

# ISO 15926 Part 12 ontology: DL profile

Id:

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## 1 What is this?

This document defines and documents the *DL profile* ontology version of ISO 15926 part 12.

## 2 Mapping between ISO 15926-12 and ISO 15926-2

The following table corresponds to that included with the Community Draft (CD) version of Part 12. We see using OWL modelling patterns and SKOS for meta-classes allows us to considerably reduce the number of entity types.

For some entries in the table we recommend to «implement as reference data». Individual cases may be found to be generic enough that they ought to be included in Part 12 itself; examples are «molecule» and «responsibility».

In the current preliminary proposal, 168 of the 202 Part 2 entity types are found not to be needed, marked with «-». They fall into one of seven categories:

- 77 are «class of class» entity types that can be handled using the SKOS vocabulary,
- 7 are modal notions and «not suitable» for a description logic ontology,
- 12 are determined to be *out of scope*, in line with the CD version,
- 11 are replaced by application of XSD data types built into OWL,
- 19 are recommended to not be part of Part 12 itself, but moved to a reference data library,
- 12 are found to be «not needed», typically entity types that are OWL native or that were only included in Part 2 due to EXPRESS specific constraints,
- 32 are marked with «use OWL» – the entity types can be represented using OWL modelling patterns.

For 34 (= 202 - 168) entity types, we have a fairly direct match in resources proposed for the Part 12 DL ontology. Note that that ontology has more than 34 resources defined. This is generally (1) to introduce new resources required to support the DL style of modelling, or (2) because Part 2 only has the «class of N» variant of an entity type explicitly defined, where the corresponding «N» type is given in the DL ontology.

ISO 15926-2 entity	LIS-12-DL	DL note
activity	Activity	
actual_individual	-	modal, not suitable for DL
arranged_individual	-	use OWL: hasArrangedPart

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ISO 15926-2 entity	LIS-12-DL	DL note
arrangement_of_individual	–	use OWL: hasArrangedPart (twice)
assembly_of_individual	–	use OWL: hasAssembledPart
beginning	begins, hasBeginning	
cause_of_event	–	use OWL: causes
class_of_atom	–	use SKOS; implement as reference data
class_of_biological_matter	–	use SKOS; implement as reference data
class_of_cause_of_beginning_of_class_of_individual	–	use SKOS; see begins
class_of_cause_of_ending_of_class_of_individual	–	use SKOS; see ends
class_of_class_of_individual	–	use SKOS
class_of_composite_material	–	use SKOS; implement as reference data
class_of_compound	–	use SKOS; see Compound
class_of_feature	–	use SKOS; see Feature
class_of_functional_object	–	use SKOS; see examples:Function
class_of_inanimate_physical_object	–	use SKOS; see InanimatePhysicalObject
class_of_individual	–	use SKOS
class_of_molecule	–	use SKOS; implement as reference data
class_of_organism	–	use SKOS; see Organism
class_of_organisation	–	use SKOS; see Organisation
class_of_particulate_material	–	use SKOS; implement as reference data
class_of_person	–	use SKOS; see Person
class_of_sub_atomic_particle	–	use SKOS; implement as reference data
composition_of_individual	isPartOf, hasPart	
connection_of_individual	connectedTo	
containment_of_individual	contains, containedBy	
crystalline_structure	–	implement as reference data
direct_connection	directlyConnectedTo	
ending	ends, hasEnd	
event	Event	
feature_whole_part	featureOf, hasFeature	
functional_physical_object	–	use OWL: hasFunction
indirect_connection	–	use OWL: directlyConnectedTo, negation modal, not suitable for DL
materialized_physical_object	–	
participation	participantIn, hasParticipant	
period_in_time	PeriodInTime	
phase	Phase	
physical_object	PhysicalObject	
point_in_time	PointInTime	
possible_individual	owl:Thing	
relative_location	locatedRelativeTo	
spatial_location	SpatialLocation	
status	–	use SKOS; implement as reference data
stream	Stream	TODO implement as reference data?
temporal_bounding	hasTemporalBound	
temporal_sequence	occursRelativeTo	
temporal_whole_part	hasTemporalPart	restricted to Activity domain/range
whole_life_individual	–	modal, not suitable for DL
class_of_class_of_definition	–	use SKOS (on annotation properties)
class_of_class_of_description	–	use SKOS (on annotation properties)
class_of_definition	–	use SKOS (on annotation properties)
class_of_description	–	use SKOS (on annotation properties)
definition	skos:definition	
description	skos:scopeNote	
involvement_by_reference	–	could add «refers to» annotation property
class_of_class_of_information_representation	–	use SKOS; see InformationObject
class_of_class_of_representation	–	use SKOS; see InformationObject
class_of_class_of_representation_translation	–	use SKOS; implement in reference data
class_of_class_of_responsibility_for_representation	–	use SKOS; see InformationObject
class_of_class_of_usage_of_representation	–	use SKOS; see InformationObject
class_of_information_object	–	use SKOS; see InformationObject
class_of_information_presentation	–	use SKOS; see InformationObject
class_of_information_representation	–	use SKOS; see InformationObject
class_of_representation_of_thing	–	use SKOS; see InformationObject
class_of_representation_translation	–	use SKOS; see InformationObject
class_of_responsibility_for_representation	–	use SKOS; see InformationObject
class_of_usage_of_representation	–	use SKOS; see InformationObject
document_definition	–	reference data InformationObject subclass
EXPRESS_string	–	use XSD data type
language	–	use RDF language tag or reference data
representation_form	–	implement in reference data (file format)
representation_of_thing	representedBy	

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ISO 15926-2 entity	LIS-12-DL	DL note
responsibility_for_representation	-	implement in reference data (roles)
usage_of_representation	-	implement in reference data (roles)
boundary_of_number_space	-	out of scope (as in CD)
class_of_dimension_for_shape	-	out of scope (as in CD)
class_of_shape	-	out of scope (as in CD)
class_of_shape_dimension	-	out of scope (as in CD)
coordinate_system	-	out of scope (as in CD)
dimension_of_individual	-	out of scope (as in CD)
dimension_of_shape	-	out of scope (as in CD)
individual_dimension	-	out of scope (as in CD)
property_for_shape_dimension	-	out of scope (as in CD)
property_space_for_class_of_shape_dimension	-	out of scope (as in CD)
shape	-	out of scope (as in CD)
shape_dimension	-	out of scope (as in CD)
class_of_class_of_identification	-	use SKOS
class_of_identification	-	use SKOS
class_of_left_namespace	-	not needed
class_of_namespace	-	not needed
class_of_right_namespace	-	not needed
identification	skos:prefLabel	use SKOS (as in CD)
left_namespace	-	not needed
namespace	-	not needed
right_namespace	-	not needed
class_of_intended_role_and_domain	-	modal, not suitable for DL
class_of_possible_role_and_domain	-	modal, not suitable for DL
intended_role_and_domain	-	modal, not suitable for DL
possible_role_and_domain	-	modal, not suitable for DL
arithmetic_number	-	use XSD data type
class_of_functional_mapping	-	use SKOS (on object/data properties)
class_of_isomorphic_functional_mapping	-	use SKOS (on object/data properties)
class_of_number	-	use SKOS, or OWL value ranges
enumerated_number_set	-	use OWL nominals
functional_mapping	-	use owl:FunctionalProperty
integer_number	-	use XSD data type
lower_bound_of_number_range	-	use OWL data range
multidimensional_number	-	implement in reference data
multidimensional_number_space	-	implement in reference data
number_range	-	use OWL data range
number_space	-	use OWL data range
real_number	-	use XSD data type
upper_bound_of_number_range	-	use OWL data range
abstract_object	-	not needed/implement as reference data
cardinality	-	use OWL cardinality constraints
class	-	not needed
class_of_class_of_relationship	-	use SKOS (on object/data properties)
class_of_class_of_relationship_with_signature	-	use SKOS (on object/data properties)
class_of_classification	-	not needed, OWL has rdf:type only
class_of_relationship	-	use OWL object/data properties
class_of_relationship_with_related_end_1	-	use OWL object/data properties
class_of_relationship_with_related_end_2	-	use OWL object/data properties
class_of_relationship_with_signature	-	use OWL object/data properties
class_of_specialization	-	not needed, OWL has rdfs:subClassOf only
classification	-	use OWL (rdf:type)
difference_of_set_of_class	-	use OWL union and negation
enumerated_set_of_class	-	use OWL nominals
intersection_of_set_of_class	-	use OWL intersection
multidimensional_object	-	use OWL list ontology – if required
other_relationship	-	use OWL object/data properties
participating_role_and_domain	-	not needed
relationship	-	not needed
role	Role	(this is left out of CD version)
role_and_domain	Role	use OWL «class from role» pattern
specialization	-	use rdfs:subClassOf
specialization_by_domain	-	use rdfs:subClassOf
specialization_by_role	-	use rdfs:subClassOf
thing	owl:Thing	
union_of_set_of_class	-	use OWL union
class_of_individual_used_in_connection	-	use OWL constraints as usual
individual_used_in_connection	-	use OWL constraints as usual
class_of_abstract_object	-	use SKOS

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ISO 15926-2 entity	LIS-12-DL	DL note
class_of_activity	-	use SKOS
class_of_arranged_individual	-	use SKOS
class_of_arrangement_of_individual	-	use SKOS
class_of_assembly_of_individual	-	use SKOS
class_of_cause_of_beginning_of_class_of_individual	-	use SKOS
class_of_cause_of_ending_of_class_of_individual	-	use SKOS
class_of_class	-	use SKOS
class_of_class_of_composition	-	use SKOS
class_of_composition_of_individual	-	use SKOS
class_of_connection_of_individual	-	use SKOS
class_of_containment_of_individual	-	use SKOS
class_of_direct_connection	-	use SKOS
class_of_event	-	use SKOS
class_of_feature_whole_part	-	use SKOS
class_of_indirect_connection	-	use SKOS
class_of_indirect_property	-	use SKOS
class_of_involvement_by_reference	-	use SKOS
class_of_multidimensional_object	-	use SKOS
class_of_participation	-	use SKOS
class_of_period_in_time	-	use SKOS
class_of_point_in_time	-	use SKOS
class_of_property	-	use SKOS
class_of_property_space	-	use SKOS
class_of_relative_location	-	use SKOS
class_of_scale	-	use SKOS
class_of_status	-	use SKOS
class_of_temporal_sequence	-	use SKOS
class_of_temporal_whole_part	-	use SKOS
approval	approvedBy, approvedOn	
class_of_approval	-	use SKOS
class_of_approval_by_status	-	use SKOS
class_of_assertion	-	use OWL annotated axioms
class_of_lifecycle_stage	-	use SKOS
class_of_recognition	-	use SKOS
lifecycle_stage	interests	see explanatory note for why this is OK
recognition	-	use OWL pattern with ScalarQuantityDatum
boundary_of_property_space	-	use OWL data ranges (complex)
class_of_scale_conversion	-	use OWL pattern with UOM reference data
comparison_of_property	-	use OWL pattern/see <a href="https://www.w3.org/TR/owl2-dr-linear/">https://www.w3.org/TR/owl2-dr-linear/</a>
enumerated_property_set	-	use OWL nominals with ScalarQuantityDatum
indirect_property	-	use OWL data ranges with ScalarQuantityDatum
lower_bound_of_property_range	-	use OWL data ranges with ScalarQuantityDatum
multidimensional_property	-	use OWL pattern with ScalarQuantityDatum
multidimensional_property_space	-	use OWL and/or approximation with ScalarQuantityDatum
multidimensional_scale	-	use OWL pattern with ScalarQuantityDatum
property	PhysicalQuantity individual	DL profile also provides the more generic Quality
property_quantification	qualityQuantifiedAs	use qualityMeasuredAs for measured quantities
property_range	PhysicalQuantity subclass	use OWL data ranges with ScalarQuantityDatum
property_space	PhysicalQuantity subclass	
representation_of_Gregorian_date_and_UTC_time	-	use XSD data type
scale	Scale	
single_property_dimension	PhysicalQuantity subclass	
specialization_of_individual_dimension_from_property	-	use OWL rdfs:subClassOf on PhysicalQuantity
upper_bound_of_property_range	-	use OWL data ranges with ScalarQuantityDatum
class_of_EXPRESS_information_representation	-	use XSD data types
EXPRESS_binary	-	use XSD data type
EXPRESS_Boolean	-	use XSD data type
EXPRESS_integer	-	use XSD data type
EXPRESS_logical	-	use XSD data type
EXPRESS_real	-	use XSD data type

## 3 Definitions

### 3.1 Declarations

#### 3.1.1 Prefixes

```
## Prefixes
Prefix: lci: <http://standards.iso.org/iso/15926/>
# note, not same as the the namespace of the CD, which looks inappropriate
Prefix: owl: <http://www.w3.org/2002/07/owl#>
Prefix: rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
Prefix: xml: <http://www.w3.org/XML/1998/namespace>
Prefix: xsd: <http://www.w3.org/2001/XMLSchema#>
Prefix: rdfs: <http://www.w3.org/2000/01/rdf-schema#>
Prefix: skos: <http://www.w3.org/2004/02/skos/core#>
Prefix: pav: <http://purl.org/pav/>
```

#### 3.1.2 Ontology

```
## Ontology declaration

Ontology: <http://standards.iso.org/iso/15926/-12/tech/ontology/DL-profile>
  Annotations: rdfs:label "ISO 15926-12, DL profile",
               owl:versionInfo "$Date: started 2016-08-02$",
               rdfs:comment "This ontology contains the DL profile of ISO 15926-12, which represents ISO 15926-2 in OWL
→2."
  Import: <http://http://standards.iso.org/iso/15926/annotationsPart2>
```

## 3.2 Classes

## Class details

## Disjointness clause for top classes:

DisjointClasses: Ici:Activity, Ici:PhysicalObject, Ici:InformationObject, Ici:Organisation, Ici:Quality, Ici:Site,  
–Ici:SpatialLocation, Ici:UnitOfMeasure

### 3.2.1 Ici:Activity

. Ici:Event

. . Ici:PointInTime

. Ici:PeriodInTime

### 3.2.2 Ici:Function

*rdfs:comment* Inspired by the BFO class «function» (BFO\_0000034).

### 3.2.3 Ici:PhysicalObject

. Ici:Compound

. Ici:Feature

. Ici:InanimatePhysicalObject

. . Ici:Stream

. . Ici:Phase

. Ici:Organism

. . Ici:Person

### 3.2.4 Ici:InformationObject

. Ici:QuantityDatum

*rdfs:comment* This class is inspired by the class «measurement datum» of the Information Artefact Ontology. The change of wording from «measurement» to «quantity» is intended to support cases where measurement is not involved, such as with nominal values.

. . Ici:ScalarQuantityDatum

*rdfs:comment* A scalar quantity datum has a unique unit of measure and a unique numeric value. This class is inspired by the class «scalar measurement datum» of the Information Artefact Ontology.

Class: Ici:ScalarQuantityDatum

SubClassOf: Ici:datumUOM some Ici:UnitOfMeasure, Ici:datumValue some rdfs:Literal

### 3.2.5 Ici:Organisation

### 3.2.6 Ici:Quality

The class *Quality* and its subclass *PhysicalQuantity* are directly inspired by corresponding classes included in the DOLCE and BFO upper ontologies. An alternative I have considered is *Property*, which may be re-interpreted vs. Part 2 into ranging over individual properties, but «quality» *seems* to be a term that better matches colloquial use (for referring to individual qualities). Furthermore, in the CD version

of Part 12, «Property» has been deprecated for «Quantity», which is not obviously a better choice for the entities in question.

#### . *Ici:PhysicalQuantity*

### 3.2.7 *Ici:Role*

*rdfs:comment* This class is motivated in the Part 2 'role' entity type, and in the same-named BFO class. Part 2 is not very specific about the meaning of roles, but the examples are clear enough. There is still much disagreement in the ontology field about how roles should be understood and modelled.

### 3.2.8 *Ici:Site*

*rdfs:comment* This class is inspired by the class «site» of the Information Artefact Ontology.

*rdfs:comment* From BFO: «b is a site means: b is a three-dimensional immaterial entity that is (partially or wholly) bounded by a material entity or it is a three-dimensional immaterial part thereof. (axiom label in BFO2 Reference: [034-002])»

### 3.2.9 *Ici:SpatialLocation*

#### . *Ici:PointInSpace*

#### . *Ici:RegionInSpace*

### 3.2.10 *Ici:UnitOfMeasure*

#### . *Ici:Scale*

## 3.3 Object relations (object properties)

## Object property details

### 3.3.1 *Ici:creates*

*rdfs:comment* Use this relation to express that an activity brings a physical object into being. (Derived from *class\_of\_cause\_of\_beginning\_of\_class\_of\_individual*).

*lci:definitionPart2* A [*class\_of\_cause\_of\_beginning\_of\_class\_of\_individual*] is a [*class\_of\_relationship*] that indicates that a member of a [*class\_of\_activity*] causes the beginning of a member of a [*class\_of\_individual*].

*lci:CD* This relation is not included in the CD. The CD however has «causesBeginningOf» with apparently the same meaning – bringing about the «beginning» of an individual. For the DL profile, we keep the name «creates» to avoid confusion with beginning/end talk about temporal bounds of activities. We also restrict the range to physical objects, to distinguish this relation from the «causes» relation between activities.

ObjectProperty: *Ici:creates*  
Domain: *Ici:Activity*  
Range: *Ici:PhysicalObject*

### 3.3.2 *Ici:hasFunction*

*rdfs:comment* Inspired by BFO's «has function» (RO\_0000085).

ObjectProperty: *Ici:hasFunction*  
Range: *Ici:Function*



### 3.3.3 *lci:realizedIn*

*rdfs:comment* Inspired by BFO's «realized in» (BFO\_0000054)

ObjectProperty: *lci:realizedIn*  
Domain: *lci:Function*  
Range: *lci:Activity*

### 3.3.4 *lci:hasQuality*

*lci:CD* With the CD version, qualities (in the CD, called quantities or properties) are assigned by way of classification. This relation to individual qualities is only implicit in Part 2.

ObjectProperty: *lci:hasQuality*  
Range: *lci:Quality*

### 3.3.5 *lci:hasRole*

*rdfs:comment* Inspired by BFO's «has role» (RO\_0000087)

ObjectProperty: *lci:hasRole*  
Range: *lci:Role*

### 3.3.6 *lci:roleOf*

*rdfs:comment* Inspired by BFO's «role of» (RO\_0000081)

ObjectProperty: *lci:roleOf*  
InverseOf: *lci:hasRole*

### 3.3.7 *lci:representedBy*

*rdfs:comment* Following Part 2, this is the top level relation from information objects to things.

*rdfs:seeAlso* Also see «is about» IAO\_0000136 of the Information Artifact Ontology, which is probably better named for a maximally general relation of «aboutness» (but note that «is about» goes in the opposite direction of «representedIn»).

ObjectProperty: *lci:representedBy*  
Range: *lci:InformationObject*

### . . *lci:qualityQuantifiedAs*

*rdfs:comment* This relation is inspired by the relation «is quality measured as» of the Information Artefact Ontology. The term «quantified» replaces «measured» to support cases where measurement is not involved, as in e.g. estimates.

ObjectProperty: *lci:qualityQuantifiedAs*  
Domain: *lci:Quality*  
Range: *lci:QuantityDatum*

### 3.3.8 *lci:interests*

*rdfs:comment* Derived from «LifecycleStage» of Part 2, this is a superproperty suitable for various intentional relationships, such as planning, approving, or ordering. The Part 2 name «lifecycle stage» is likely to confuse, but the intended use of this type is clear enough from this Part 2 annotation to ClassOfLifecycleStage: «EXAMPLE Planned, required, expected, and proposed can be represented by instances of [class\_of\_lifecycle\_stage].»

#### . *lci:approvedBy*

*rdfs:comment* Relation for stating that some item or activity was approved by an entity, typically a person or an organisation.

### 3.3.9 *lci:locatedRelativeTo*

*lci:definitionPart2* A [relative\_location] is a [relationship] that indicates that the position of one [possible\_individual] is relative to another.

#### . *lci:contains*

*rdfs:comment* For the DL profile, we restrict this relation to physical objects. Note that this rules out using «lci:contains» for spatial locations.

ObjectProperty: lci:contains  
Domain: lci:PhysicalObject  
Range: lci:PhysicalObject

#### . *lci:containedBy*

*lci:definitionPart2* A [containment\_of\_individual] is a [relative\_location] where the located [possible\_individual] is contained by the locator [possible\_individual] but is not part of it.

ObjectProperty: lci:containedBy  
InverseOf: lci:contains

### 3.3.10 *lci:hasPart*

*lci:definitionPart2* A [composition\_of\_individual] is a [relationship] that indicates that the part [possible\_individual] is a part of the whole [possible\_individual]. A simple composition is indicated, unless a subtype is instantiated too. [composition\_of\_individual] is transitive.

#### . *lci:hasArrangedPart*

*lci:definitionPart2* An [arrangement\_of\_individual] is a [composition\_of\_individual] that indicates that the part is a part of an [arranged\_individual]. The temporal extent of the part is that of the whole. An [arrangement\_of\_individual] may be an [assembly\_of\_individual].

*rdfs:comment* In line with intended use, for the DL profile this relation has a domain restricted to physical objects.

ObjectProperty: lci:hasArrangedPart  
Domain: lci:PhysicalObject

## **. . Ici:hasFeature**

*rdfs:comment* Example of usage: stating that an entity has a surface suitable for connection, such as a flange face.

*lci:definitionPart2* A [class\_of\_feature] is a [class\_of\_arranged\_individual] whose members are contiguous, non-separable parts of some [possible\_individual] and have an incompletely defined boundary.

## **. . Ici:hasAssembledPart**

*rdfs:comment* This is the recommended (super-) relation for capturing physical breakdown of mechanical assemblies.

*lci:definitionPart2* An [assembly\_of\_individual] is an [arrangement\_of\_individual] that indicates that the part is connected directly or indirectly to other parts of the whole. The parts and wholes are super-molecular objects.

## **. Ici:hasTemporalPart**

*lci:CD* The DL profile restricts temporal parts to Activity individuals.

ObjectProperty: Ici:hasTemporalPart  
Domain: Ici:Activity

## **. . Ici:hasTemporalBound**

### **. . . Ici:hasBeginning**

### **. . . Ici:hasEnd**

## **. Ici:hasParticipant**

*rdfs:comment* This is the recommended superrelation for roles that entities can take in activities – the agent, the matter being acted upon, etc. (There may be reason to include Ici:creates as a subrelation of this relation.)

*lci:definitionPart2* A [participation] is a [composition\_of\_individual] that indicates that a [possible\_individual] is a participant in an [activity].

*rdfs:comment* Note that BFO does not have 'has participant' as a subrelation of 'has part'. This can be motivated in that 4D objects are not obviously able to have 3D parts.

ObjectProperty: Ici:hasParticipant  
Domain: Ici:Activity

### **3.3.11 Ici:datumUOM**

*rdfs:comment* Relation (functional) to assign unit of measure to measurement data.

ObjectProperty: Ici:datumUOM  
Domain: Ici:QuantityDatum  
Range: Ici:UnitOfMeasure  
Characteristics: Functional

### 3.3.12 *lci:connectedTo*

*lci:CD* For the DL profile, we add the restriction that only physical objects may be connected. We also add a symmetry constraint.

ObjectProperty: *lci:connectedTo*  
Domain: *lci:PhysicalObject*  
Characteristics: Symmetric

#### . *lci:directlyConnectedTo*

*lci:CD* For the DL profile, we leave out the CD relation «*indirectlyConnectedTo*».

### 3.3.13 *lci:partOf*

ObjectProperty: *lci:partOf*  
InverseOf: *lci:hasPart*

#### . *lci:arrangedPartOf*

ObjectProperty: *lci:arrangedPartOf*  
InverseOf: *lci:hasArrangedPart*

#### . . *lci:featureOf*

ObjectProperty: *lci:featureOf*  
InverseOf: *lci:hasFeature*

#### . . *lci:assembledPartOf*

ObjectProperty: *lci:assembledPartOf*  
InverseOf: *lci:hasAssembledPart*

#### . *lci:participantIn*

ObjectProperty: *lci:participantIn*  
InverseOf: *lci:hasParticipant*

#### . *lci:temporalPartOf*

ObjectProperty: *lci:temporalPartOf*  
InverseOf: *lci:hasTemporalPart*

#### . . *lci:temporalBoundOf*

ObjectProperty: *lci:temporalBoundOf*  
InverseOf: *lci:hasTemporalBound*

#### . . . *lci:begins*

ObjectProperty: *lci:begins*  
InverseOf: *lci:hasBeginning*

#### . . . *lci:ends*

ObjectProperty: *lci:ends*  
InverseOf: *lci:hasEnd*

### 3.3.14 *lci:occursRelativeTo*

*rdfs:comment* This relation is introduced for the DL profile as a top relation for various temporal relations between activities.

ObjectProperty: lci:occursRelativeTo  
Domain: lci:Activity  
Range: lci:Activity

#### . **lci:before**

*rdfs:comment* Use this relation to state that one activity occurs before another.

*lci:CD* The domain and range of this relation is restricted to activities for the DL profile, where no such restriction is included in the CD.

#### . . **lci:causes**

*lci:CD* The CD has no domain or range restrictions, but mentions Event in the description. For the DL profile, we lift the restriction to allow also non-instantaneous events to stand in «causes» relationships. We also make «causes» a subrelation of «before».

#### . **lci:after**

*rdfs:comment* Use this relation to state that one activity after before another.

*lci:CD* The domain and range of this relation is restricted to activities for the DL profile, where no such restriction is included in the CD.

### 3.4 Data relations (data properties)

## Data property details

#### 3.4.1 **lci:datumValue**

*rdfs:comment* This relation is inspired by the relation «has measurement value» of the Information Artefact Ontology.

*rdfs:comment* Consider whether xsd:float is the correct data type. Perhaps it's too limiting to require this type.

DataProperty: lci:datumValue  
Range: xsd:float  
Characteristics: Functional

#### 3.4.2 **lci:qualityQuantityValue**

*rdfs:comment* This is a super-property for «template» relations that combine a quality, the weak *lci:qualityQuantifiedAs*, and a unit of measure into a simple data property. For instance, «mass in kilograms» can be introduced as such a data property, for expressing the mass of an entity on the kilogram scale. *lci:qualityQuantifiedAs* is «weak» in the sense that it doesn't distinguish between designed or estimated, and measured, values.

#### 3.4.3 **lci:approvedOn**

*rdfs:comment* This is a super-property for stating the time that an entity was approved, derived from Part 2 «approval». Introduce sub-properties to match different contexts and types of approval. The range of sub-properties should be xsd:date or xsd:dateTime.

## 3.5 Annotation relations (annotation properties)

## Annotation property details

### 3.5.1 *skos:definition*

*rdfs:comment* This SKOS relation replaces the Part 2 «definition» attribute.

### 3.5.2 *skos:example*

*rdfs:comment* This SKOS relation replaces the Part 2 «example» attribute.

### 3.5.3 *skos:scopeNote*

*rdfs:comment* This SKOS relation replaces the Part 2 «definition» attribute.

### 3.5.4 *CD comment (Ici:CD)*

*rdfs:comment* Annotation property for use in Part 12 DL profile drafts, to comment on how the annotated resource relates to (typically, deviates from) the RDFS profile of the CD version of Part 12.

### 3.5.5 *Ici:definitionPart2*

*rdfs:comment* Annotation property for recording definitions of entity types given in the original Part 2 of ISO 15926, where the Part 2 and Part 12 entities are equivalent in meaning for all practical purposes.

### 3.5.6 *equivalent Part 2 (Ici:equivalentPart2)*

*rdfs:comment* Annotation property for recording annotations of entity types given in the original Part 2 of ISO 15926, where the Part 12 entity type is equivalent in meaning to that of Part 2. Metaclass («class of ...») entity definitions are included.

### 3.5.7 *deprecated Part 2 (Ici:deprecatedPart2)*

*rdfs:comment* Annotation property for recording annotations of related entity types given in the original Part 2 of ISO 15926, where Part 2 entity type is considered not suitable for a DL rendering.

### 3.5.8 *remodelled Part 2 (Ici:remodelledPart2)*

*rdfs:comment* Annotation property for recording annotations of entity types given in the original Part 2 of ISO 15926, where the Part 12 entity type provides the same expressive power using a different category, typically by recasting a Part 2 class as a constraint pattern.

### 3.5.9 *see also Part 2 (Ici:seeAlsoPart2)*

*rdfs:comment* Annotation property for recording annotations of entity types given in the original Part 2 of ISO 15926, where the Part 12 entity type is related to the Part 2 entity type, so that the definition of the latter may be a useful reference.

### 3.5.10 *template reference (Ici:templateReference)*

*rdfs:comment* Superrelation for referring to ontology resources that act as parameter values in «template» short-cut relations that represent complex patterns. These are informal with regard to the OWL semantics.

**. UOM parameter (lci:tplUOM)**

*rdfs:comment* Annotation for templates that have a Unit of Measure role. Annotations should point to individual members of lci:UnitOfMeasure.

AnnotationProperty: lci:tplUOM

Range: <<http://standards.iso.org/iso/15926/UnitOfMeasure>>

**. Quality parameter (lci:tplQuality)**

*rdfs:comment* Annotation for templates that have a Quality relation role. Annotations should point to subproperties of hasQuality; for example, «has mass» for a generic mass assignment, or «body temperature».

AnnotationProperty: lci:tplQuality

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

**. Quantification parameter (lci:tplQuantification)**

*rdfs:comment* Annotation for templates that have a Quantification role. Annotations should point to subproperties of qualityQuantifiedAs; for example, «has mass» for a generic mass assignment, or «body temperature».

AnnotationProperty: lci:tplQuantification

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