

CDM-RST Wiki Documentation

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1 CDM-RST compiled wiki pages

Self-contained version with local images

1.1 Version

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2 Rolling stock consist

2.1 Purpose

Represent rolling stock vehicles and formations, their parthood relationships, and the order and orientation of vehicles in a formation.

2.2 Vehicles and formations

2.2.1 Purpose

Simple distinction between a vehicle and a formation. A formation consists of vehicles or other formations. A formation that cannot be broken down further is called a “vehicle”. The old debate is whether the breakdown can, or cannot be performed in operations. “It depends”, not necessarily on the rolling stock, so the rolling stock ontology is neutral about it.

The main statement, under the ontology, is: if a piece of rolling stock cannot be broken down into other pieces of rolling stock, then it is a vehicle.

A TGV trainset or ICE3 for instance have trailers, but these will not be handled separately in operations (ICE case) and cannot even rest on rails (TGV trailers rest on 0 to 2 bogies), but are still considered “vehicles” by many, and for sure they cannot be further broken down into smaller pieces of rolling stock - only parts (carbodies, bogies, HVAC units, seats...).

2.2.2 Diagram

The diagram illustrates a composite pattern (known from UML) which expresses that a formation may contain vehicles or other formations.

The flattened black hexagon is the GRAPHOL symbol for disjoint unions: hence the set of all rolling stock contains two disjoint subsets, vehicles and formations. A vehicle cannot be a formation, and conversely. A formation X can however contain a single vehicle Y, but X and Y remain distinct objects.

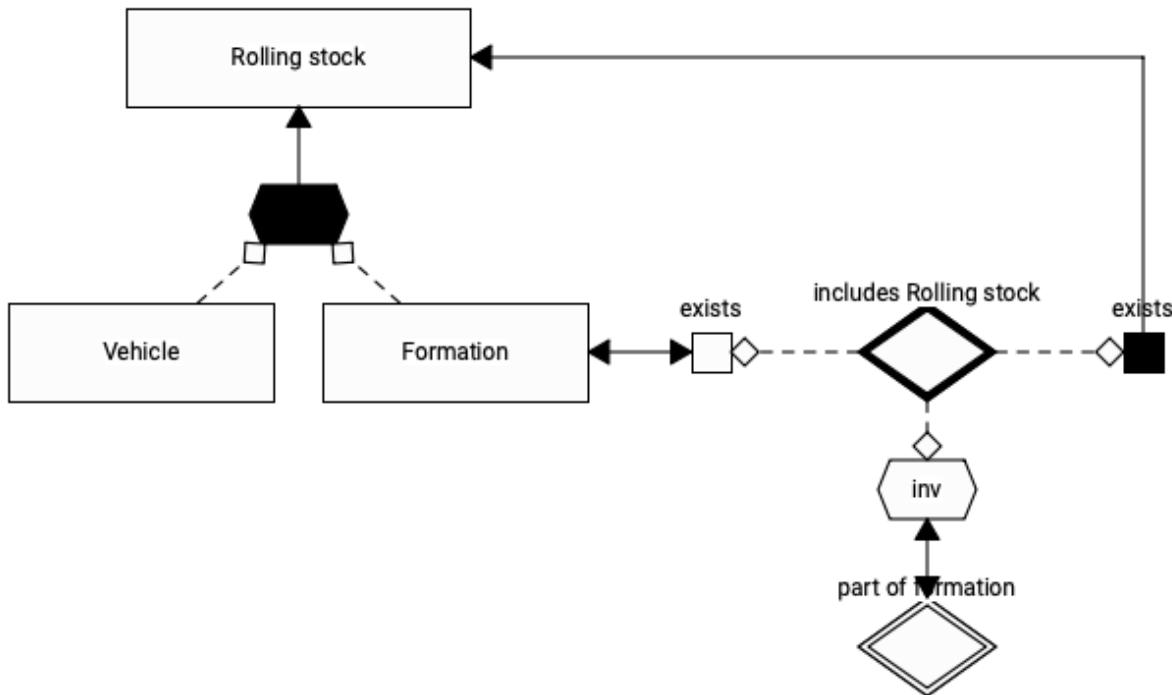


Figure 1: GRAPHOL diagram, formations

Property “part of formation” is functional (and its inverse “includes Rolling stock” is inverse functional): this means that a piece of rolling stock cannot be part of two formations. For reference, an OWL “functional property” has at most one object.

2.2.3 Comments

2.2.3.1 More details about the representation of properties in GRAPHOL The GRAPHOL diagram (and the OWL2 ontology) also expresses that a formation includes *at least* one piece of rolling stock. The double arrow (equivalence) between class Formation and the small white box means exactly that. In detail:

- property “includes Rolling stock” has an extension, which is the set of pairs (a formation, a rolling stock) for which the property holds.
- the white box represents the set of formations for which the property holds
- the black box represents the set of rolling stock for which the property holds
- the double arrow means mutual inclusion, i.e. equivalence, so the extension of formation is equivalent to the set of formations that includes some (existential quantifier = at least one) rolling stock.
- this double arrow entails “every formation includes at least one rolling stock”.
- please note that the RDFS domain semantics are different: `cons:includesRollingStock rdfs:domain cons:Formation` means:
 - “a formation *may include* rolling stock”
 - the corresponding GRAPHOL representation would show a single arrow pointing from the white box into the Formation box (Formation is a super-set of the things that include rolling stock).

2.2.3.2 About handling of constraints We generally use OWL2 constraints when they also carry some semantics. Here, having a container (formation) without contents (vehicles or other formations) is pretty much meaningless.

Constraints only dealing with data correctness are better represented as SHACL shapes. These can be checked, but do not interact with the semantics of the data representation.

In some cases, we move to SHACL such constraints that are semantically relevant but do not match the self-imposed limitations on OWL2 usage. For instance, an ETCS Balise Group consists of at most 7 balises, but the qualified cardinality restriction “at most 7” cannot be expressed in the OWL2 RL profile; the OWL2 DL profile at least is required.

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