PLM needs from Swedish automotive and transportation industry

Focus area: Part, Geometry and Position

ODETTE Sweden
Product Structure and Configuration

Workshop purpose

- Outline common needs from Swedish automotive industry based on findings in the Odette Structure and Configuration work group
- Explain rationale behind the presented needs
- Build business understanding at COTS PLM vendors
- Answer questions related to the presented needs
- Give vendors the opportunity to present their corresponding solution approach in separate meetings

Goals

Workshop goals:
- Present common needs
- Initiate discussion with vendors
- Gain vendor understanding

Overall goal:
- Implementation in COTS PLM systems

Goal statement

ODETTE SWEDEN

We need to be able to retrieve a geometric representation of any product that complies with the physical realization of the same.

Goal description

Variant specification

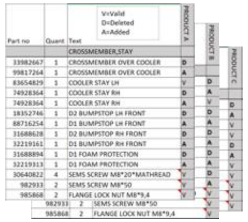
Input
- Valid/possible order
- Variant based

Output 1
- Physical structure breakdown
- Part based

Material content

Geometrical representation

Output 2
- Geometrical representation
- Model based including:
  - Properties
  - Behavior
  - Position



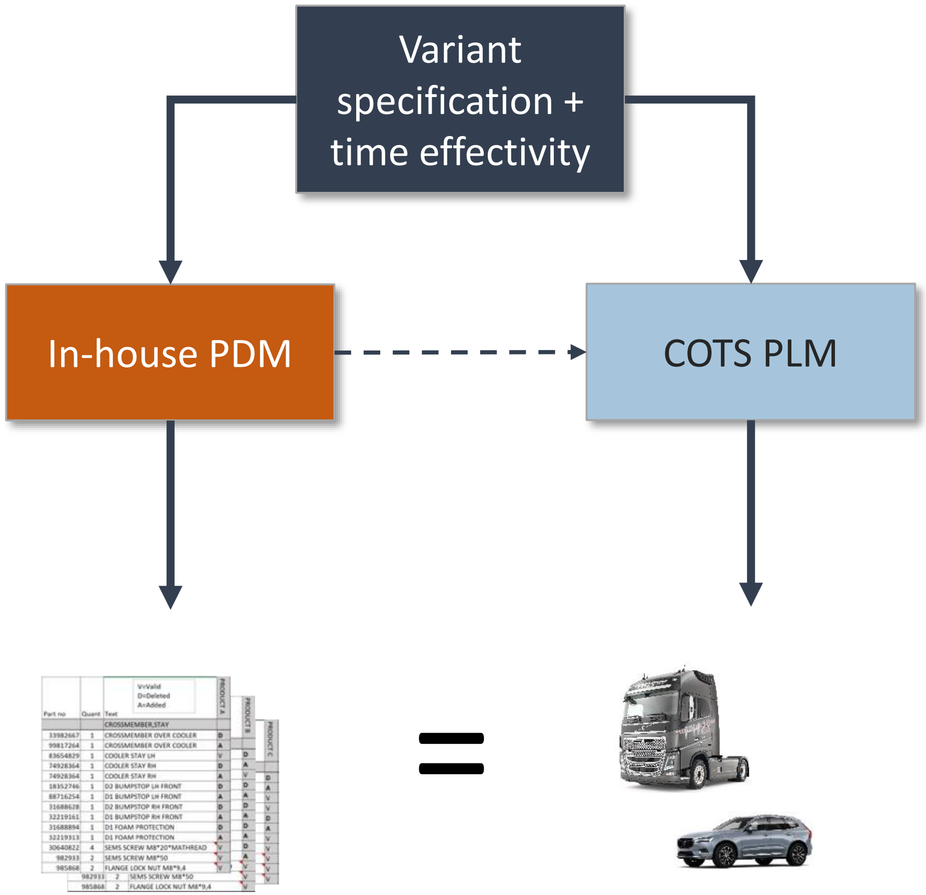
V=Valid
D=Deleted
A=Added

Part no	Quant	Text	PRODUCT A
		CROSSMEMBER,STAY	
33982667	1	CROSSMEMBER OVER COOLER	D
99817264	1	CROSSMEMBER OVER COOLER	A
83654829	1	COOLER STAY LH	V
74928364	1	COOLER STAY RH	D
74928364	1	COOLER STAY RH	A
18352746	1	D2 BUMPSTOP LH FRONT	D
88716254	1	D1 BUMPSTOP LH FRONT	A
31688628	1	D2 BUMPSTOP RH FRONT	D
32219161	1	D1 BUMPSTOP RH FRONT	A
31688894	1	D1 FOAM PROTECTION	D
32219313	1	D1 FOAM PROTECTION	A
30640822	4	SEMS SCREW M8*20*MATHREAD	V
982933	2	SEMS SCREW M8*50	V
985868	2	FLANGE LOCK NUT M8*9,4	V

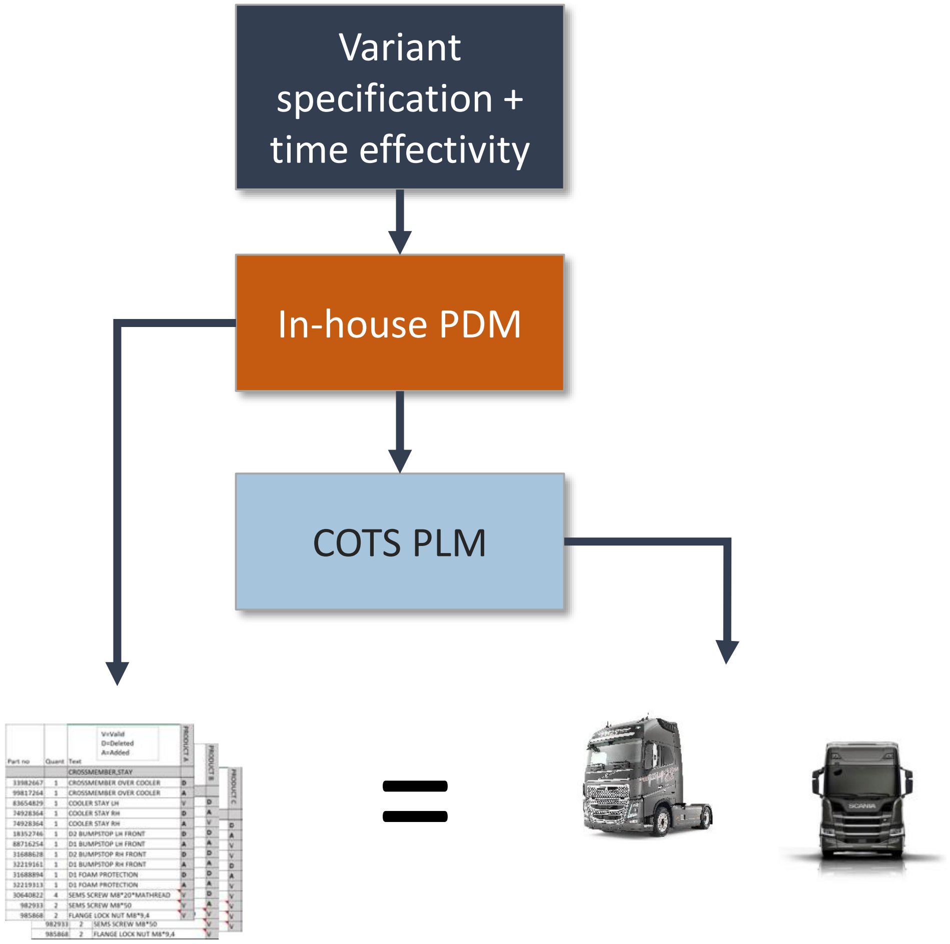
=

Filtering of Part and 3D Geometry Usage

Based on variant specification and time



Based on result from filtering in In-house PDM



Success factors

- Physical and virtual structure alignment
- Unambiguous documentation logic and level (building blocks)
- Support for increased complexity in product documentation
  (Part, 3D geometry and position)
- Consideration of the complete context during development (i.e. 150%)

Related COTS PLM Challenges

- Physical and virtual structure alignment
- In-house PDM and COTS PLM integration
- Variant driven relative positioning

General business challenges

ODETTE SWEDEN

Pre-defined, highly configurable products

- Configure to order is the basis
- With additions:
  - Easy to allow technically possible solutions based on need
  - Customer adaptations
  - Update product during complete lifecycle

Virtual product verification and usage during the complete lifecycle

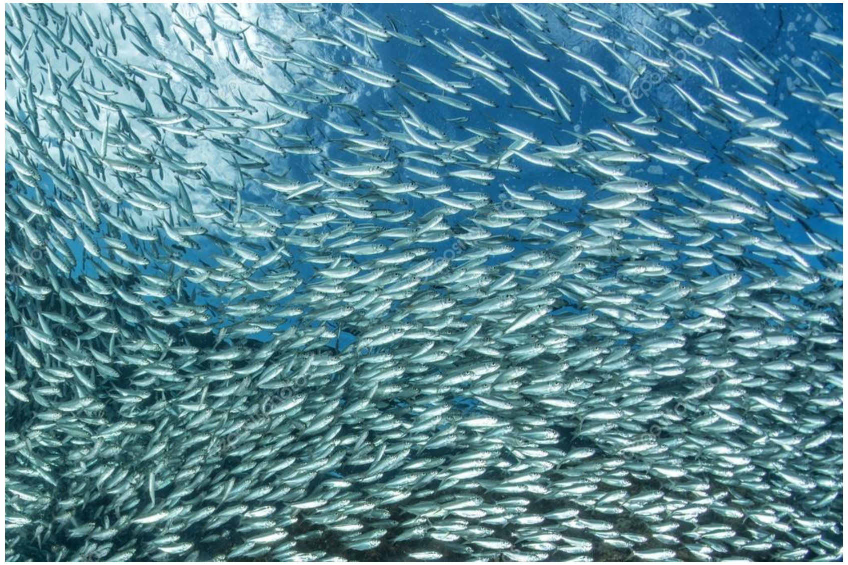
- Reduce Physical Tests
- Improve Manufacturing efficiency
- Support Sales
- Improve Aftermarket processes

Product complexity increase

- Parallel alternative of Drivelines
- Preparation for Body works (for trucks)
- Multiple Top hats for one platform (for cars)
- Customer options and functions
- Accessories
- Industrial footprint
- Mechatronic dependencies

Related COTS PLM Challenges for trucks

- Extremely high number of resulting positions for Parts (>100.000.000.000 positions)
- No possibility for manual documentation of absolute positions
- Storage and performance issues



Physical and Geometrical structure alignment

Aligning Part usage and 3D usage

- Flexibility in usage of Objects
- Decoupling of Objects
- Variant control and effectivity of Part usage and 3D usage

Decoupling of objects

Rationale

- Different Objects follow different lifecycles
- Objects shall be possible to change independently of each other

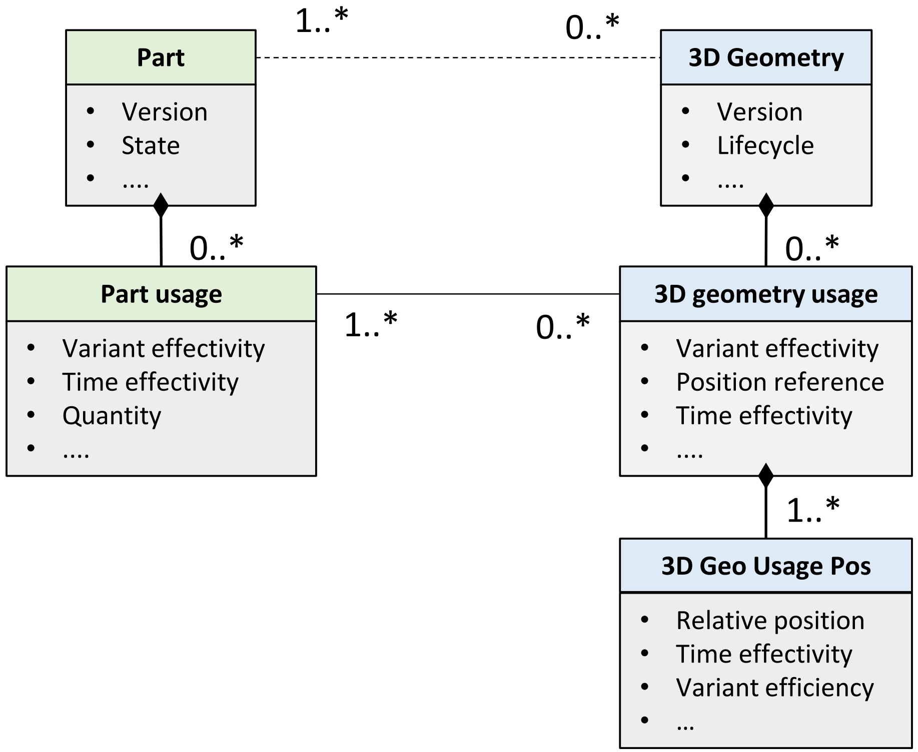
Objects

- Part
- Part Usage
- 3D Geometry
- 3D Geometry Usage
- 3D Geometry Usage Position

Aligning Part usage and 3D geometrical data

ODETTE SWEDEN

- Part Usage and positioned 3D Geometry Usage are aligned in the same structure/system
- COTS PLM masters the alignment relations
- 3D Geometry Usage is described in the context of the Part Usage

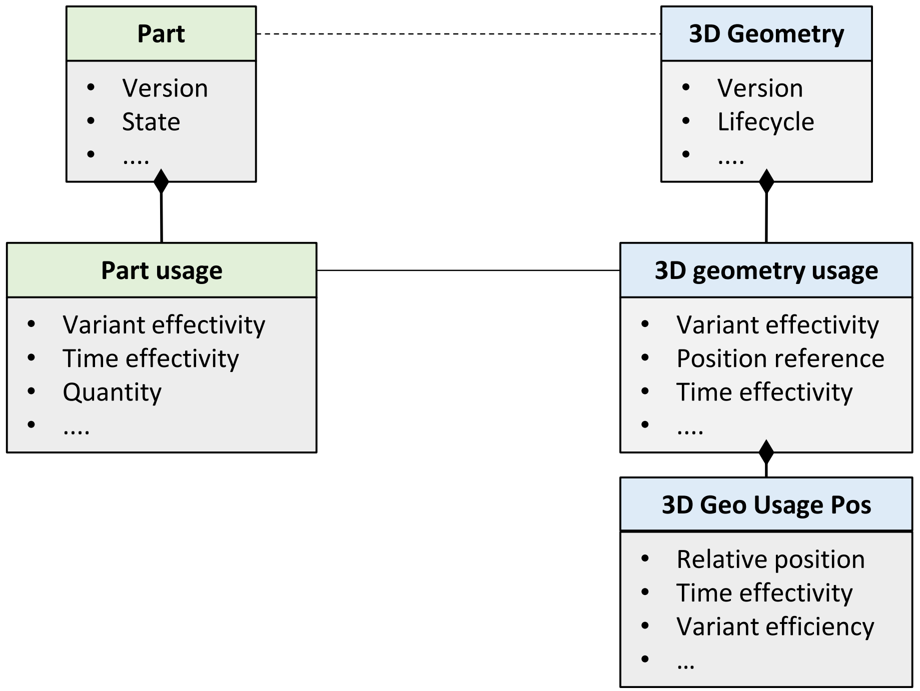


Examples

- The need of relation differs between use cases:
  - Hoses, wiring harnesses etc.
  - Different states (loaded/unloaded)
  - Different colors
  - Surface treatments

Variant control

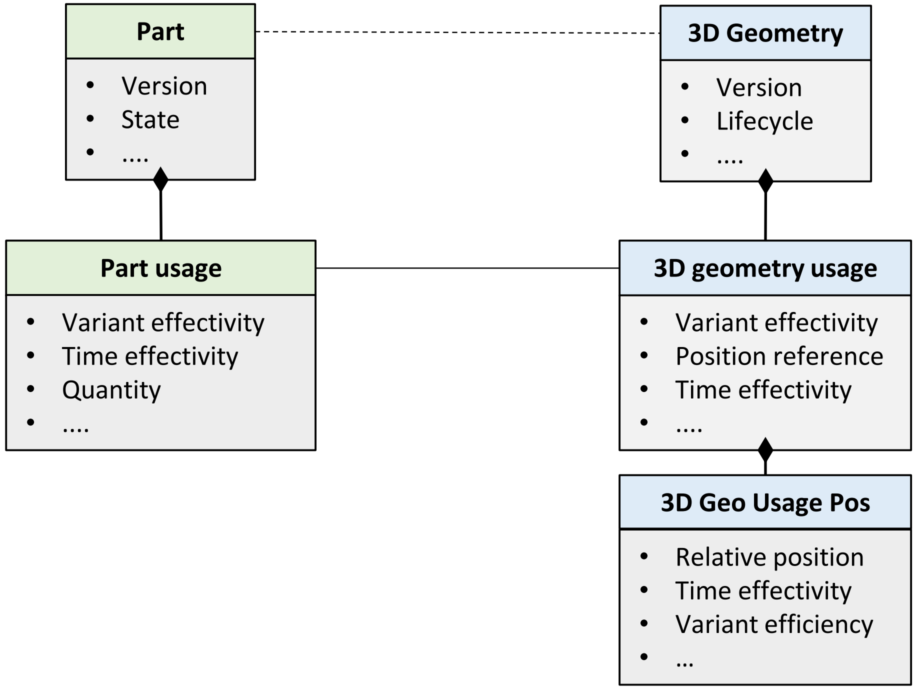
- Part Usage, 3D Geometry Usage and 3D Geometry Usage Position must be separate Objects with Variant and time effectivity to cover the described use-cases
- The variant combination of the Part Usage and of the 3D Geometry usage must be combined to resolve the position

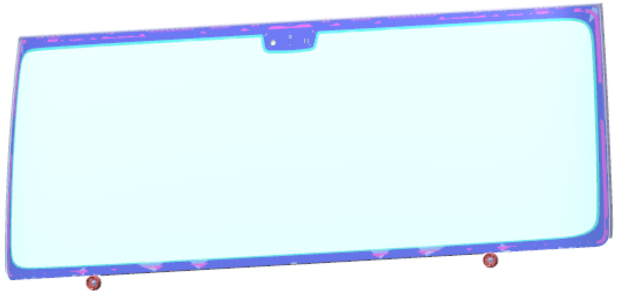


Part Usage Quantity 1, single spec

Description

- Front windscreen has quantity 1 in material struture

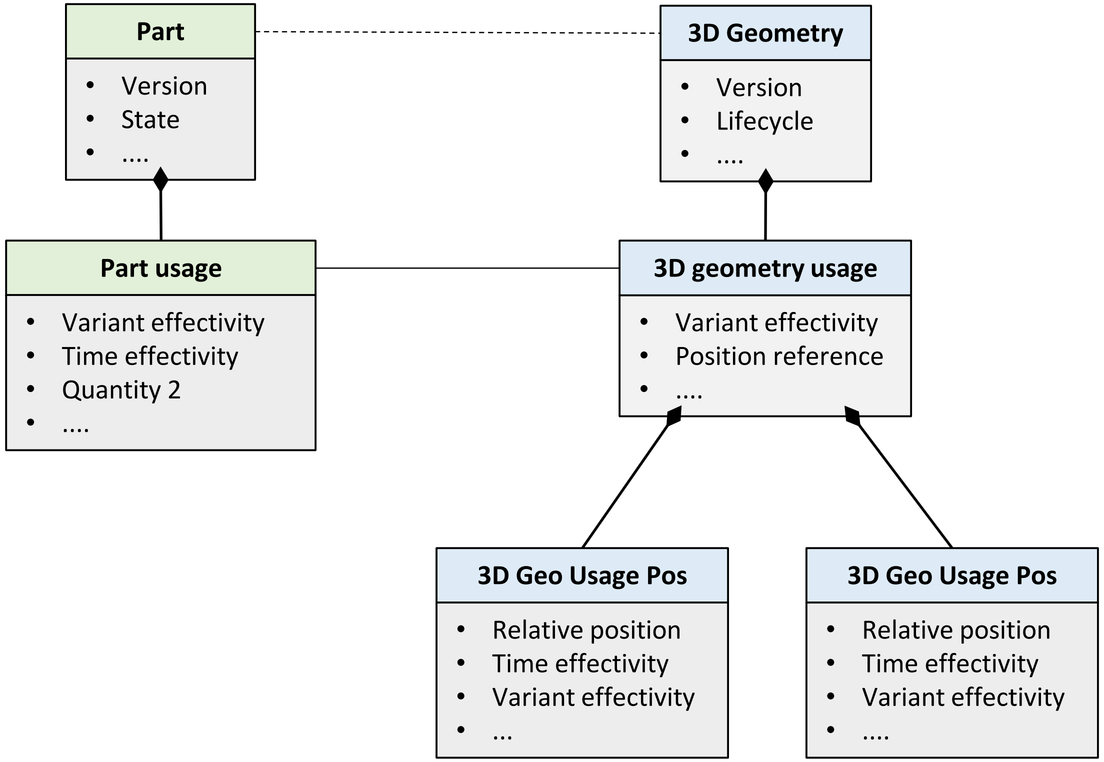


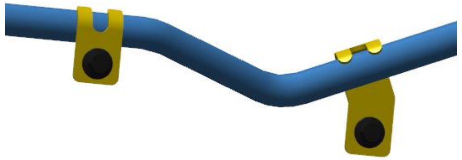


Part Usage Quantity > 1, single spec

Description

- A screw has quantity 2 in the material structure



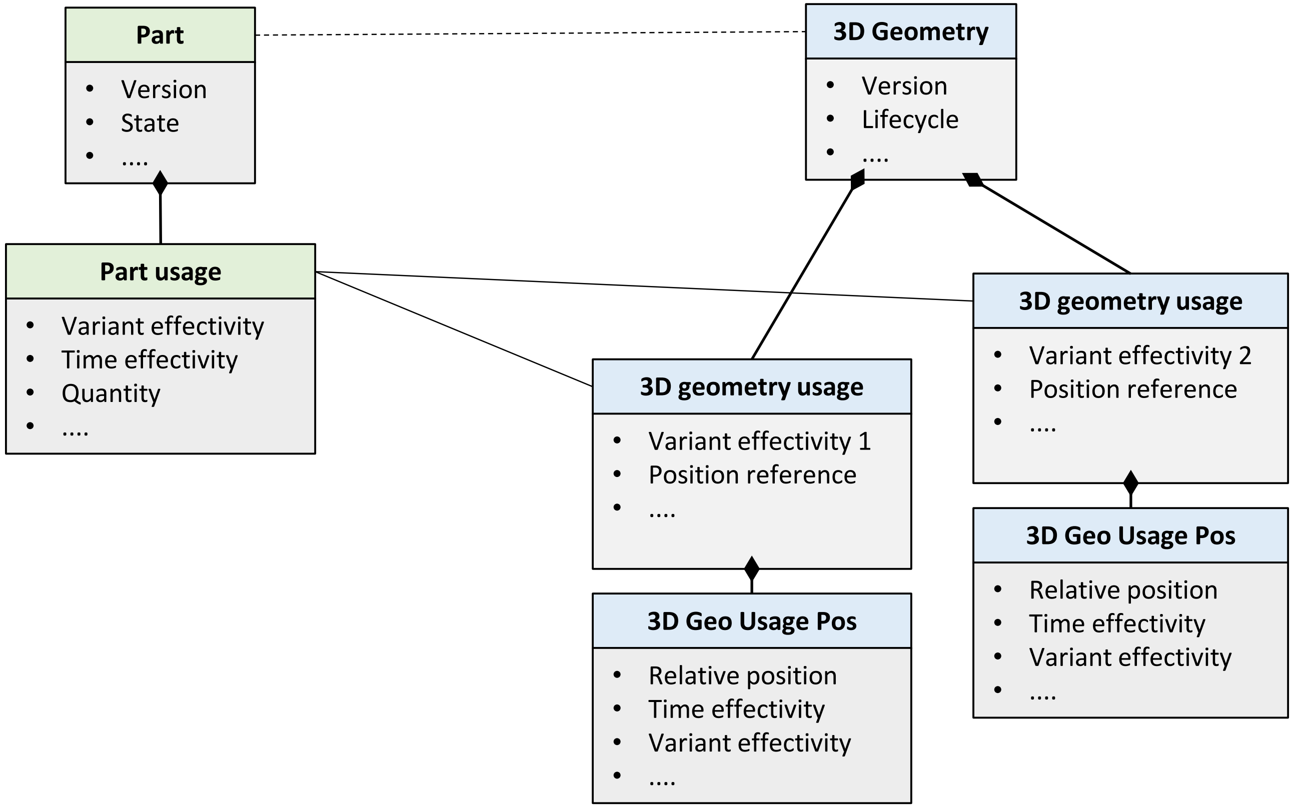


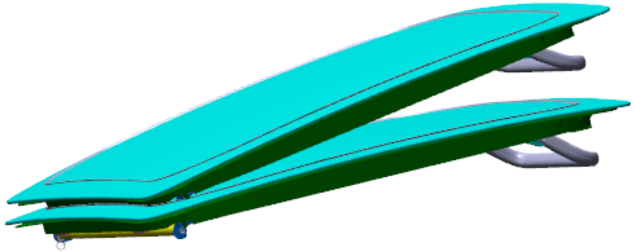
ODETTE SWEDEN

Position driven by variant, multi spec

Description

- Same Roof hatch on different positions driven by different variants



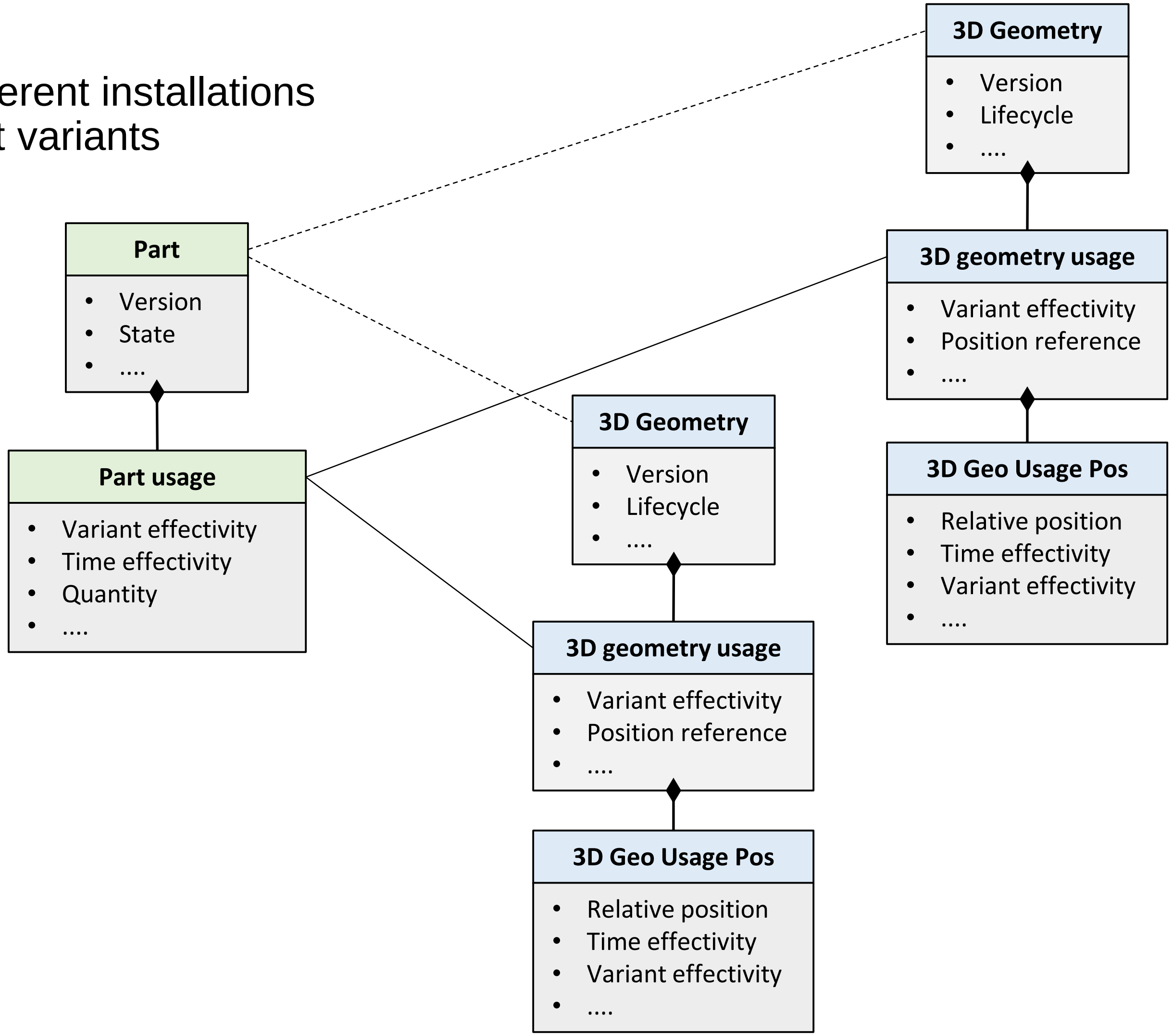


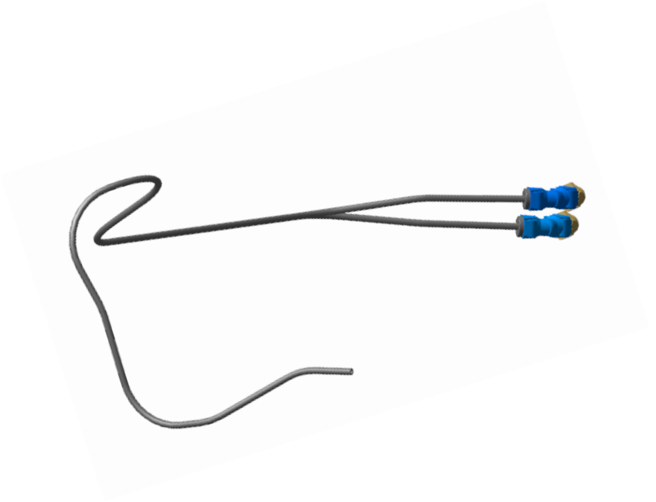
ODETTE SWEDEN

One Part has several geometries, Multi spec

Description

- Same hose in different installations driven by different variants

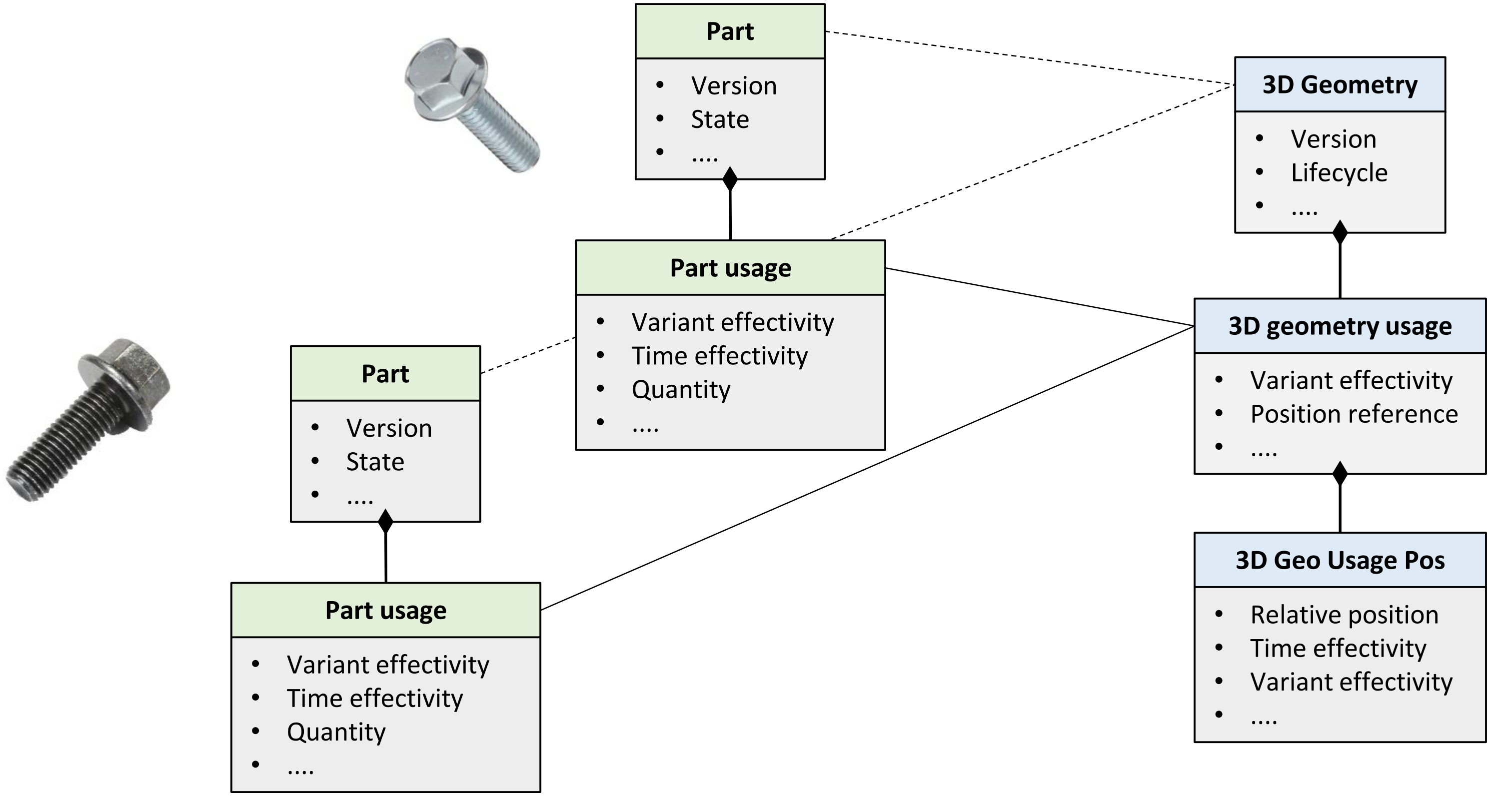




Surface treatment, Multi-spec

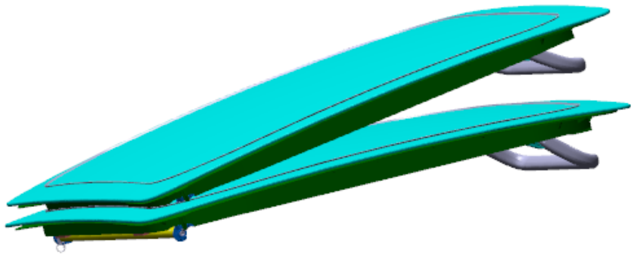
Description

- Same 3D Geometry for screws with the same dimensions, but different surface treatments



Variant control, cont.

- Alternative positions for each 3D Geometry Usage is controlled by Variants
- Position Variant is needed in the COTS PLM



ODETTE SWEDEN

In-house PDM and COTS PLM integration

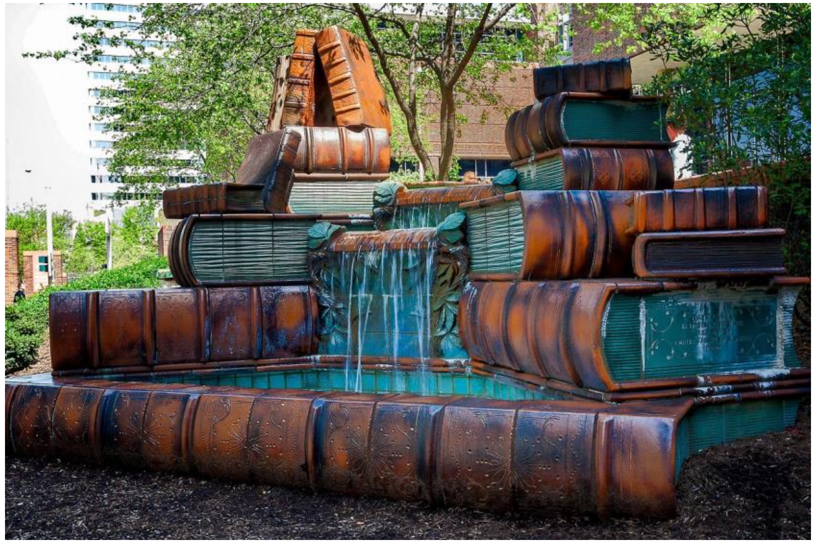
In-house PDM

Material/Physical structure master

- Management of Engineering effectivity
  - Time and Variant
- Engineering Change and Release

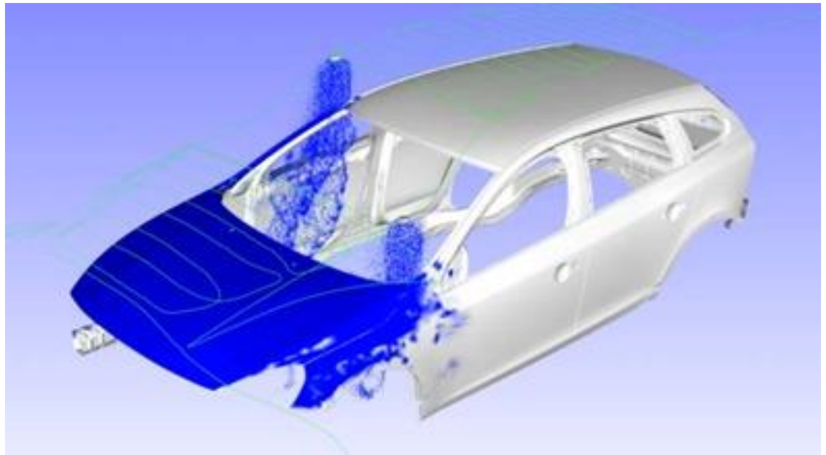
Definition of Product Configuration

- Variants and rules



COTS PLM

- Geometrical Structure master
  - Change and Release
- Masters the alignment relations
- Positioning of Geometries in the vehicle
- Base for all virtual authoring, simulation, preparation, analysis and collaboration

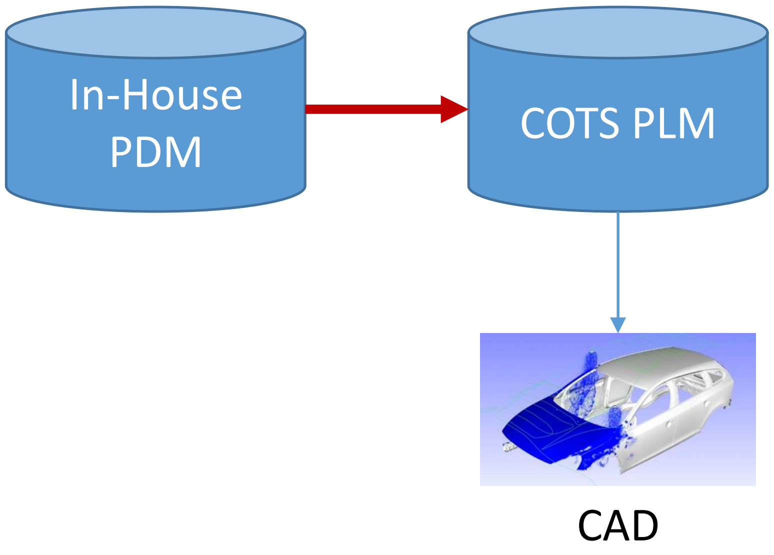


Information flow

Parts and part usages mastered in In-house PDM should be synchronized to COTS PLM

- Instant synchronization
- Standard format for information flow

Geometries and geometry usages are connected to parts and part usages in COTS PLM



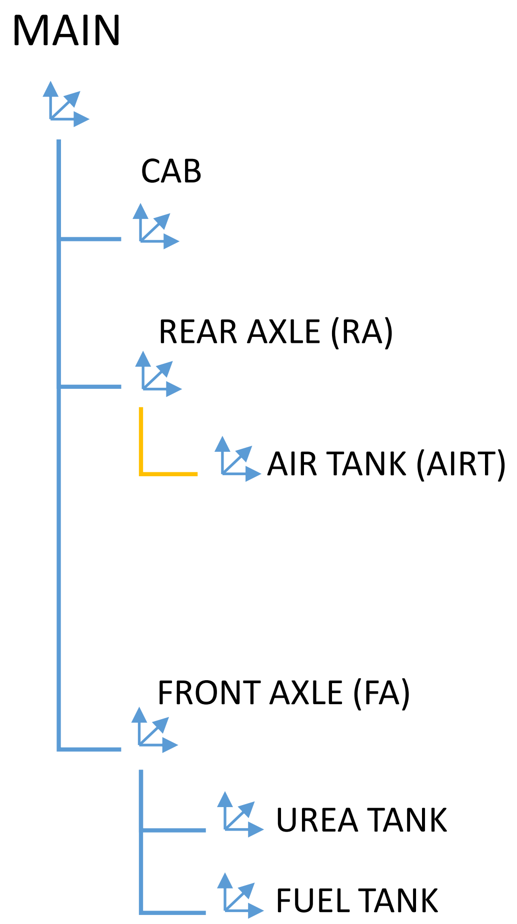
Variant driven relative positioning

Relative positioning

Positioning of a Geometry is always dependent on the individual product configuration for complex, configurable products with geometrical constraints.

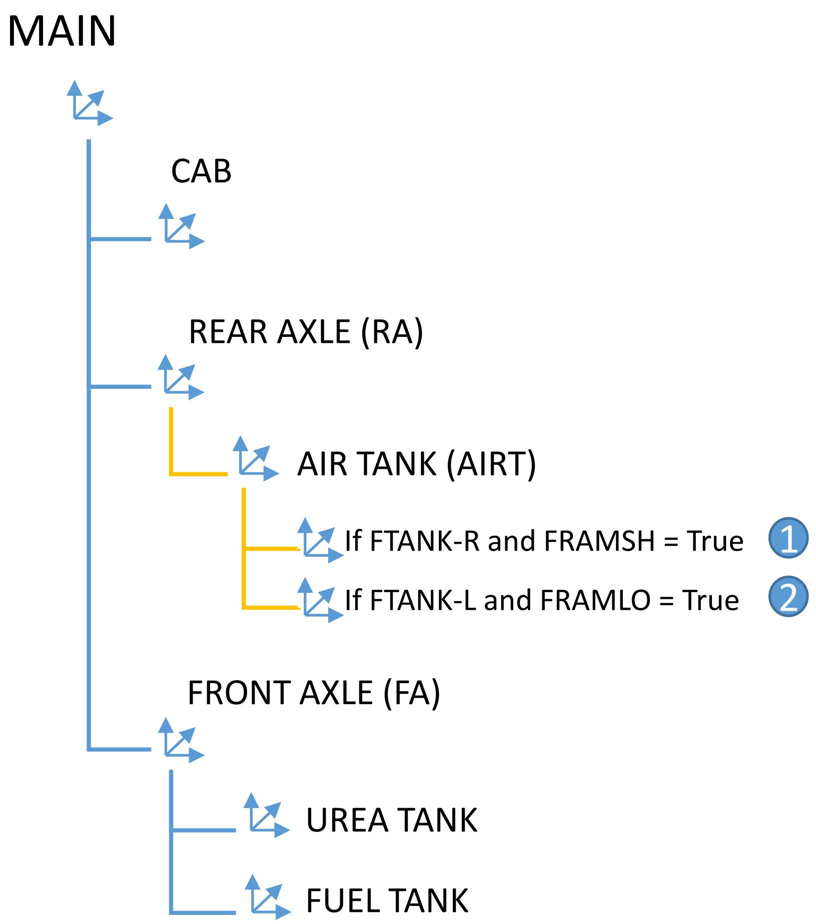
Relative positioning

- The positioning references shall be documented in a hierarchical structure



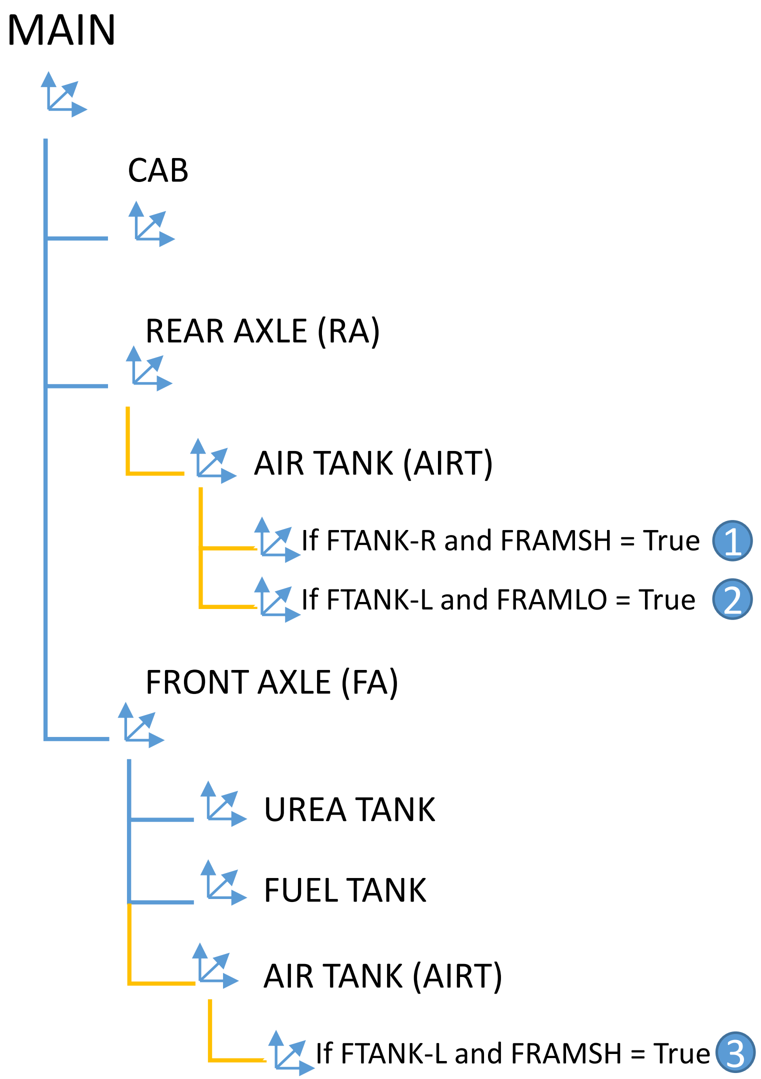
Position variance

- The position references or 3D geometry usage position may have different positions dependent on product configuration – offset positions
- Offset positions are controlled by variants and time effectivity

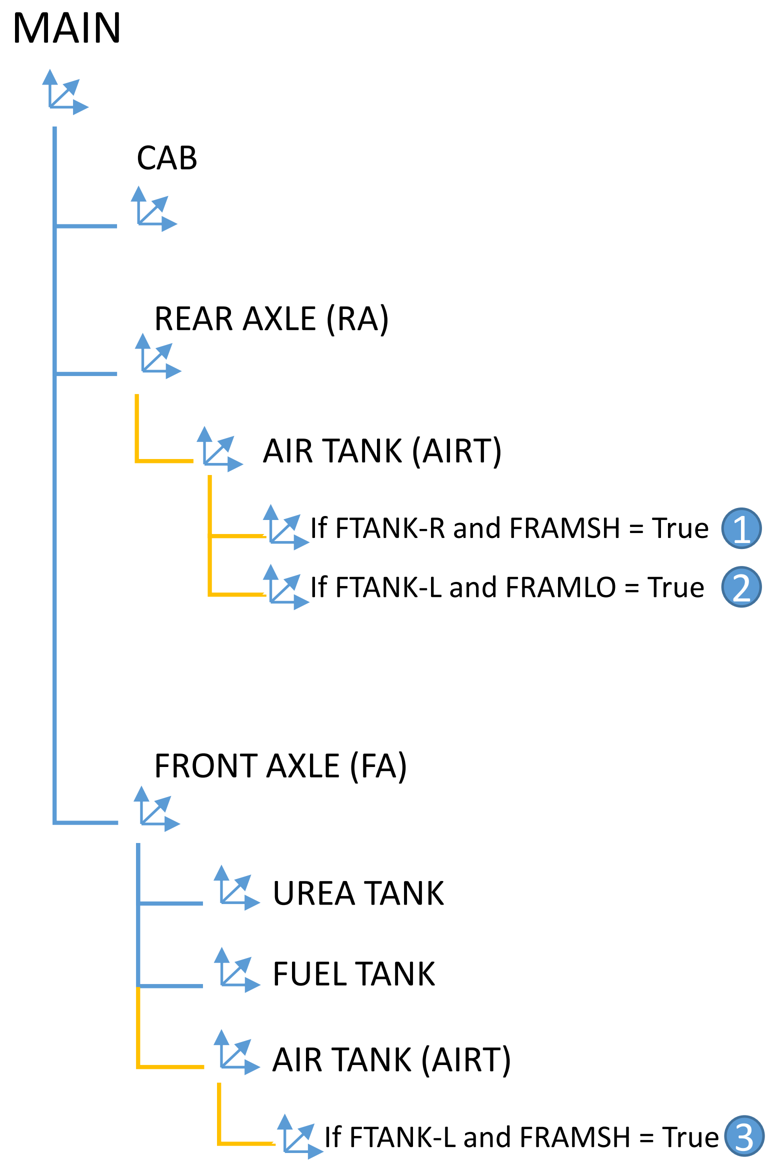


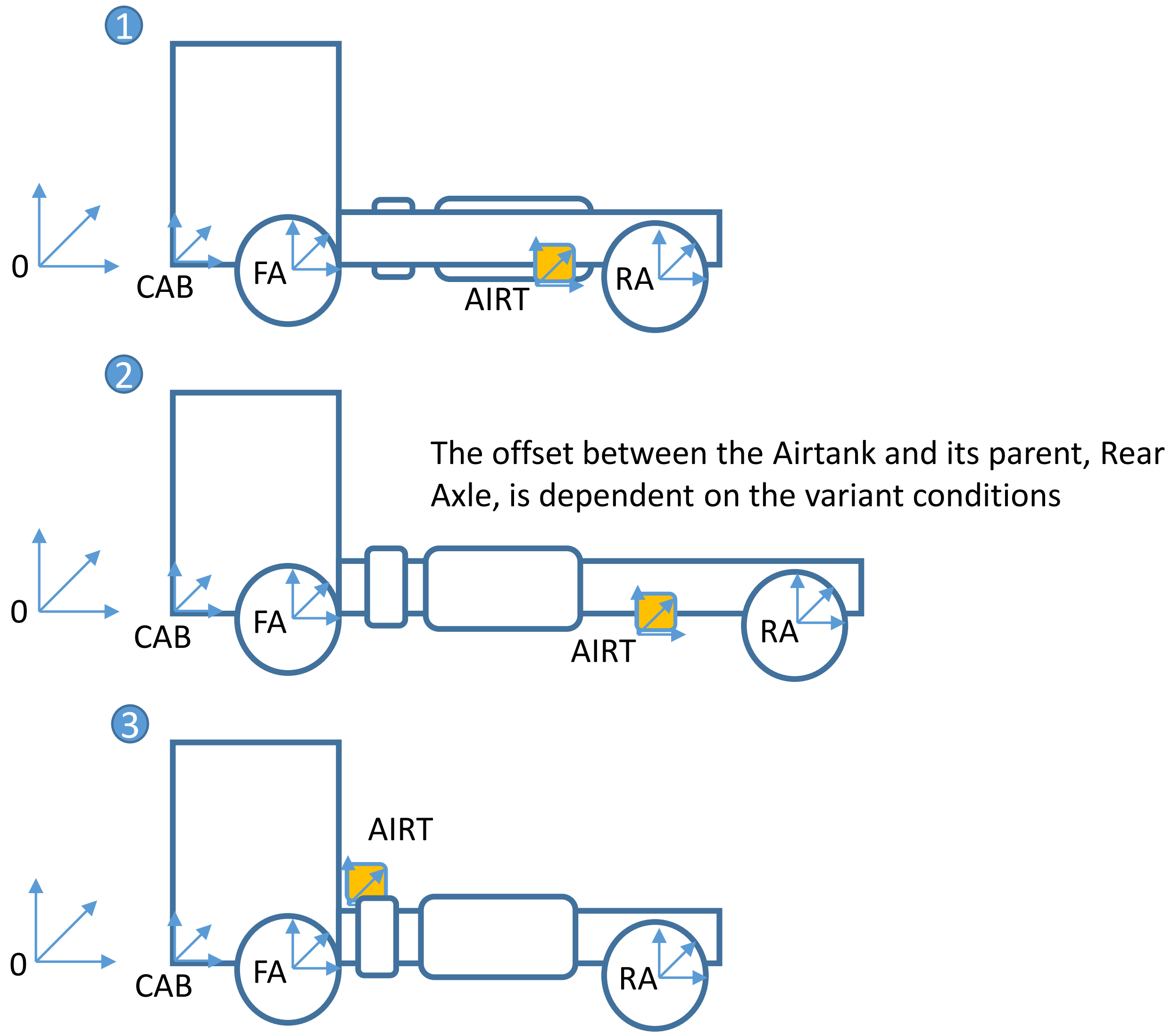
Parent child relationships

- A position reference can have different “parents” in the hierarchy
- All parent child relationships between position references are controlled by variant and time effectivity
- Variant and time effectivity and can be applied to each level

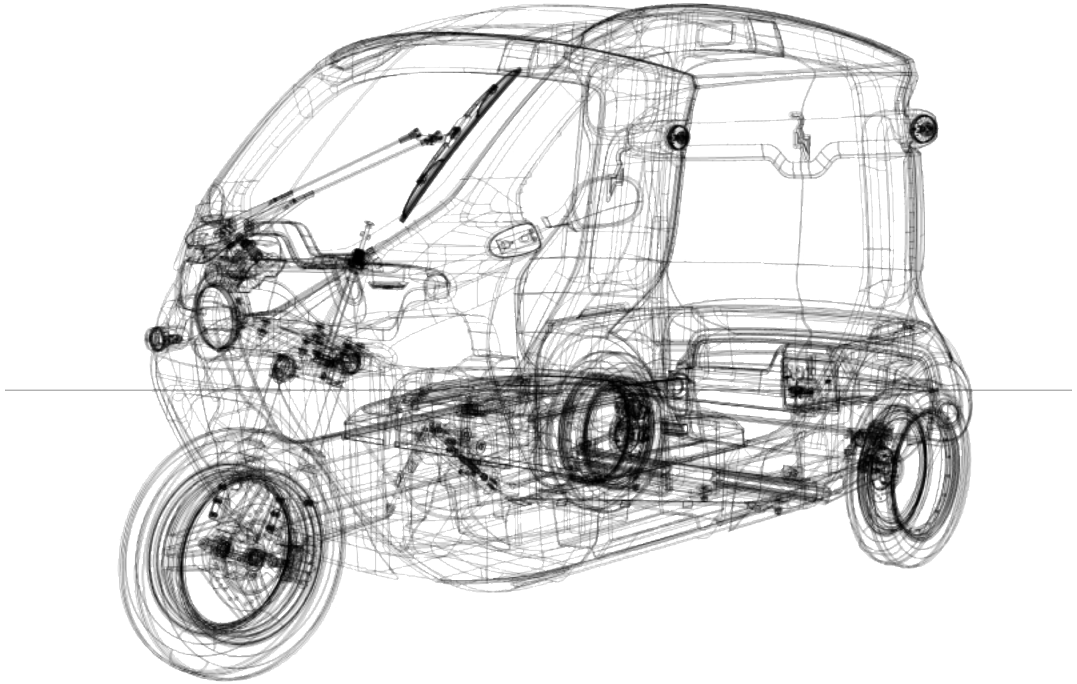


Illustrative example of relative positioning





Virtual vehicle



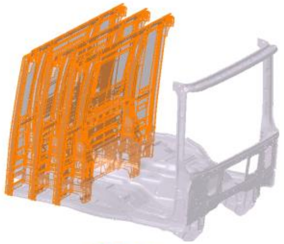
Virtual vehicle

- Multi-spec visualization (>100%)
- Component based Center-of-the-world
- Intelligent Filtering based on Component

DMU = filtered product structure with a 3D result

un-ambiguous = 100% material and positions

ambiguous = >100% material and 100% positions



ambiguous = 100% material and >100% positions

ambiguous = >100% material and positions

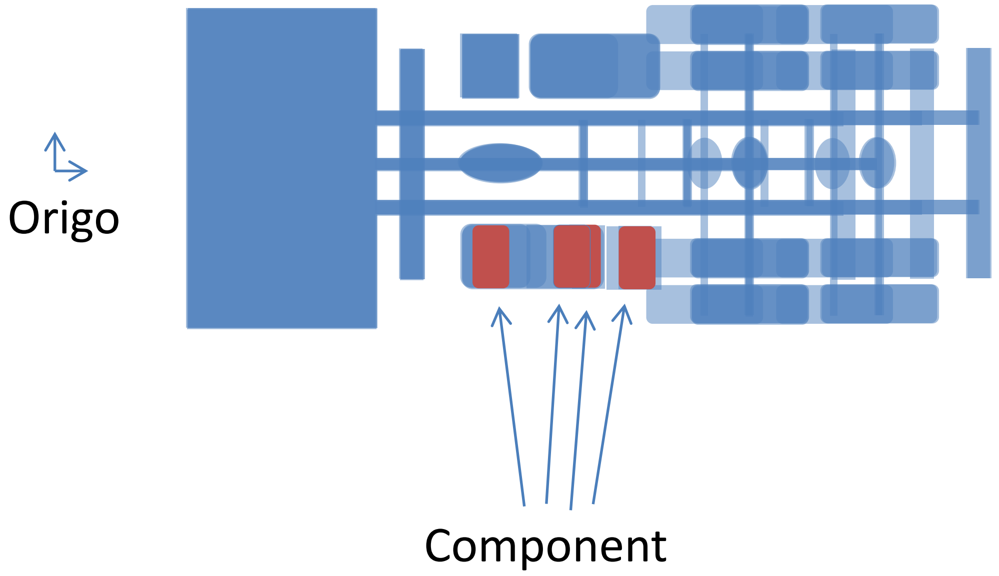
Prerequisites

- Position reference is connected to 3D geometry usage
- Positioning information is managed in a standardized, neutral format
- Ability to display and analyze the dependencies in the positioning reference structure

ODETTE SWEDEN

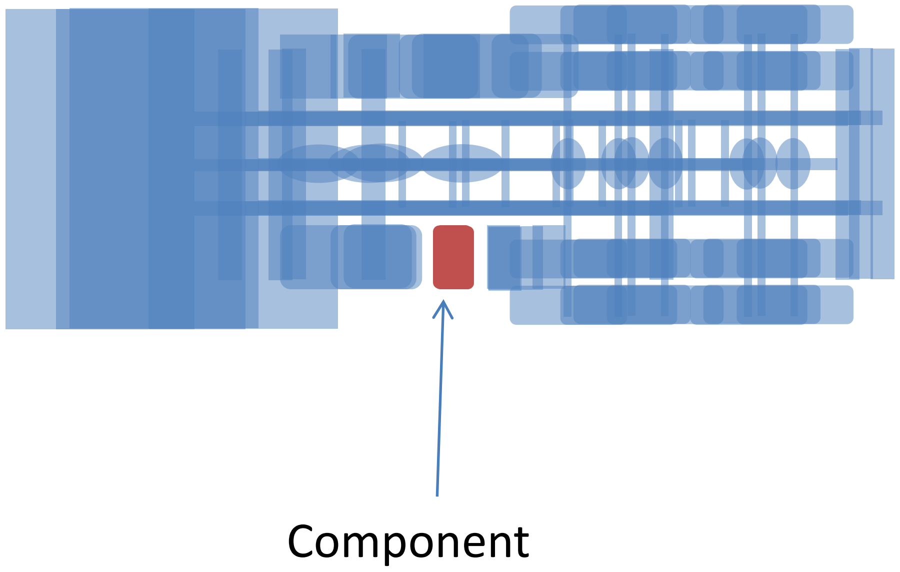
Multi-spec visualization

- Overlay of multiple specifications
- Ability to resolve under- and over-specified specifications
- The component position varies in different product configurations



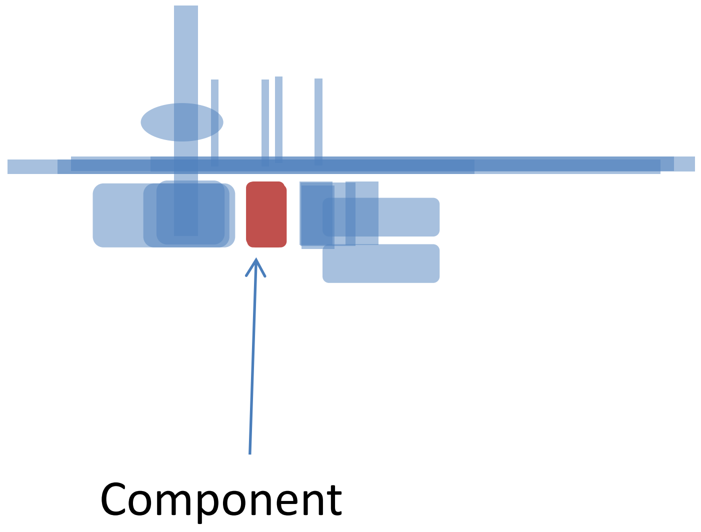
Component based Center-of-the-world

- Positioning needs to be resolved based on Component as Center-of-the world
- Any number of specifications should be generated in seconds



Intelligent filtering

- Calculate filter based on Component position and defined bounding box
- Visualize multiple specifications with Component as center with volume filter
- Possibility to define filter without displaying geometry, then load relevant geometry



Conclusions

Conclusions

- Common needs have been identified in the areas:
  - Physical and virtual structure alignment
  - In-house PDM and COTS PLM integration
  - Variant driven relative positioning
- Presented needs are common for the automotive/transportation industry in Sweden
- Solutions fulfilling needs are essential to be able to fulfil business challenges