Transforming Airbus through Product Line Engineering

Foundation and real-life Implementation

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DDMS @ Airbus
OUR CHALLENGES

Step **change in our operational efficiency** across the whole lifecycle of our programs and products

Increase maturity
Product Industrial system Operability

Enable customization
Product line, Decoupling Modular approach

Cut the development Lead Time
Start of concept / MG3 to Entry Into Service

Aviation Safety

Robust production ramp-up
Design for Manufacturing Robust production set-up Flexible production update

Quality
Mastering of our industrial system Continuous improvement of the cost

Zero AOG
Operational availability & reliability

Design for value

Sustainable

Support **Services** ambitions

Customer Loyalty

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DDMS five pillars

Transformation & competences

Identify and develop key skills and competences to the business and existing programmes

Modelling and simulation

Allow to have a virtual world to be able to model and simulate the A/C, the industrial system and services

Co development & Integration

Make all the disciplines (engineering, manufacturing, customer services, supply chain of the partners) working together in a single process and single environment

Digital continuity

Every time you change a data everybody get access to this data and know what is the impact of the modification we have done on the complete tool chain

Product line

Reduce non-added value variability and stop variability propagation through modularization & standardization.

Enforce reuse in product, industrial & services.

5 pillars provide capabilities to the business to create values on the program

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Product line

- Flexible modular architecture
- Decoupling architecture principles
- Standardization

Systematic approach through Systems Engineering of the product, industrial & services systems considered as the system of interest

The Product Line Pillar acquired for 2021 even higher priority in the realization of the Airbus Digital Transformation

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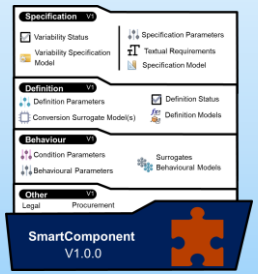
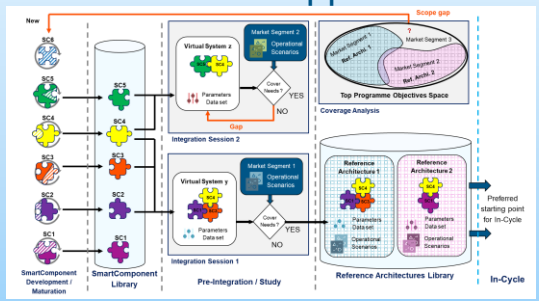
DDMS Modelling and Simulation key development axis

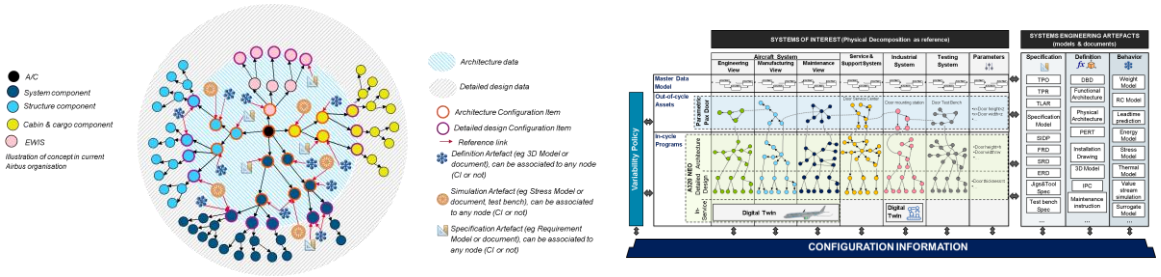
Product Line is closely linked to the **Modelling & Simulation** pillar due to its realization through **smart principles, reuse mechanisms** and **reference modular architectures**

- Smart principles, reuse mechanisms and reference modular architectures to enable the Product line approach

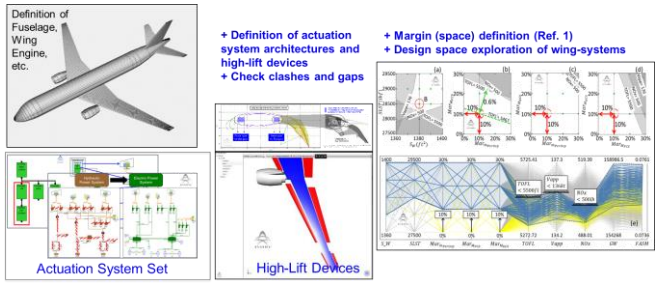




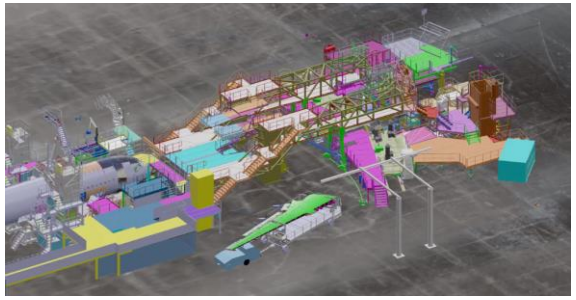
- Global ontology (from Market to Service) to create the back bone for model based continuity (connect all the models)

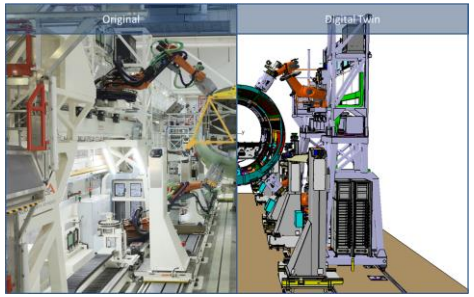


- Multidisciplinary optimization approach going across disciplines (Engineering and Manufacturing for instance) to support trade-off analysis



- Industrial system modelling and simulation (going much beyond the flow rate simulation)





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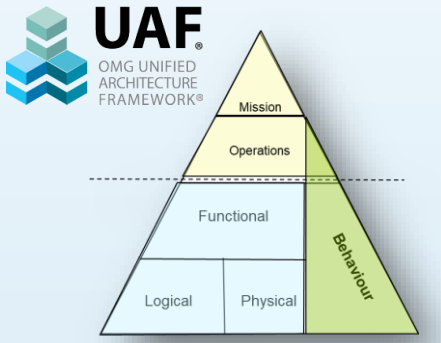
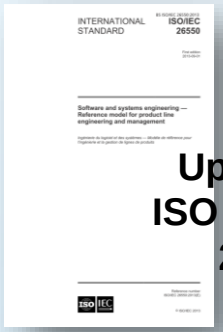
Model Based Product Line Engineering (MBPLE) Guiding Principles

The methodological sphere of Product Line Development is strongly related to the **Modelling & Simulation** pillar mainly for its close relationship with **MBSE** but not exclusively…

Integration with UAF and MBSE framework

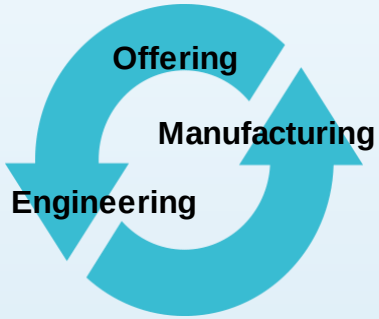


PLE solution based on standards

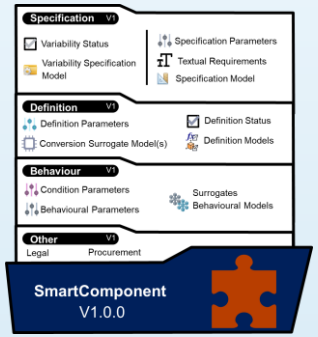


Upcoming ISO standard 26580

PLE-based Digital continuity



Reuse of Smart Principles



Product Line Definition with Data mining and AI

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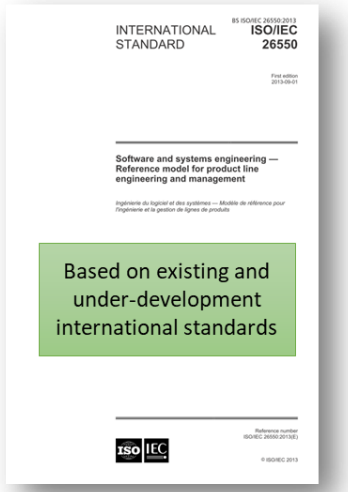
MBPLE Foundation
Building the enablers and backbone of the product line development

MBPLE Foundation

Environment

Enables/disables "WHAT & HOW"

Process
Defines "WHAT"



Based on existing and under-development international standards

Methods
Defines "HOW"

- Feature Modeling Method
- Requirements Variability Definition
- Variant Modeling Method in SysML

Ontology
Enhances "WHAT" & "HOW"

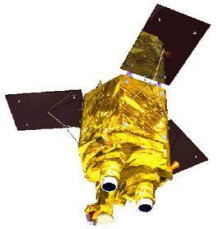
Based on a Standard Modeling Language as SysML 2

Based on Feature Model Language

Tools
Enhances "WHAT" & "HOW"

- SysML Tool
- PLE-toolchain
- Requirement Management Tool
- Plug-ins for AI and Collaboration

The MBPLE foundation is developed to be applied to Airbus products industrial systems and services



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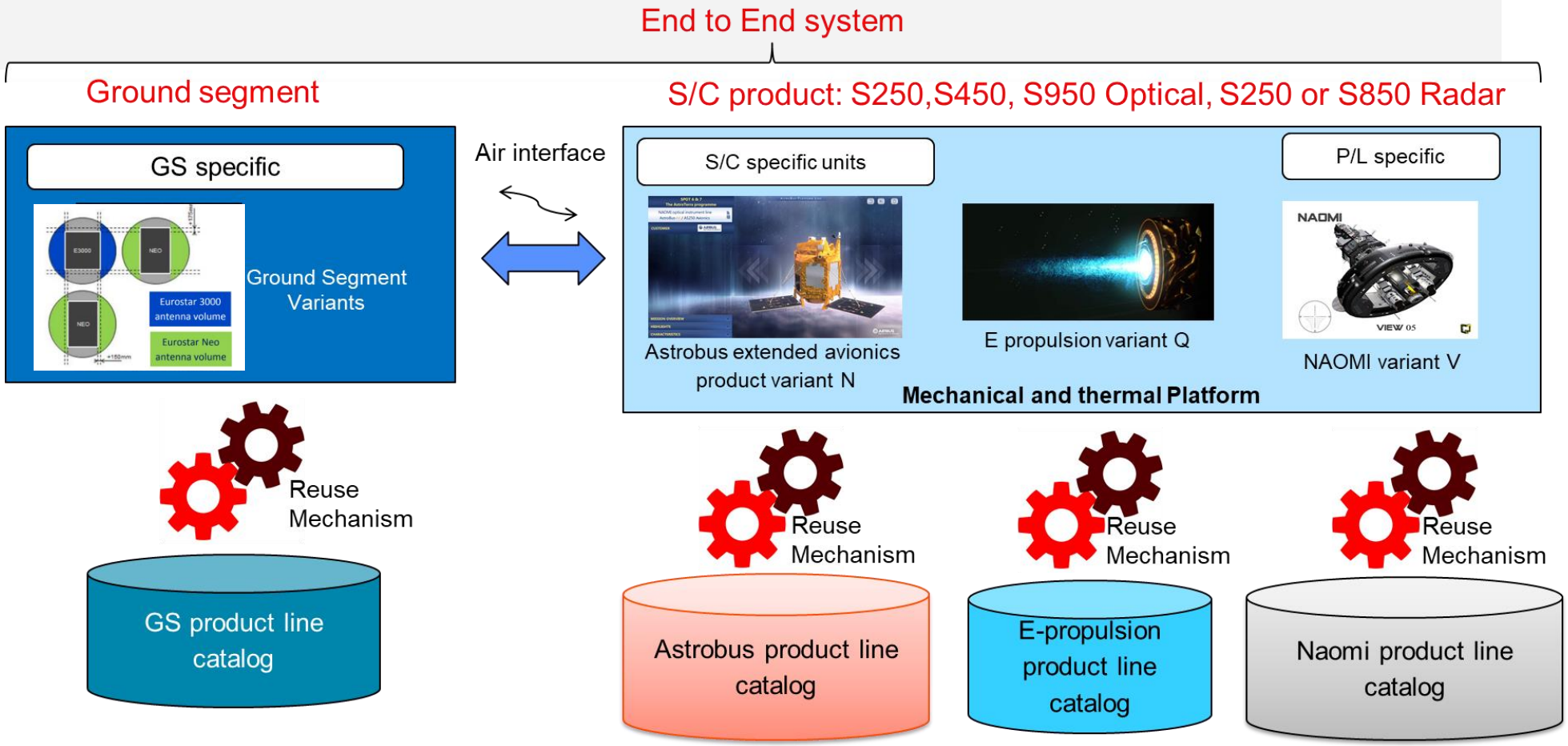
Product Lines @ Airbus Defense & Space
From Legacy systems to product lines



Commonalities across Space legacy systems are identified in order to establish a reused mechanism based on product lines

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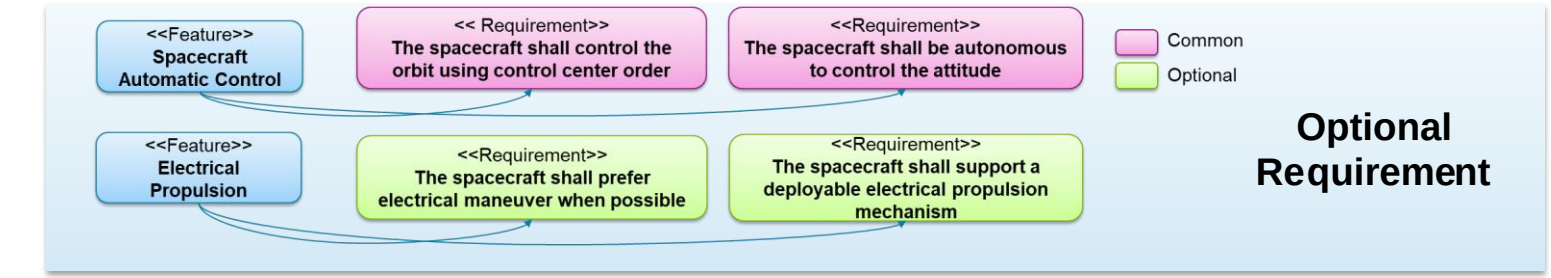
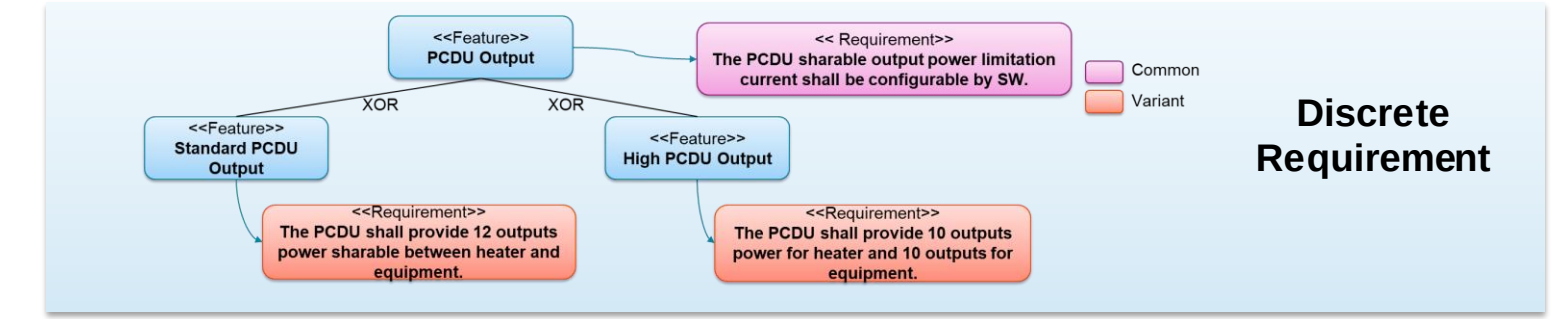
Product Lines @ Airbus Defense & Space
Starting from defining variability in Requirements to enable their reuse

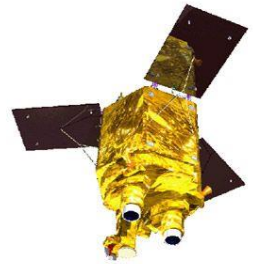


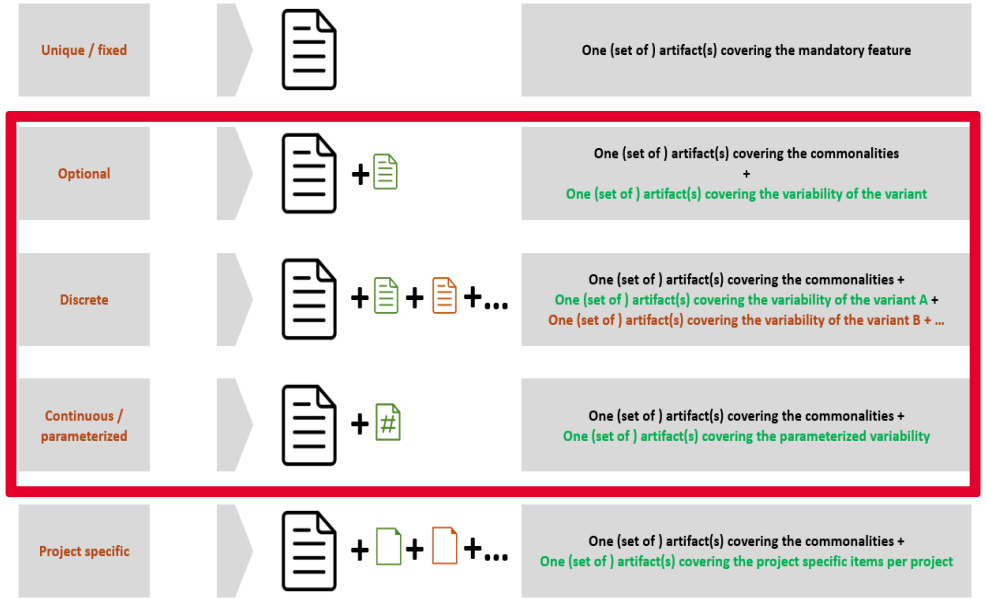
Optional Requirement



Discrete Requirement

Parametrized Requirement





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Product Lines @ Propulsion Systems
The variety and complexity of Airbus products lead to high products variability

Commercial Aircraft

How to manage the variability?
What is common and what is variable?

Military Aircraft

Variability drivers

Variability for the Propulsion Scope

Tank Installation Tank type Tank amount	Refuelling method Refuelling system	Engine Power Engine Type	Propulsion Technology	Mileage Range

The product porfolio is incredible huge and includes very complex products. Finding opportunities to reduce variability requires a very structured approach and is not always possible

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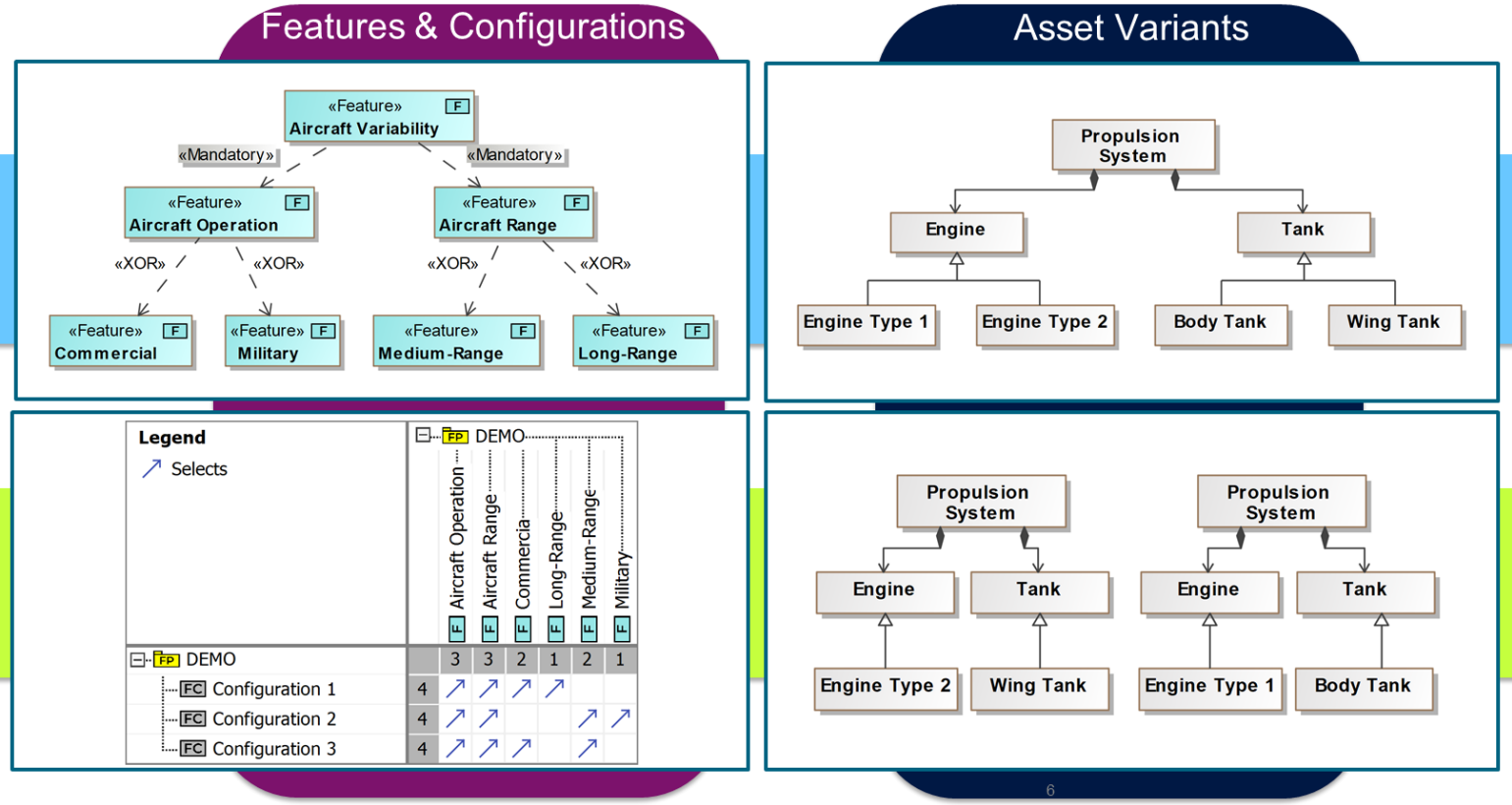
Product Lines @ Propulsion Systems
Model Based Product Line Engineering Framework



The variability is defined in the features and the variation points are built-in the correspondent model arfifacts.

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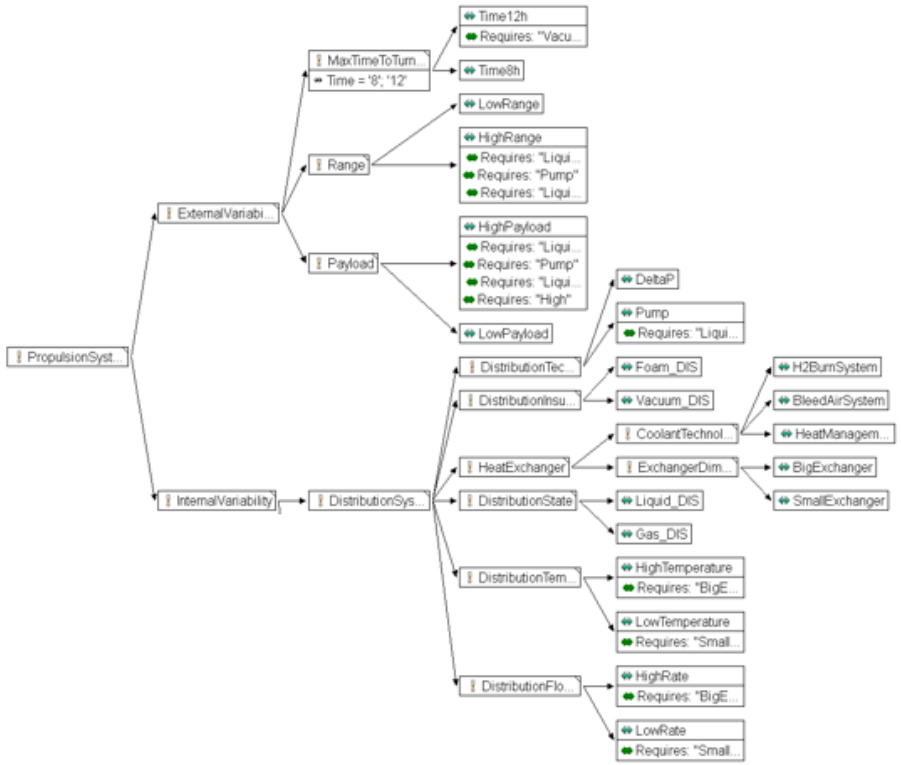
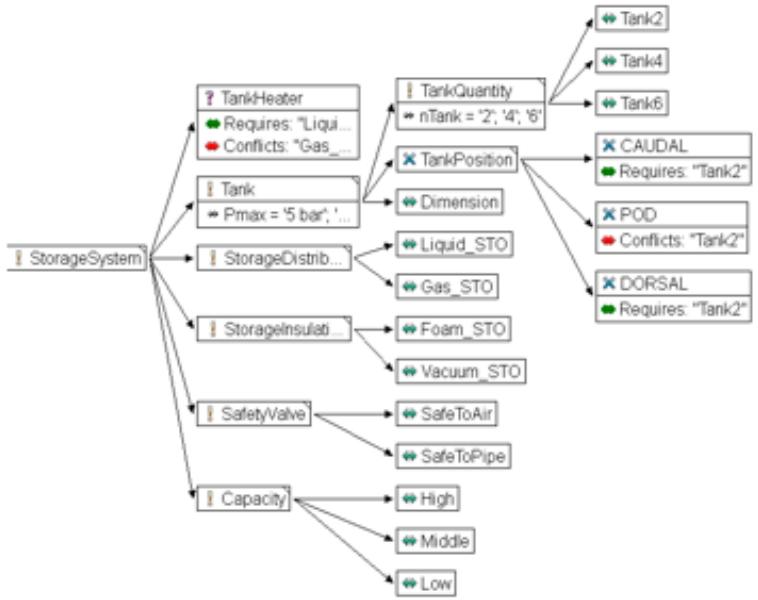
Product Lines @ Propulsion Systems
Feature models definition for the product line variability





Feature models are created with the support of a PLE-tool to prove part of the MBPLE methodological approach, using the current propulsion variability

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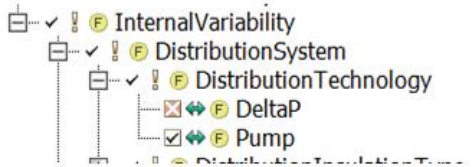
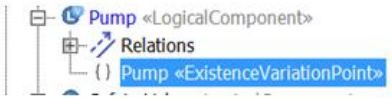
Product Lines @ Propulsion Systems
Building Variation Points in the model artefacts to enable their reuse and instantiation

VARIATION POINT: EXISTENCE

FEATURE MODEL	SYSML MODEL
	
Any Feature that can disappear in a configuration can be used to define an existence point • **Optional** • **Alternative** • **Or**	A Variation Point **Existence** shall be created on the desired element. Recommendation is the use it on definition* element and not their usage. This guarantee that generation of 100% Configuration keep into account all the element usage. *In the example you see how the Pump don't exist when the feature Pomp is not selected in the configuration* SYSML Element: **Block, Activity, Requirement, Port, Connector, Flow Property** * Definition/Static Usage/Dynamic 

Features helps defining variation points in the model artefact.

The reuse mechanism offered by the PLE-tool enables the selection of the feature and all its connected model elements.

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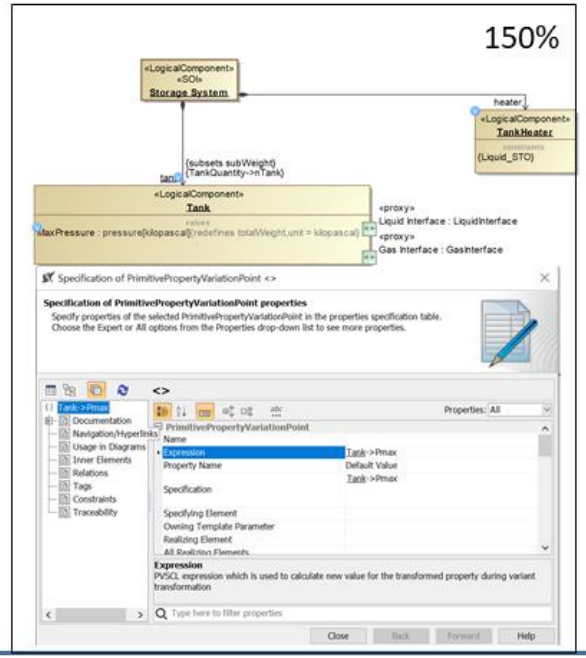
Product Lines @ Propulsion Systems
Building Variation Points in the model artefacts to enable their reuse and instantiation

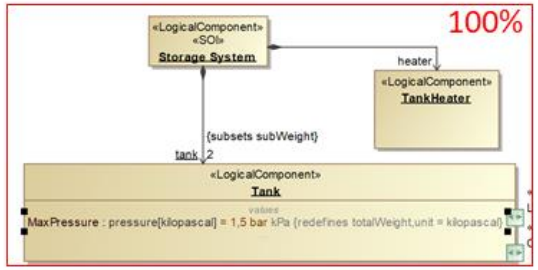
FEATURE CREATION – ATTRIBUTE- MBSE-(Parametric Variation)

ARTEFACT

- InternalVariability
  - DistributionSystem
    - DistributionTechnology
      - DeltaP
      - Pump
  - StorageSystem
    - StorageDistributionKind
      - Liquid_STO
      - Gas_STO
    - Tank
      - Pmax = '5 bar'; '1,5 bar'
        - '5 bar'
          - "DeltaP"
        - '1,5 bar'
          - "Pump"

GUI





A primitive propertyVariation Point in Cameo retrieve the value of the attribute Pmax, that is given by the configuration/variant in PureVariant.

Features helps defining variation points in the model artefact.

The reuse mechanism offered by the PLE-tool enables the selection of the feature and all its connected model elements.

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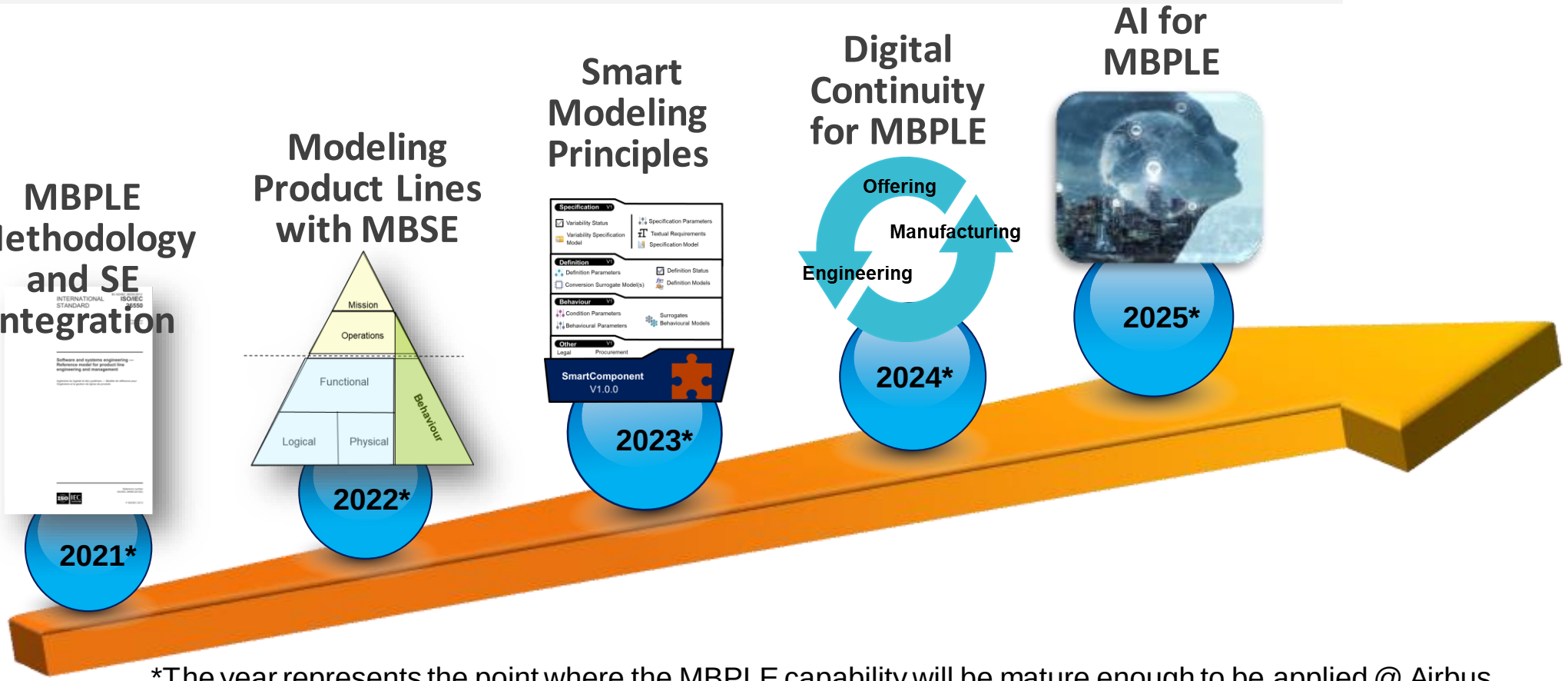
MBPLE @ Airbus DDMS
2020-2025 CapabilitiesTrajectory



*The year represents the point where the MBPLE capability will be mature enough to be applied @ Airbus

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Thank you

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