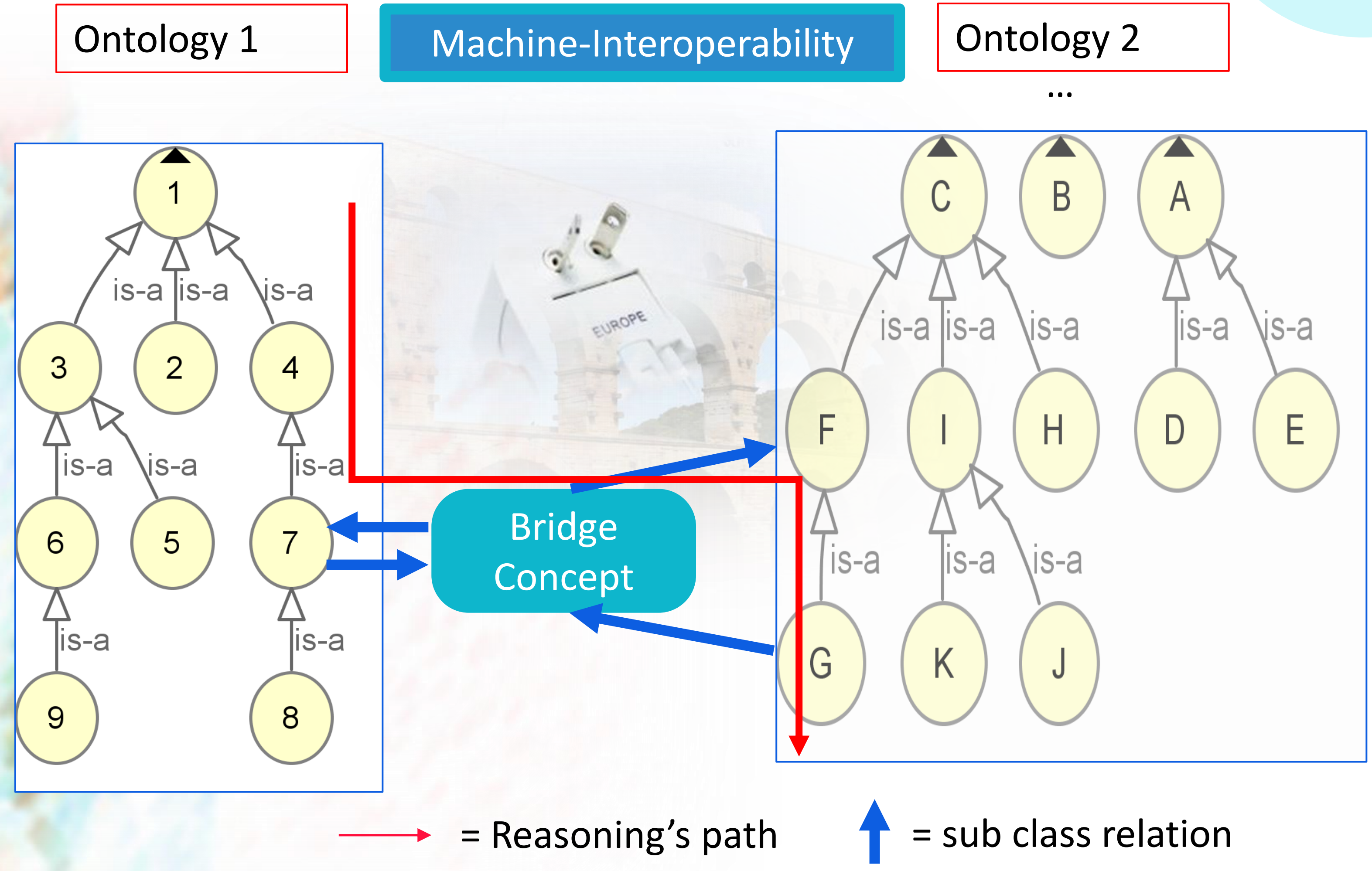


how Bridge-Concepts connect the OCES

= sub class relation

Bridge-Concepts and the OCES

- Example:
  - Via the Bridge-Concept, G becomes subClassOf 7 (which is subClassOf 4 and 1).
  - Given that, ontology 2 can benefit from relations supported by ontology 1, and reasoning is enhanced overall.
    - Each Ontology can benefit from the other: specialisation and complementarity



Bridge-Concepts: how they are characterised

- **Formal vs Informal characterisations of classes:**
  - **Formal**: constraints ingrained in the ontology itself.
    - **Hierarchical structure**.
    - Constraints from **Relations**.
  - **Informal**: can be extrapolated from labels, annotations and contextual information, pragmatic considerations concerning actual and intended usage included (focus on the individuals - extensions).

Machine

Human

- **With Bridge-Concepts the focus is on Informal characterisations.**

They have to bridge between different formal characterisations picking out similar things.

Handles for Human Users

Bridge-Concepts' Templates

Tools for each task:
Templates, for the Conceptual Engineering of Bridge-Concepts

NEW CONCEPT NAME[1]

(use the preferred label, or IRI name, provided in the first table as title)

Concept elucidation

General Concept Info:

IRI:	*Suggested entity new IRI.*
OWL Type:	*Class | ObjectProperty | Individual.*
Concept Elucidation:	*Natural language definition of the concept (elucidation).* *Here the concept that we want to introduce is expressed as precisely as possible, making references to knowledge domain resources, including instance and usage examples when relevant.*
Labels:	*Labels used to address the concept, ordered as:* *i) preferred (one) (the label to primarily used to shortly refer to the concept)* *ii) alternative (multiple) (labels that are commonly used to address the concept in practice, even if they are used with narrower of wider sense)* *iii) deprecated (multiple) (labels that are misleading with respect to the concept, because of misuse, ambiguity or too wide meaning).*

Knowledge domain resources

Knowledge Domain Resources:

Related Domain Resources:	*Existing domain resources (e.g. standards, books, articles, dictionaries) that defines or are related to the concept (provide reference to the resource and quote the relevant informational content).* *More than one resource can be reported.* *These resources are aimed to support the choice of the above concept choice and elucidation.*
Comments:	*Explain the motivations behind the concept definition with reference to the domain resources, underlying similarities and differences.*

Alignment with (classes fom) existing formal ontologies

Alignments To Existing Ontologies:

Target Ontology:	*Existing IRI of the ontology that will express the concept according to its logical framework (concept alignment).*
Related Ontology Entities:	*List of terms and IRIs of the Target Ontology entities that are relevant for the concept (documentation is supposed to be accessible through the target ontology).*
Mapping Elucidation:	*Natural language description of the mapping choice and motivations.*
Semantic Relation Level:	*The level of semantic relationship between the Concept and the Target Ontology entities:* - *Equivalence (strong mapping) (e.g. owl:equivalentClass, owl:equivalentProperty)* - *Strong Hierarchical (e.g. rdfs:subClassOf, rdfs:subPropertyOf)* - *Weak Hierarchical (e.g. skos:narrower, skos:broader)* - *Similarity (e.g. skos:related).*
Mapping Axioms:	*Proposed mapping axiom (or axioms) between the Concept entity and the Target Ontology entities in a OWL2 compliant syntax (e.g. Turtle, Manchester, RDF/XML, Functional-Style, OWL/XML).*

The template has many features:

- It acts as a guide in Bridge-Concept Engineering
- It is hinged on FAIR-ness
- It has parts dedicated to both users and ontologists
- It is Implementation-ready

There is also an entire section documenting and explaining the rationale underlying the alignments for those interested

Bridge-Concepts: Starting from the goal

- 2 core desiderata:
  - **(1) Interoperability Desiderata**: Bridge-Concepts have to connect the ontologies at the right joints, and thus they have to pick out the right things (individuals).
  - **(2) Accessibility Desiderata**: Bridge-Concepts have to be **accessible to industrial stakeholders and domain experts**, and be the one they need and want to employ.
    - Another Core issue limiting ontologies' widespread usage, especially for higher level ontologies.
    - To provide the best tools, engagement with the user is pivotal (CQs).
    - Establishing **explicit connections** with widely **employed and well-known standards** is key.

Plus Reusability beyond the ontologies considered

Bridge-Concepts: Starting from the goal

The quest for Conceptual Grails

- **Conceptual Engineering with a clear pragmatic goal** helps sidestepping meaningless discussions on semantic/labelling preferences and frictionless theoretical points.
  - Different stakeholders employ the **same terms in different ways**; they have **different stances** on cases involving certain concepts; they follow **different standard definitions**; even if there was a most appropriate/correct/referentially natural/best-under-this-or-that regard concept, there would be **no way to impose its use**, even assuming it could be demonstrated that it has said characteristics.
  - **Pluralism + Fit rather than match**.

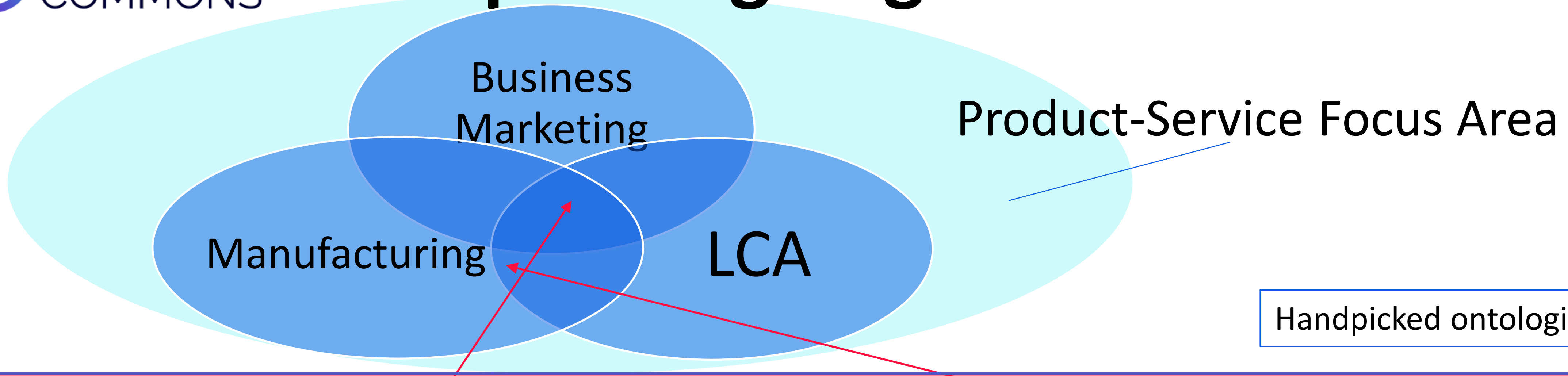
Selecting Bridge-Concepts Candidate-terms

Two Methodologies for the selection of candidate-terms

- **(1) Semi Automatic:**
  - Exploitation of **automatic mapping tools** in an **ancillary role** to improve the analysis.
  - Especially effective to deal with a large sample of ontologies, allowing for extrapolation via **mathematical tools**.
  - Yet to be consolidated, as we’re still testing it.
- **(2) Manual:**
  - Via tentative Semantic alignments.
  - Aiming at covering the entirety of the ontologies’ domain and to produce meaningful links.
  - Taking into account closeness to glossaries/standards and CQs.

Holistic Process

Example: Aligning PSS and PRONTO



Handpicked ontologies

Ontologies currently employed as a Reference

PSS:
The Product Service System (PSS) working group under Industrial Ontology Foundry (IOF) aims to create an ontology for enhancing the engineering of PSS in manufacturing, by modelling all the aspects that affect, or could affect a PSS. In this group, the understanding is that a Product Service System is a system that includes products, services, supporting networks and infrastructure, designed to be competitive, and jointly satisfy the customers' needs and have a lower environmental impact than other business models.

PRONTO:
PRONTO (PRoduct ONTOlogy) is an ontology for the Product Modelling domain, able to efficiently handle product variants, which defines and integrates two hierarchies to represent product information: the Abstraction Hierarchy and the Structural one. This proposal efficiently handles a great number of variants and allows representing product information with distinct granularity degrees, which is a requirement for planning activities. PRONTO easily manages crucial feature, such as the efficient handling of product families and variants.

The Product-Service Conceptual Area

- Transversal area/domain with many **non-domain specific core concepts.**

- An area undergoing substantial **changes.**
  - **Servicification** of the transaction focus.
  - **Servitization** of Firms.
  - **Eco – Manufacturing** and Sustainability.
  - Digitalization.
    - New policies, new laws.
      - Strong link between business and jurisprudence' conceptual areas.

Liquid, disunified and rapidly shifting **Conceptual Landscape**

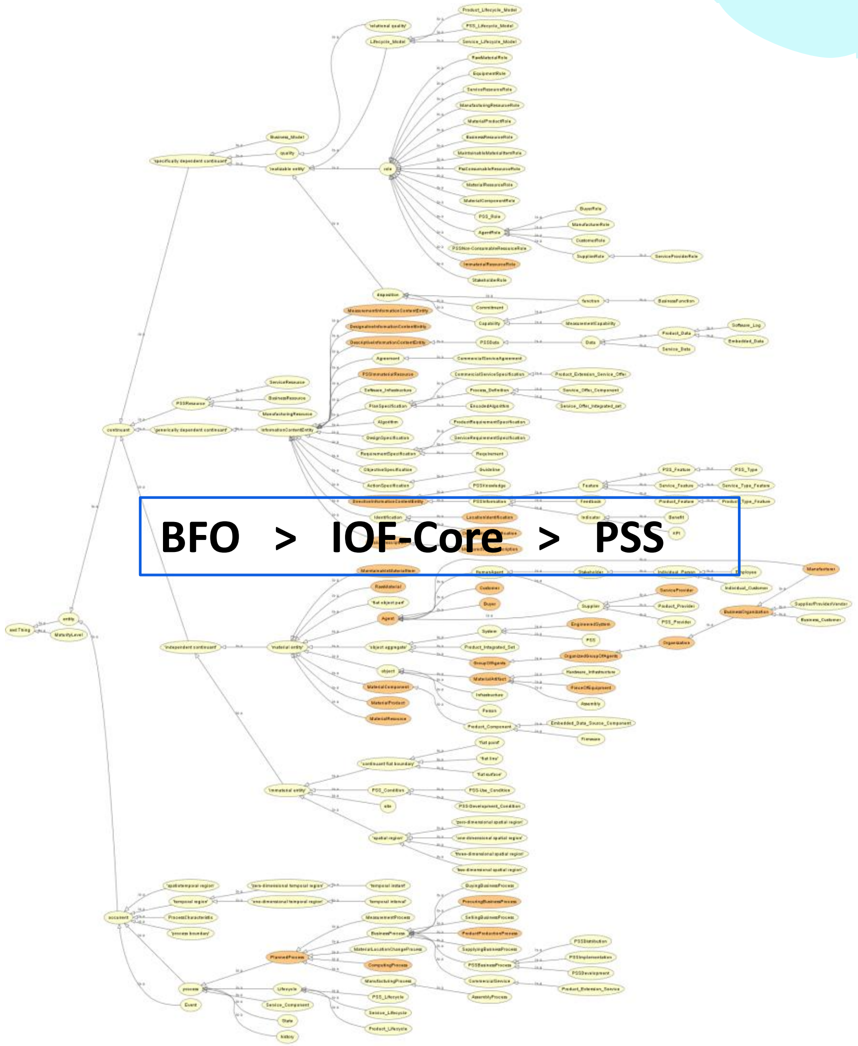
Conceptual Quicksand?

A challenge for Interoperability

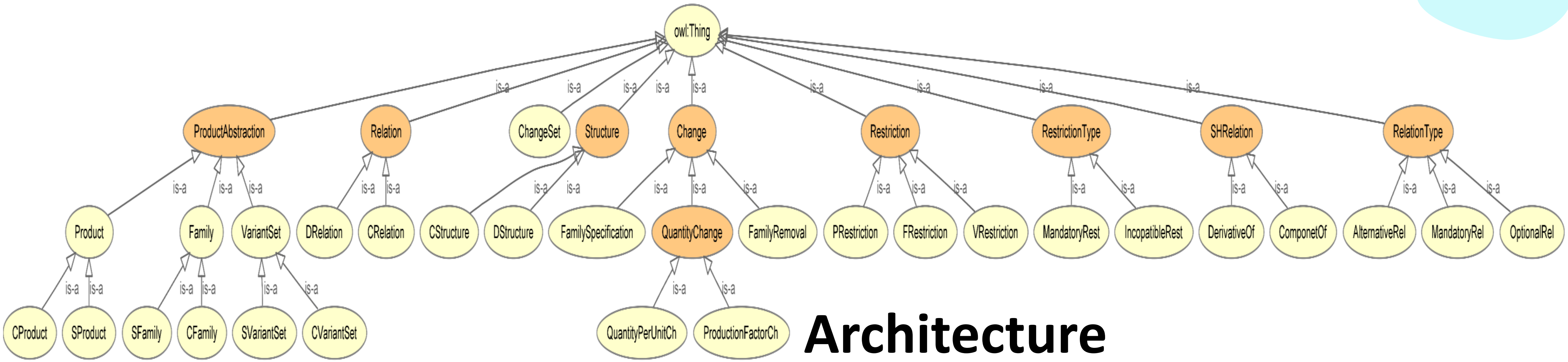
Selecting Candidate Terms: examining the ontologies - The PSS ontology

- **Creating alignments among the considered ontologies; further bridge-concepts candidates can be considered afterwards.**
  - Given a contained number of ontologies, it is important to consider the possible alignments among them before anything else.

  - PSS is based on IOF-Core which is based on BFO
    - As such, the architecture is rich/complex, and developed both horizontally and vertically
    - If connections cannot be established with PSS directly, they can be made with classes from IOF-Core or BFO



The PRONTO ontology



Architecture

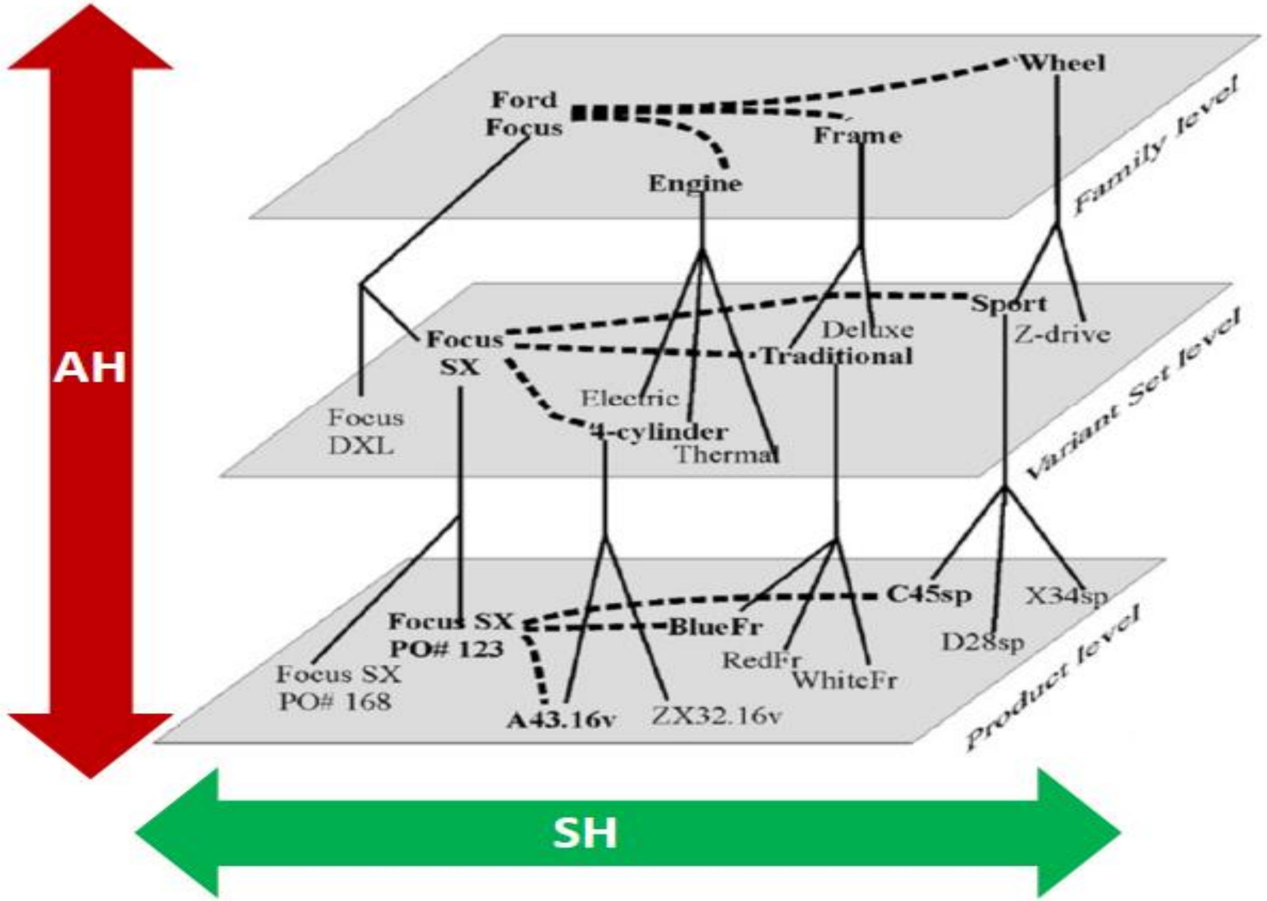
- Preeminently “Horizontally”-Organized
  - Reification of relations
- 2 cores: 1) abstraction hierarchy; 2) structural hierarchy (including composition and decomposition when it applies, plus “higher order tools”)
  - (1) application can -but needn’t necessarily- be based on (2)

For a more detailed introduction to Pronto see Vegetti M. (2007), *Un Modelo Integrado Para La Representaciòn De Productos Con Estructura Complejas*

(Understanding) PRONTO

Pronto's approach in a nutshell (+ example):
Abstraction Hierarchy + Structural Hierarchy

Examples of PRONTO Hierarchies

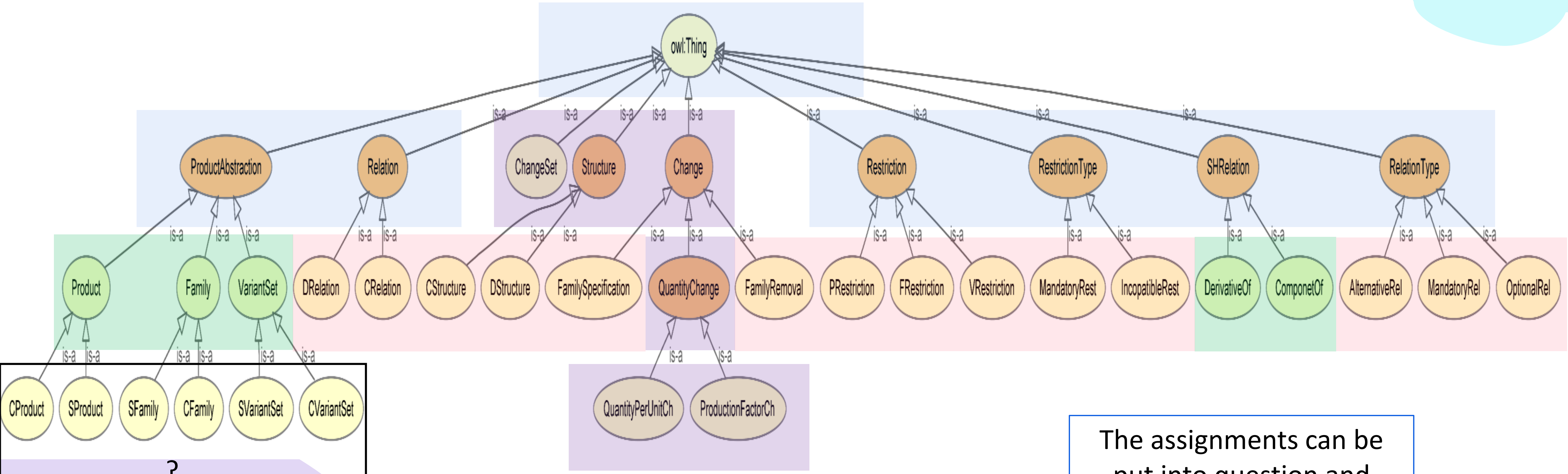


Structural Hierarchy at the Family Level

Structural Hierarchy at the Variant Set Level

Structural Hierarchy at the Product Level

PRONTO: evaluating the classes for the alignment



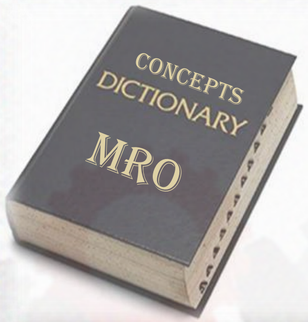
?
These might turn out to be candidates for bridge-concepts with pragmatic constraints

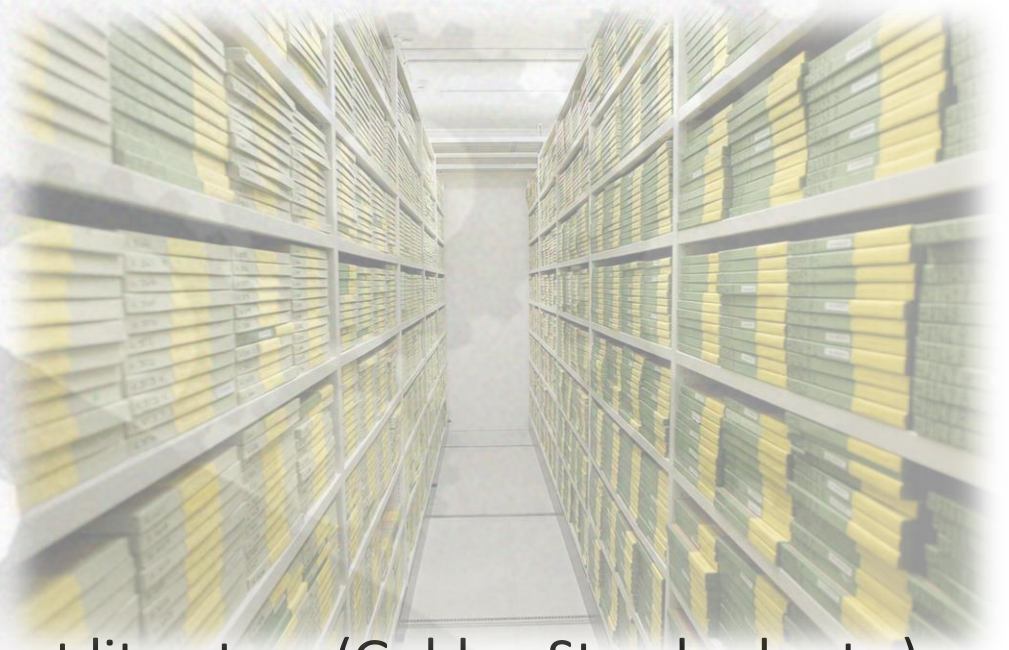
The assignments can be put into question and should be taken with a pinch of salt

Legend:
- "Instrumental" Classes
- Classes with Domain A-specific Concepts
- Ontology-specific Classes
- Candidates

Selecting Candidate Terms
(when dealing with few ontologies to be aligned)

- We found it pragmatically easier to take PRONTO as the starting point, also considering links via IOF-Core/BFO classes to produce a satisfactory number of horizontal connections
  - PRONTO:Product
  - PRONTO:Family/VariantSet
  - PRONTO:ComponentOf
  - ...





- “Interesting” concepts from PSS:
  - PSS:PSS [product service system]
  - PSS:Service
  - ...
- Further candidates will be added from the relevant literature (Golden Standards etc.)

‘Product’: analysis; tentative alignments; Bridge-Concepts engineering

Analysis, formulation of hypotheses and negotition

- Once a candidate is individuated, iterative refinements to pin down the most useful proto-Bridge-Concepts.
  - Preliminary analysis of the landscape and of stakeholders' desiderata.
  - Analysis of the salient classes in the target ontologies.
  - Formulation of hypotheses and (when possible) negotiation.
- Considerations regarding which other Bridge-Concepts are available/will be engineered are also taken into account.
- As it has been anticipated, sometimes it's better to engineer Bridge-Concepts supporting weaker semantic connections, but more "natural" for users.

‘Product’: glossaries and Golden Standards

- **2 cores** underlying the **term** (and no major differences when it comes to its use in the domain under examination):
  - **“Output of a Process”.**
    - Figurative meaning: “output of mathematical operations (multiplication; set-intersection)”; Derivative specifications: “output of a process guided by a telos”; “output of human labour”.
      - The specifications usually have a material connotations (artifacts).
  - **“Object of a Transaction”.**
- Many “hybrid” or non-committal meanings: **certain questions simply do not arise until the mismatches cause issues.**

<table>
<tr><th colspan="3">Product…?</th></tr>
<tr><td>ISO 10303:

• Thing or substance or information produced by a process</td><td>ISO 9000:

• Output of an organization that can be produced without any transaction taking place between the organization and the customer
• (Generally) tangible</td><td>ISO 14040:

• Any goods or service
• Can be either tangible or intangible</td></tr>
</table>

Prima facie relevant Classes in the two ontologies

IOF-Core:MaterialProduct

Annotations

rdfs:label [language: en]
material product

semi-formalNaturalLanguageDefinition [language: en]
Material Product x implies x is a 'material entity' that 'participates in at some time' some Act Of Buying or Act Of Selling or Act Of Supplying y

counterExample
certified pre-owned warranty plan; software as a service (SaaS); training course; consultancy services,
Office 365 offered as a service. In this case, Office 365 Service Agreement (an Information Content Entity) is rather a product. And there is a Commercial Service that is prescribed by the Service Agreement in which Microsoft is an entity involved in the Service Agreement.

rdfs:comment
The definition does exclude services sold as product which deviates from some standard definitions and economic theory but the definition still allows service agreement to be a product.

naturalLanguageDefinition
Material entity for which there is market or internal demand, which some person or organization intends to sell or grant ownership rights to in some economic exchange.

semi-formalNaturalLanguageDefinition
Material Product is a 'material entity' that is the 'bearer of' the Material Product Role

SubjectMatterExpertExplanation [language: en]
1. A good or service produced for sale, barter, or internal use [APICS].
2. A tangible outcome of a process [ISO 6707-3:2017, para. 3.1.5]
3. Any good or service [ISO/Guide 64:2008]

skos:example
1. Natural resources: the seashells lying on the beach that some person intends to collect, package and sell; the iron ore in a mountain the rights to which some mining company has just purchased which they intend to mine and sell to iron-making processors. Parcels of real estate some land developer sells to builders.

2. Any manufactured good

firstOrderLogicDefinition
$\mathrm{MaterialProduct}(x) \rightarrow \mathrm{MaterialEntity}(x) \wedge \exists y((\mathrm{actOfPurchasing}(y) \vee \mathrm{actOfSelling}(y) \vee \mathrm{actOfSupplying}(y)) \wedge \mathrm{participatesInAtSomeTime}(x,y))$

firstOrderLogicDefinition
$\mathrm{MaterialProduct}(x) \leftrightarrow \mathrm{MaterialEntity}(x) \wedge \exists r(\mathrm{MaterialProductRole}(x) \wedge \mathrm{inheresIn}(r,x))$

How to evaluate Potential discrepancies between Formal and Informal characterisations, and ambiguities in the latter?
(1) Formal triumphs over informal;
(2) actual use guides the resolution of ambiguities;
(3) explicit definitions take priority over references;
(4) use context

Prima facie relevant Classes in the two ontologies

PRONTO:Product

Annotations

rdfs:label [language: en]

Product

rdfs:comment [language: en]

Lowest level of the AH representing individual items, having physical existence, which are memberOf a particular VariantSet. Therefore, all the products associated with a given VariantSet have the same structure, the one defined for such VariantSet. Minor modifications in some parameter values(e.g., flavor, color,etc.) can also be introduced at this level.

PSS:PSSProduct

Annotations

rdfs:label

PSS Product

rdfs:comment

It may serve as an interface class for merging with other ontologies.

dcterms:source

5. Wikipedia contributors, 'Product', Wikipedia, The Free Encyclopaedia, 10 July 2017, 15:21 UTC, <https://en.wikipedia.org/w/index.php?title=Product&oldid=789934020> [accessed 20 July 2017]

naturalLanguageDefinition

PSS Product (for manufacturing industry) is a material product, manufactured to satisfy a need of the market [5] (e.g. to be sold in order to provide profit and support customers by covering their needs).

semiFormalNaturalLanguageDefinition

A PSS Product is a material product that 'has role' some PSS Product Role

Prima facie relevant Classes in the two ontologies

PSS:Product_Role

Annotations

rdfs:label

PSS Product Role

naturalLanguageDefinition

A Product Role is a role borne by an entity that is the specified output of a product production process

xDefinitionOtherCommon

A Product Role is a role borne by an entity that is the specified output of a product production process Role that is borne by a BFO: Continuant intended to be sold (and bearing some economic value, the value can be zero, positive, or negative)

xDefinitionOtherCommon

Product Role is an optional characteristic of a material object manufactured to satisfy a need of the market (e.g. to be sold in order to provide profit and support customers by covering their needs).

First hypotheses: starting from the basics

- PRONTO:Product EquivalentClass IOF-Core:MaterialProduct? NO
  - IOF-Core:MaterialProduct makes explicit commitments on transactions, while the PRONTO ontology prima facie seems to be focused on the manufacturing side.
- PRONTO:Product EquivalentClass PSS:PSSProduct? NO
  - PSS:PSSProduct makes even stronger commitments than IOF-Core:MaterialProduct (it is a subClassOf the latter).

AT THIS STAGE in the analysis…

- PRONTO:Product and IOF-Core:MaterialProduct seem “more or less” committed respectively to one of the two **cores** underlying the (standard usages/”meaning” of the) **term** ‘product’; PSS:PSSProduct seems to have both the relevant (groups of) constraints.
- It is still unclear whether meaningful connections can be established considering only those classes.

Tentative Ideas for Bridge-Concepts

(to be engineered)

Bridge-Concept: Product of Manufacturing

“A Product of Manufacturing is the outcome of a manufacturing process, i.e. an activity involving the transformation or re-arrangement of material entities. […]” - **Short incipit for domain experts**

“A Product of Manufacturing needn’t be explicitly offered on the market for purchase or barter, though they are often produced to that end: e.g., they can be manufactured for internal usage or testing. […]” **Addressing general ambiguities for ontology use**

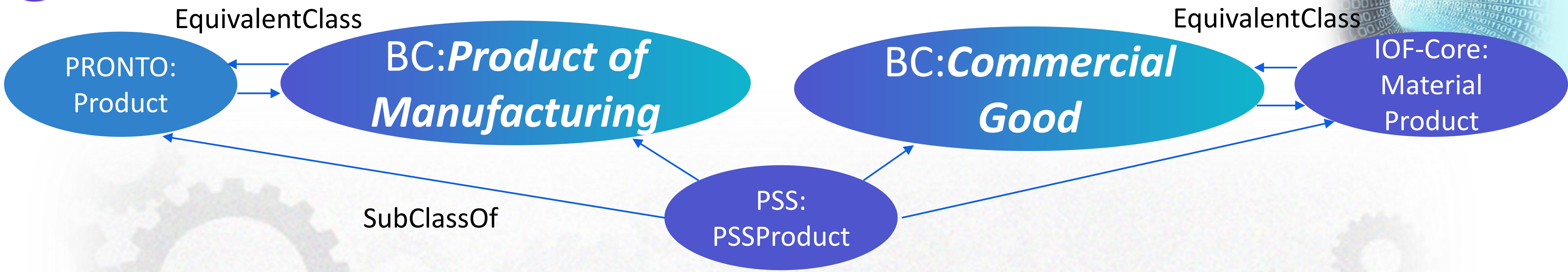
Domain: Manufacturing

Bridge-Concept: Commercial Good

“A Good is something which is explicitly offered on the market for purchase or barter, whose ownership is transferred to the purchaser as a condition for the completion of the transaction, and which is associated with a specific material entity which doesn’t merely act as a legal placeholder or as a contingent medium to the end of completing a transaction. […]”

Domain: Economics – Business – Marketing

Semantic Relations? Not-straightforward links?



- The process was quite complex, so I won't cover all the hypotheses and negotiation steps.
  - The test led to the improvement/clarification of the aligned ontologies themselves and the analysis for 'product' provided us with useful information w.r.t. other candidates terms.
  - BC:Product Specification was ultimately engineered:
    - BC:Product Specification EquivalentClass PRONTO:Product
    - BC:Product Specification EquivalentClass PSS:DesignSpecification [SubClassOf BFO:Generically Dependent Continuant]
- The other 2 proto-Bridge-Concepts were retained for their general applicability/reusability.

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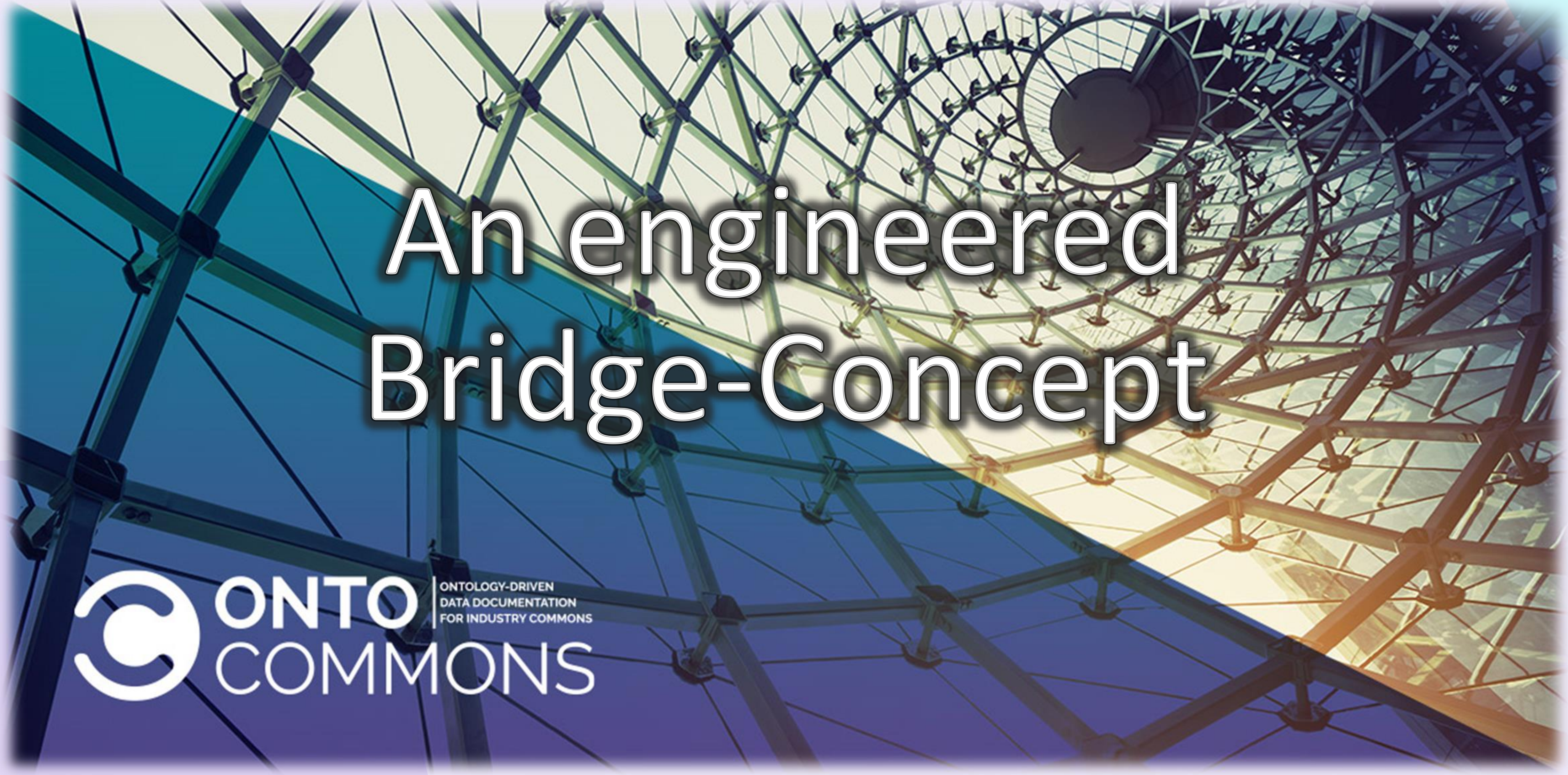
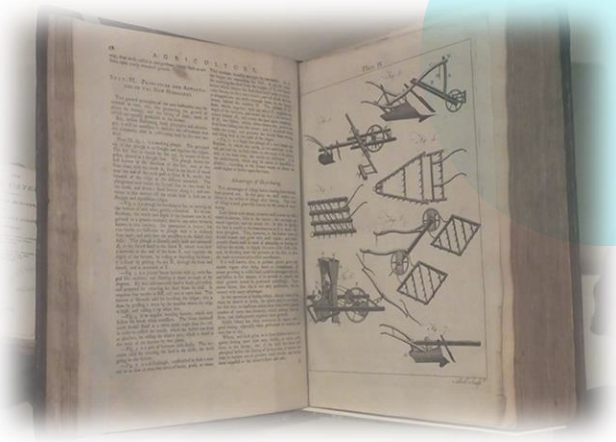


OntoCommons' *Atom*: Domain and Labels

General Concept Info:

IRI:	*Suggested entity new IRI.*
OWL Type:	*Class*
Concept Elucidation:	An atom is a nucleus surrounded by an electron cloud. The nucleus consists of electrically positive protons and electrically neutral neutrons, and carries almost all of the atom's mass; the electron cloud is a quantum system made of one or more bounded electrons, and is pivotal in determining the atom's size and properties. It is the smallest system that has the characteristic properties of a chemical elements and, as such, it is often employed as a unit in the domain of chemistry. Atoms can either be standalone or bonded; they can have an unbalanced number of electrons with respect to their atomic number (the latter being determined by the number of protons in the nucleus) or have a net electric charge. Domain: Natural sciences - Physics / Chemistry.
Labels:	*Labels used to address the concept, ordered as:* *skos:prefLabel: Atom* *skos:altLabel: Atom (Broad)* *skos:hiddenLabel: Chemical Element; Neutral-or-Ion Atom; Standalone-or-Bonded Atom*

OntoCommons' *Atom*: Knowledge Domain Resources



- Resources for both specialists and users
- An open, dynamic list of entries

KNOWLEDGE DOMAIN RESOURCES:

Related Domain Resources:	-*Wikipedia:* "an atom is the smallest unit of ordinary matter that forms a chemical element"; "an atom is a basic unit of matter consisting of a nucleus within a cloud of one or more electrons". -*Encyclopedia Britannica:* "smallest unit into which matter can be divided without the release of electrically charged particles. It also is the smallest unit of matter that has the characteristic properties of a chemical element". -*WordNet 3.1:* "the smallest component of an element having the chemical properties of the element". -*WikiData:* "smallest indivisible unit of a chemical substance" (Q9121). -IUPAC Goldbook: "Smallest particle still characterising a chemical element. It consists of a nucleus of a positive charge (Z is the proton number and e the elementary charge) carrying almost all its mass (more than 99.9%) and Z electrons determining its size".

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Template Analysis: Elucidation

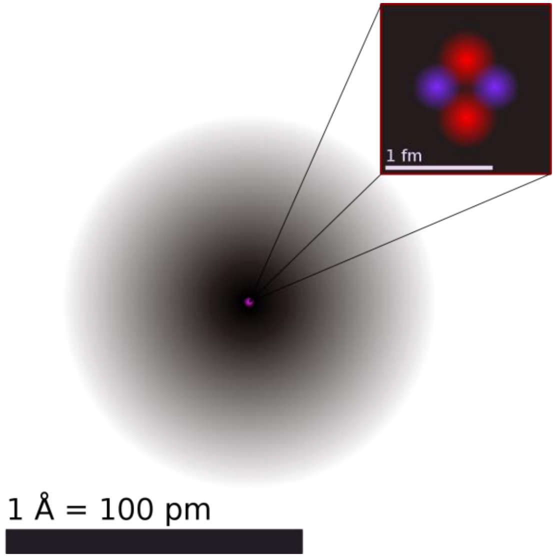
- A short introduction focusing on few **recognizable traits pertaining to the relevant Domain, without a strong commitment to them.**
  - Relying on Domain Experts’ Knowledge and Common-Sense for Standard Scenarios.
  - Providing **rigid resolutions to Standard Ambiguities** (found in the relevant MLOs/Resources) for Ontology-Use.
    - Focus on Discrepancies emerging in **Golden Standards’ and from CQs.**
      - **Choices** have to be made: pragmatism first. Bridge-Concepts are a tool first and foremost.
    - Explicitly **Addressing Borderline Cases** and prima facie exceptions.

OntoCommons' *Atom*:

Elucidation-Resources Comments

Bridge-Concepts can be (and often are) perfectly in line with Golden Standards.

Comments:	*This engineered OntoCommons bridge-concept aims to provide a general, up-to-date and ambiguity-free characterisation of one of the most employed and successful notions in physics and chemistry. In this case, the lack of a shared common ground might not have immediate consequence for stakeholders, but there is a serious risk of compromising some of the most notable advantages in data exchange via ontologies, and, specifically having to do with reusability and the overall network's predictive potential. Ultimately, as a result of a survey of the related concepts appearing in MLOs, it was decided to put forward a very general Atom bridge-concept, and explicitly specify value gaps with respect to two characteristic traits: net charge and bonds. Thus, a neutral atom and a charged atom (ion) are joint into the concept Atom, and the same goes for Standalone Atoms and Bonded Atoms. It should be noted that this last point solves a serious representational issue whereas atoms are considered as mereological parts of molecules, as many resources (and even golden standards such as the IUPAC, do: <https://doi.org/10.1351/goldbook.M04002>. There was in fact an effort to ensure that the proposed bridge-concept would be aligned with said golden standard, even relatively to the definition/elucidation itself. The trait of "being the smallest particle still characterising a chemical element" was explicitly stated to be domain specific, for the sake of clarity: in line with that, it was decided not to include the trait "basic unit of matter", even though it could point to a taxonomical, hierarchical, informative characteristic. Notably, the resulting definition is also not too far from the ones provided by well known and pervasively employed domain resources, such as Wikipedia, Wikidata, WordNet and the Encyclopedia Britannica. The trait of being "indivisible", appearing in Wikidata's has been deemed obsolete and potentially confusing qua too close too the notion of Mereological Atom, which cannot be ignored due to Mereology's pervasiveness in formal ontologies. It is factually possible to split Atoms into their subatomic components, and Encyclopedia Britannica's definition depicts a vastly more accurate picture.*



- A Goal
- A Rationale

Proposed Alignments & comments

- Alignment as an **Holistic process**
  - A caveat: **Methodological Risks** due to the focus on core concepts
    - **Inconsistency** and **Modularization**
  - Focus on the target **Ontology's Applications** to deal with lack of **documentation**
  - Inconsistency in target Ontologies: **Charity** and the **Gordian Knot**
- Properly identifying the place the bridge-concepts would occupy in an ontology: **Strong Semantic Links**
  - rdfs:subClassOf + owl:superClassOf *OR* owl:equivalentClass
    - **Flexibility** as the key: **Pragmatism** above all
    - **Findability** and weak connections (using **skos** relations)

OntoCommons' *Atom*: Alignments

1: Vertical Alignments

BFO

Target Ontology:	*<http://purl.obolibrary.org/obo/bfo.owl>*
Related Ontology Entities:	*Material Entity: <http://purl.obolibrary.org/obo/BFO_0000040>*
Mapping Elucidation:	*Given BFO's internal organization, there do not seem to be many options beside BFO:Material Entity for an alignment. In general, as far as BFO's distinctions are concerned, Atoms do not seem to be vastly different from moderate-sized specimens of dry goods such as tables and bricks. Arguably, the real question concerns whether the proposed OntoCommons bridge-concept, Atom, is a subclass of BFO:Object, BFO:Object Aggregate, or BFO:Fiat Object (which is arguably the rightful categorisation for a restriction of Atom via the bonded trait); however the classes are not mutually disjoint as the relevant BFO universals are not rigid, so the questions is, to a degree, meaningless. In fact, the possibility of the relevant individuals of migrating among the classes seems especially appropriate in this specific scenario. There do not seem to be reasons to consider a different alignment, and the examples of usage appear to be pertinent. Despite the intuitive gap between Material Entities and Atoms, the connection seems informative and appropriate: in fact, it is pivotal to be wary of intuitions which might derive from unrelated considerations pertaining to concepts' prototypes and scale. Finally, it is worth considering whether such an alignment is conductive to an appropriate representation of electron clouds, but -it could be argued- that would be putting the cart before the horse.*
Semantic Relation Level:	*The level of semantic relationship between the Concept and the Target Ontology entities:* *rdfs:subClassOf*
Mapping Axioms:	*TBD*

All the relevant info is provided in the template:

-Target Ontology

-Target Entity

-Semantic Relation Level

-Mapping Axioms (coming soon)

OntoCommons' *Atom*: Alignments

They needn't necessarily be complex!

EMMO

Target Ontology:	*<http://emmo.info/emmo>*
Related Ontology Entities:	*Atom: <http://emmo.info/emmo#EMMO_eb77076b_a104_42ac_a065_798b2d2809ad>*
Mapping Elucidation:	*EMMO:Atom appears to be the perfect candidate for an alignment based on class equivalence with the proposed OntoCommons bridge-concept, Atom. The tentative connection is supported by the relevant documentation, which makes explicit relevant value gaps by means of subclasses. There do not seem to be reasons to consider other alignments, and, in this case, even the problems involving the eventual in-framework representation of electron clouds can be dismissed.*
Semantic Relation Level:	*The level of semantic relationship between the Concept and the Target Ontology entities:* *rdfs:equivalentClass*
Mapping Axioms:	*TBD*

Target Ontologies’ relevant documentation: FAIR-ness to the roots

References at hand

NON AGENTIVE PHYSICAL OBJECT (DOLCE)

GENERAL CONCEPT INFO:

IRI:	*<http://www.loa.istc.cnr.it/dolce/dolce-owl/DOLCEbasic#NonAgentivePhysicalObject>*
OWL Type:	*Class*
Concept Elucidation:	A Non-Agentive Physical Object is a physical object to which intentions, believes and desires are not ascribed. *Examples of Usage:* a pebble, a house, a computer, a human body.
Labels:	*NonAgentivePhysicalObject*

KNOWLEDGE DOMAIN RESOURCES:

Related Domain Resources:	*Dolce D18:* “within Physical Objects, a special place have those those to which we ascribe intentions, beliefs, and desires. These are called Agentive, as opposite to Non-agentive. Intentionality is understood here as the capability of heading for/dealing with objects or states of the world. This is an important area of ontological investigation we haven’t properly explored yet, so our suggestions are really very preliminary”.

Bridge-Concepts in the Protégé Environment

ONTO COMMONS — ONTOLOGY-DRIVEN DATA DOCUMENTATION FOR INDUSTRY COMMONS

The content of the template (now a table), can be expressed using more flexible formats (e.g. XML, JSON) and documented within the RDFS version of the ontology.

NEW CONCEPT NAME[1]

(use the preferred label, or IRI name, provided in the first table as title)

General Concept Info:

IRI:	*Suggested entity new IRI.*
OWL Type:	*Class / ObjectProperty / Individual.*
Concept Elucidation:	*Natural language definition of the concept (elucidation). Here the concept that we want to introduce is expressed as precisely as possible, making references to knowledge domain resources, including instance and usage examples when relevant.*
Labels:	*Labels used to address the concept, ordered as: i) preferred (one) (the label to primarily used to shortly refer to the concept) ii) alternative (multiple) (labels that are commonly used to address the concept in practice, even if they are used with narrower of wider sense) iii) deprecated (multiple) (labels that are misleading wit… o the concept, because of misuse, ambiguity or too wide meanin…*

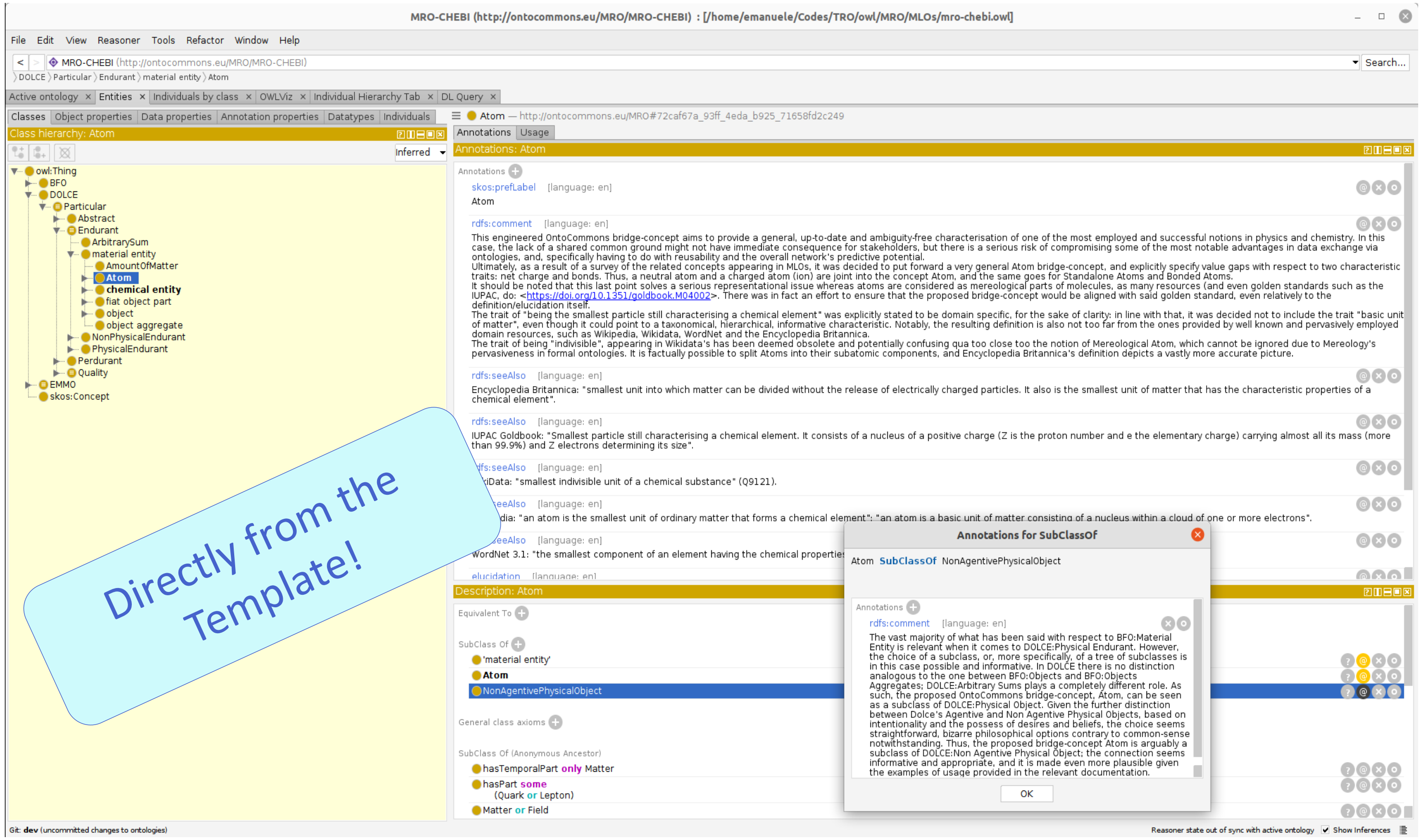
Knowledge Domain Resources:

Related Domain Resources:	*Existing domain res… that defines or are related… nd quote the relevan… Mor… These… oice of the above concept choice and elucid…*
Comments:	*Explain … the concept definition with reference to the domain resources, … milarities and differences.*

Implementation-ready by design!

Alignments To Existing Ontologies:

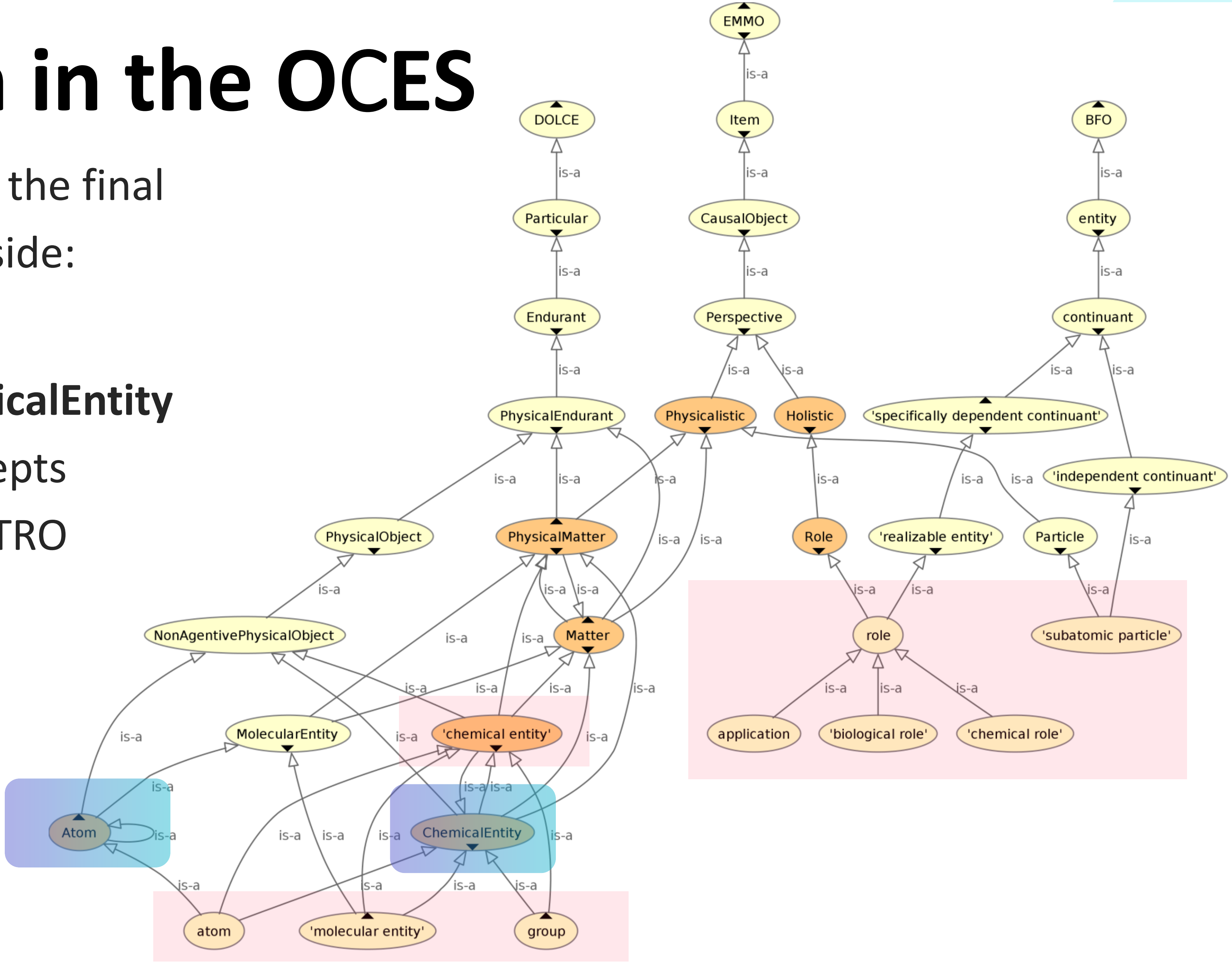
Target Ontology:	*Existing IRI of the ontology that will express the concept according to its logical framework (concept alignment).*
Related Ontology Entities:	*List of terms and IRIs of the Target Ontology entities that are relevant for the concept (documentation is supposed to be accessible through the target ontology).*
Mapping Elucidation:	*Natural language description of the mapping choice and motivations.*
Semantic Relation Level:	*The level of semantic relationship between the Concept and the Target Ontology entities:* - *Equivalence (strong mapping) (e.g. owl:equivalentClass, owl:equivalentProperty)* - *Strong Hierarchical (e.g. rdfs:subClassOf, rdfs:subPropertyOf)* - *Weak Hierarchical (e.g. skos:narrower, skos:broader)* - *Similarity (e.g. skos:related).*
Mapping Axioms:	*Proposed mapping axiom (or axioms) between the Concept entity and the Target Ontology entities in a OWL2 compliant syntax (e.g. Turtle, Manchester, RDF/XML, Functional-Style, OWL/XML).*



Directly from the Template!

Atom in the OCES

- A simple example of the final result on the ontology side:
  - TRO + ChEBI.
- Thanks to the **ChemicalEntity** and **Atom** Bridge-Concepts ChEBI is aligned to the TRO and hence **to all TLOs.**
- Other lower-level ontologies could be obviously included.



Thank you for your Attention