

Leveraging Product Line Engineering (PLE) for Enhanced Digital Continuity in Systems Engineering



Capella Days
19/11/2025

lgm / leading great movements

DIETER WAGNER

- 37 years of experience at MBDA Germany
- 25 years experience in MBSE
- 20 years expert for System Engineering
- 15 years lecturer at the University of German Arms in Neubiberg/Munich
- Head of NATO Working Group
- Member INCOSE/GfSE
- Member OSLC Working Group
- Member of the OMG PLE working group



MBDA Deutschland
Excellence at your side

lgm/
SÉBASTIEN DUBÉ

- 25 years of experience on Systems Engineering, Software engineering and Project management
- Active member of AFIS/INCOSE communities on MBSE & PLE topics
- Part of an experienced team of 6 members for MBDA

With the support of

MANAGEMENT AND ENGINEERING OF COMPLEX PROJECTS AND SUPPORT
MAINTENANCE AND SUPPORT ENGINEERING

2023 **SYSTEMS ENGINEERING** & RAMST (Reliability, Availability, Maintainability, Safety, Testability)



ORGANISATIONS AND PROGRAMME PERFORMANCE

1550

DIGITALISATION, DATA & INFORMATION TECHNOLOGY



SYSTEM ENGINEERING METHODS & TOOLS SPECIALISTS

168



GET (MBDA NEXT) CONTEXT & OBJECTIVES

50% lead time reduction

- Customers do not accept anymore to wait many years to get their order
- Main competitors are organized to react quickly



25% Non recurrent cost reduction

- Customers are less willing to pay NRC
- Competitors seem having accepted this new constraint

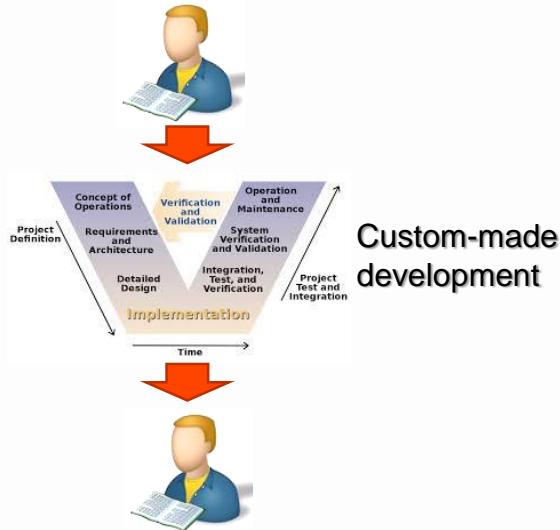


Reaching these objectives impose to change the way of working

Changing our product development strategy from Engineering to Order (ETO) to Configure to Order (CTO)

Engineering to Order (ETO)

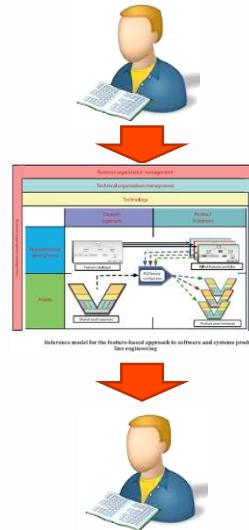
Customer expresses his operational needs



Customer receives a product
that satisfies his needs

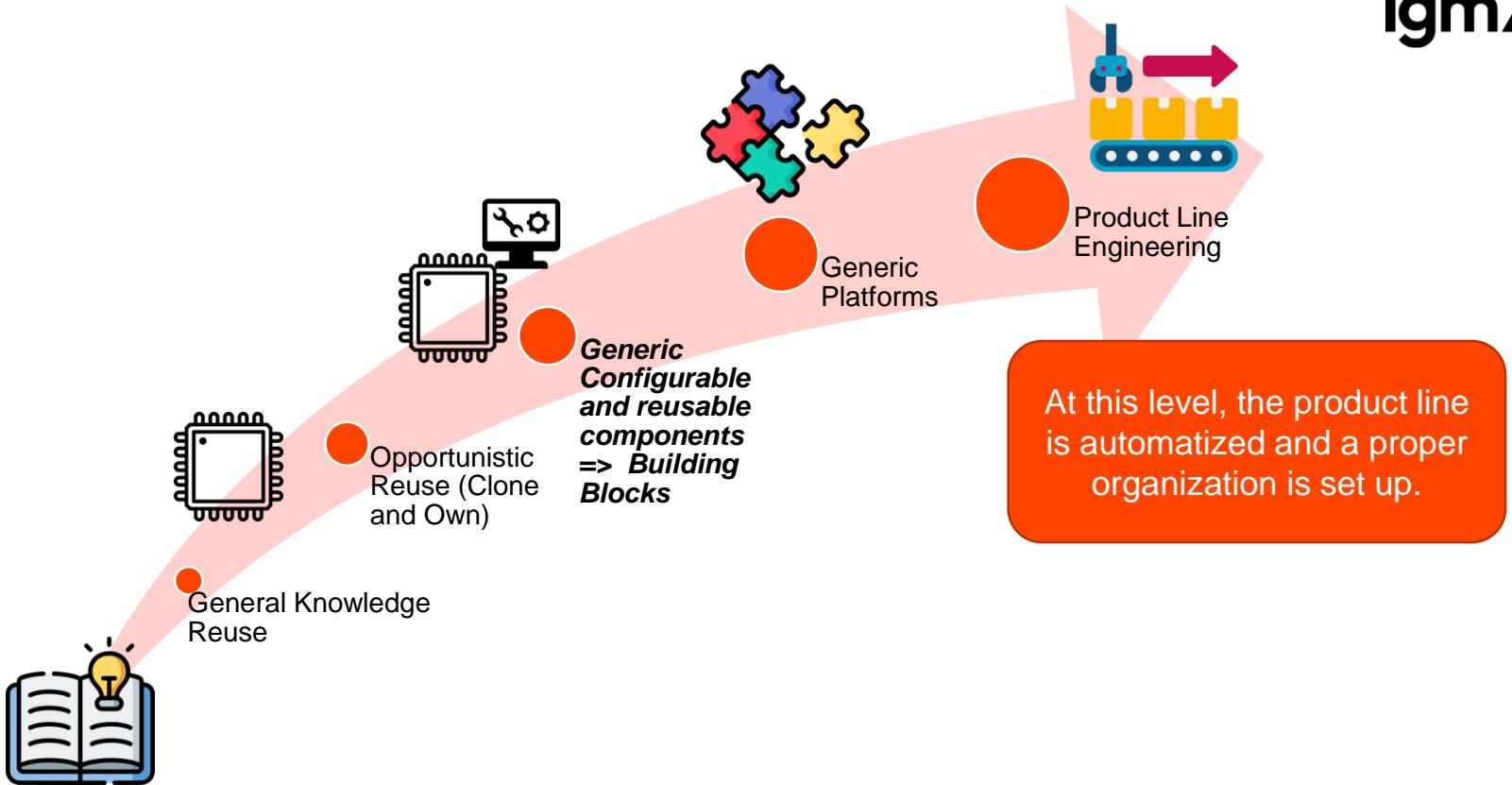
Customer configures the capabilities in a catalogue

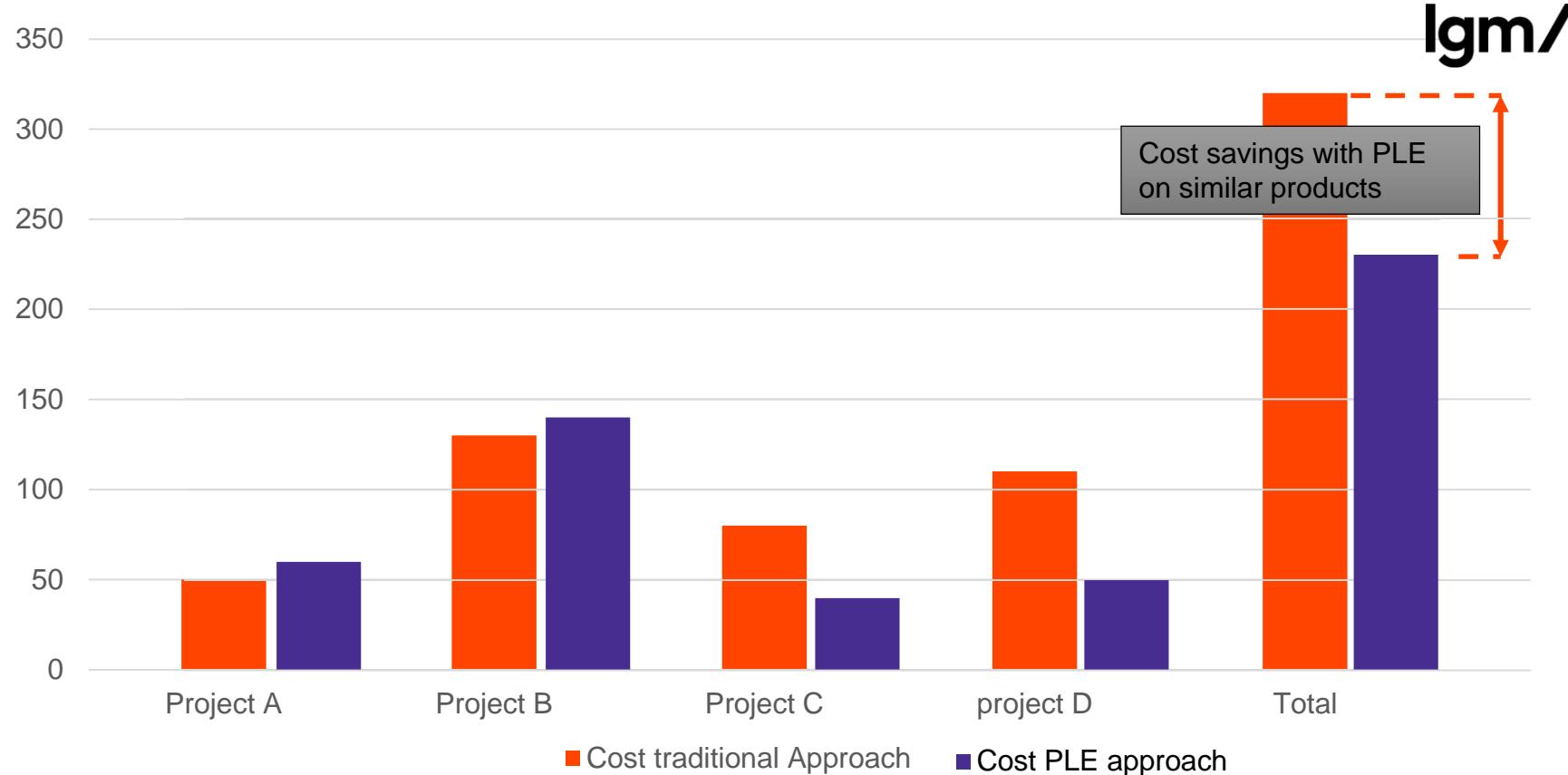
Semi-automated development



Customer receives a product
that satisfies his needs

Configure to Order (CTO)



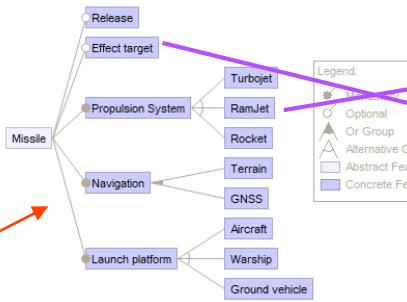
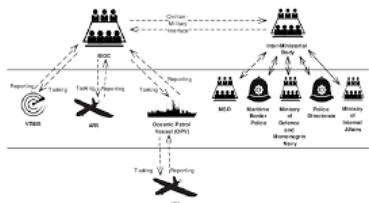


Needs for Reuse Enhancement - vision

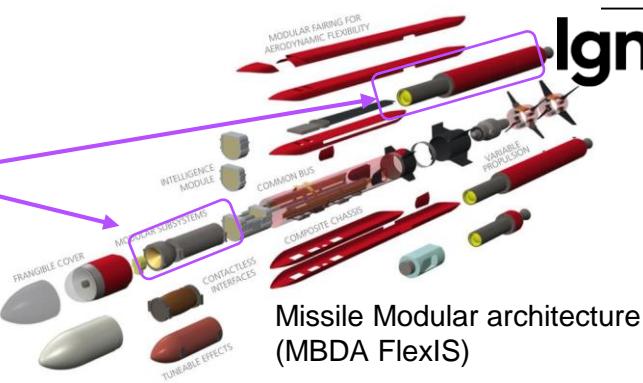
How to reuse efficiently existing systems for the new need ?



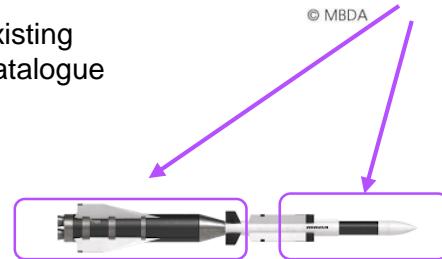
Select existing features in catalogue



Existing Catalogue



Missile Modular architecture (MBDA FlexIS)



Product A



Product C

1

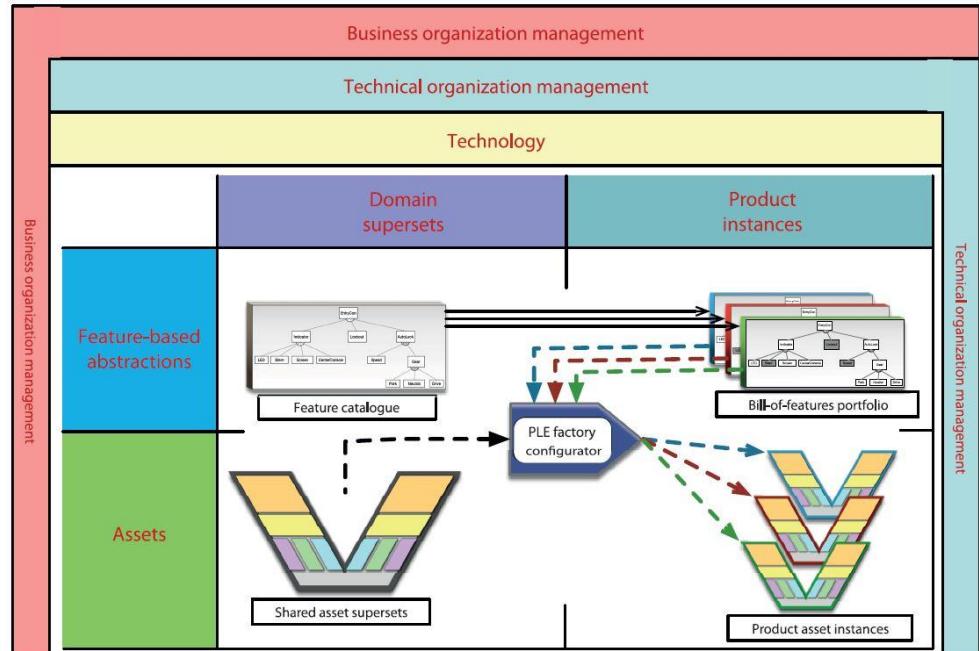
Business organization

2

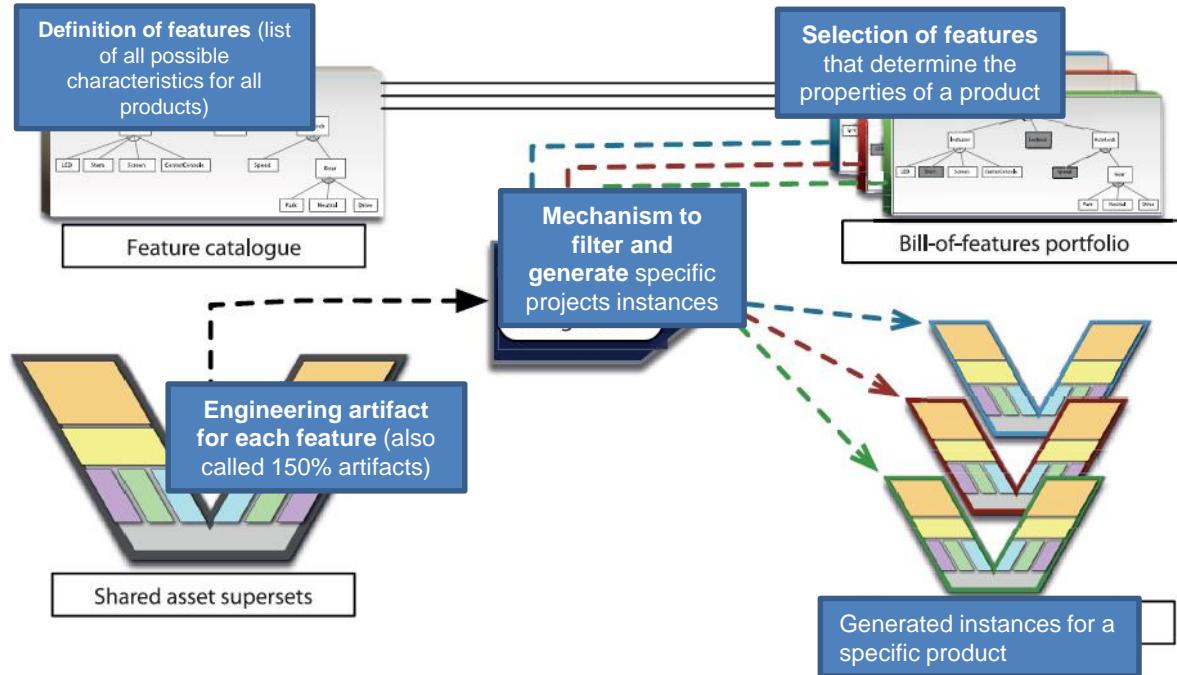
Technical organization management

3

Technology



Reference model for the feature-based approach to software and systems product line engineering





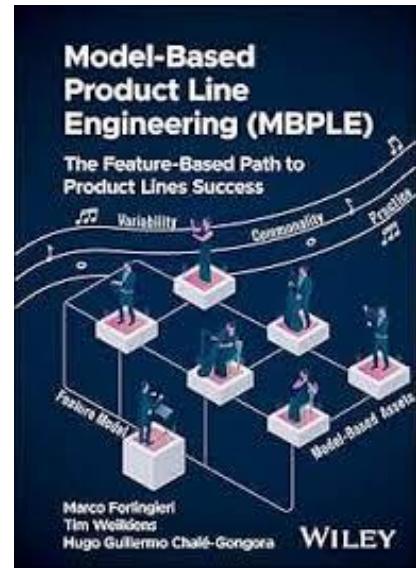
Working
Group PLE

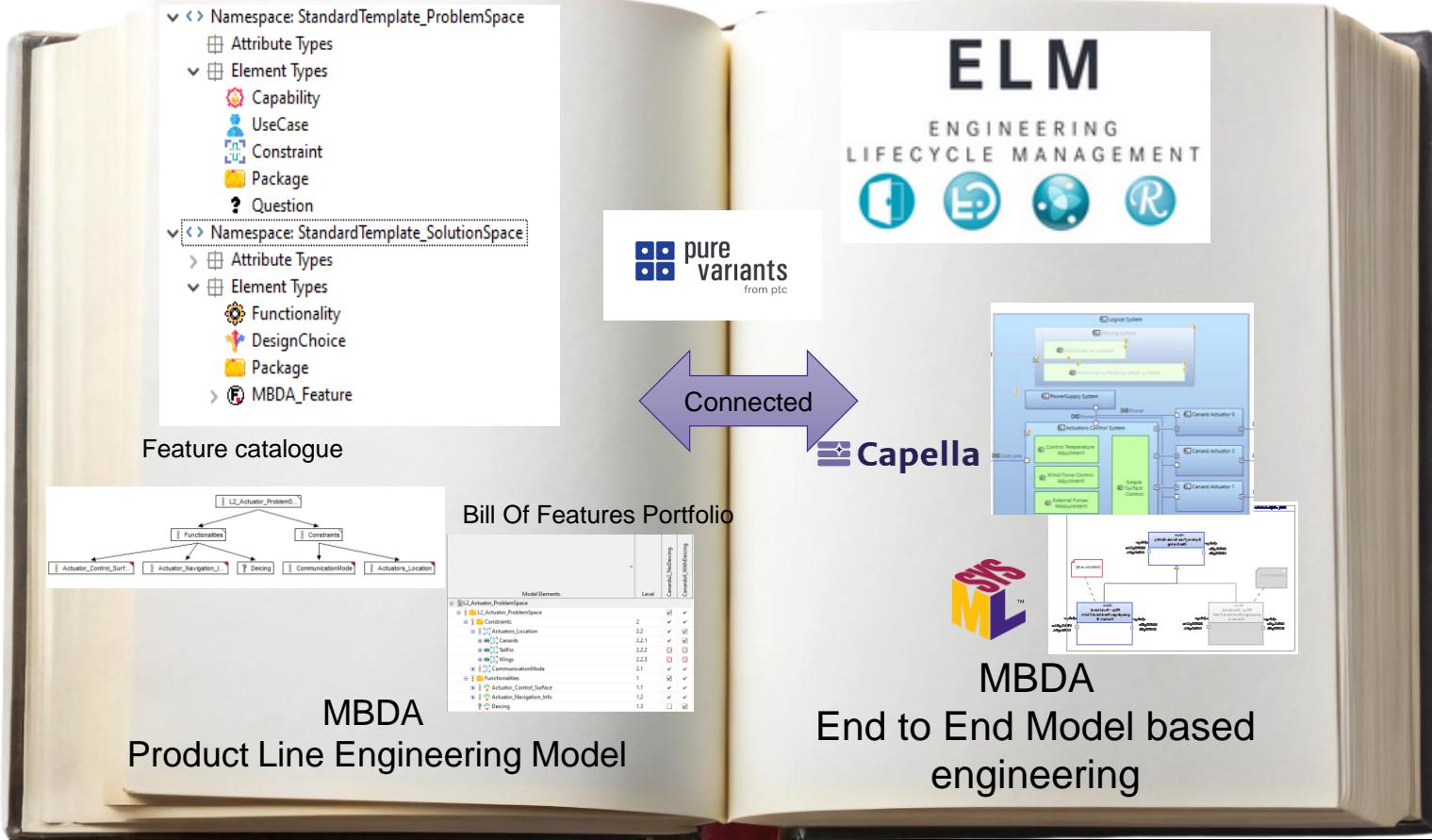
Working
Group
MBPLE

ISO
Standards
26581

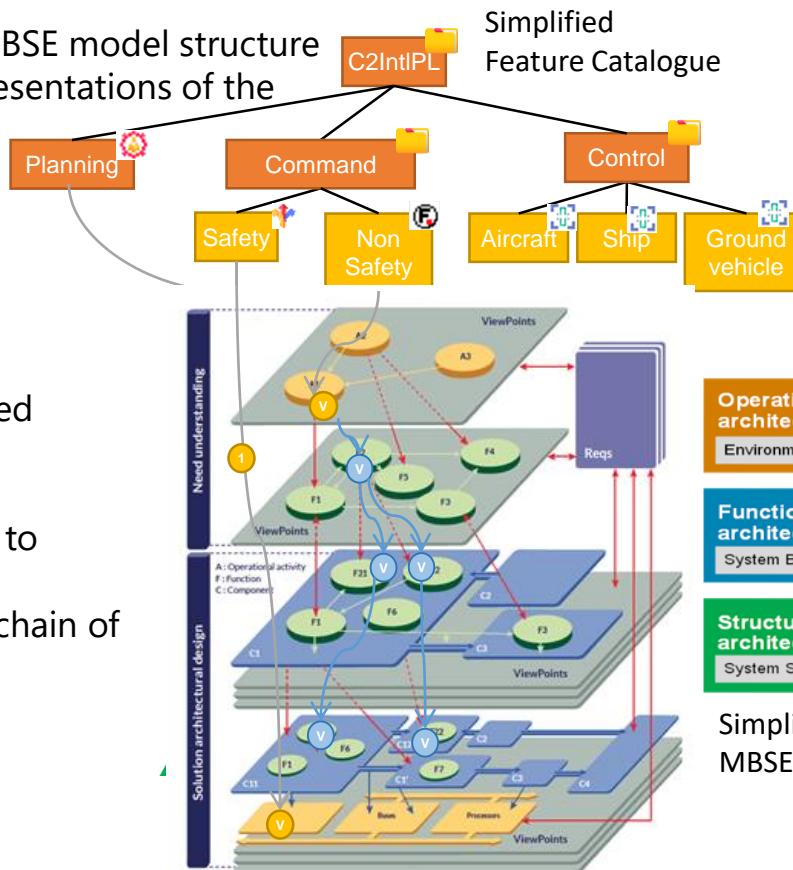
PLE
glossary
(EN-FR)

PLE
metamodel
(tool
agnostic)





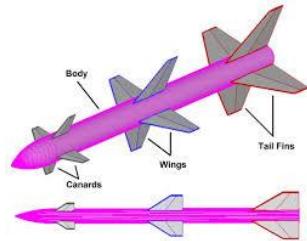
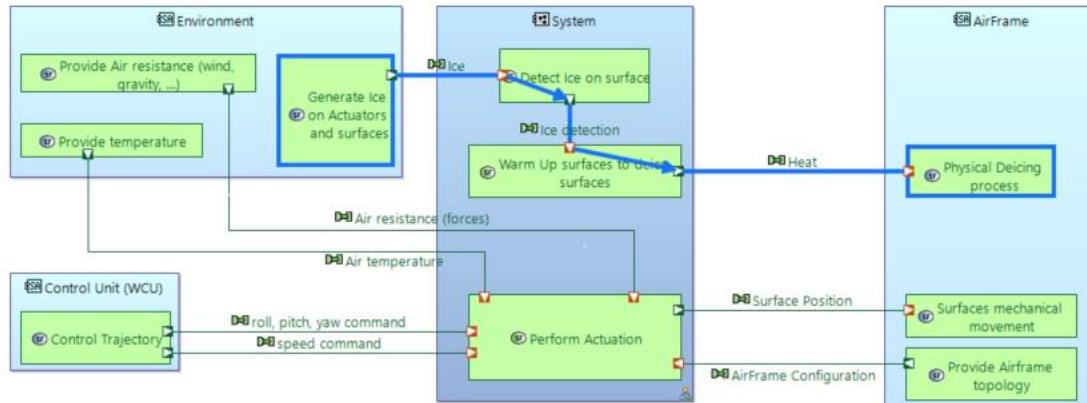
The feature catalogue shall mirror the MBSE model structure to allow an easy navigation in both representations of the 150% product line.



Variability:

- **Atomic Variation points** are assigned directly to a model element.
- **Starting Variation points** are used to minimize the engineering effort by automatic assignment features to a chain of MBSE model elements.

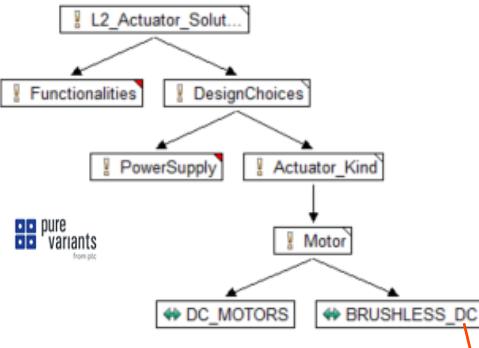
Deicing



- Variability sources
- Kind of actuators
 - Nb of controlled surfaces
 - Deicing

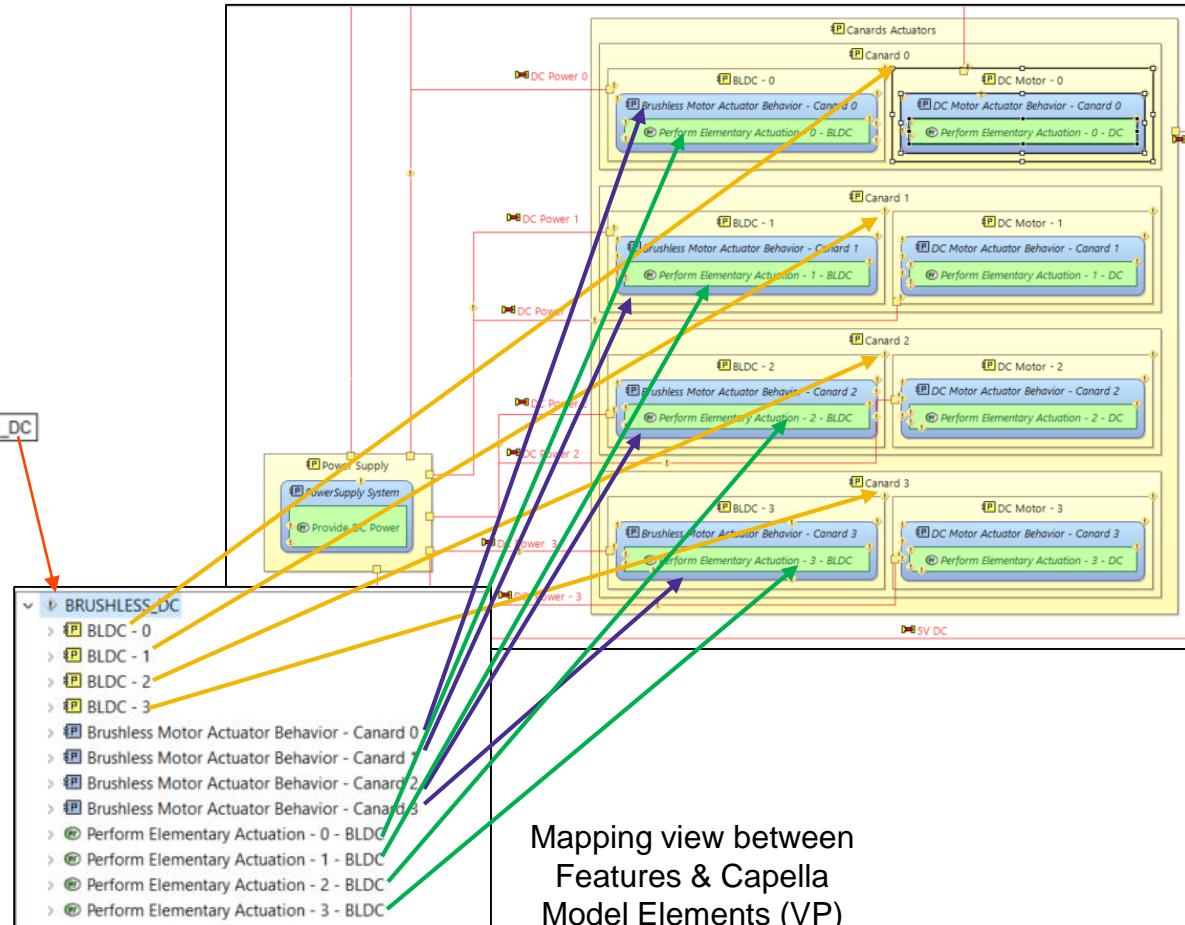
Equipment with a fictive feature « Deicing » in charge to warm up surfaces when ice appears

Feature Catalogue



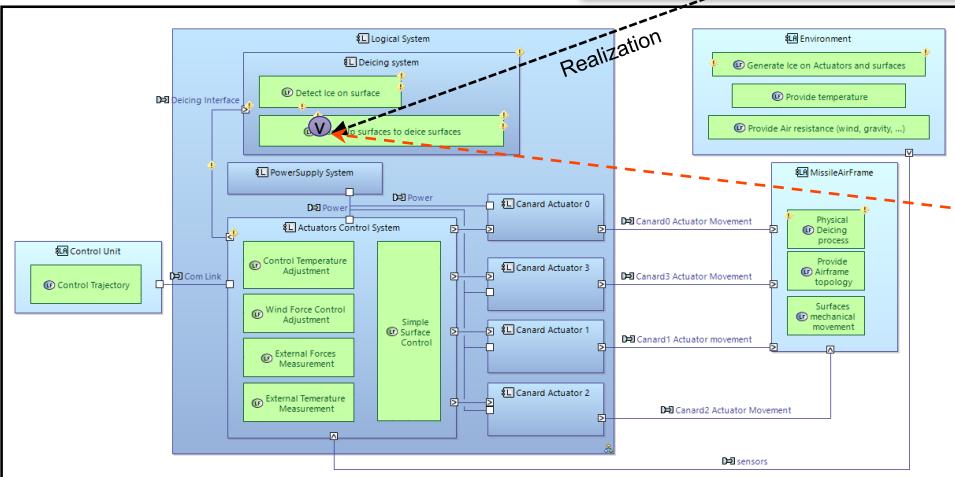
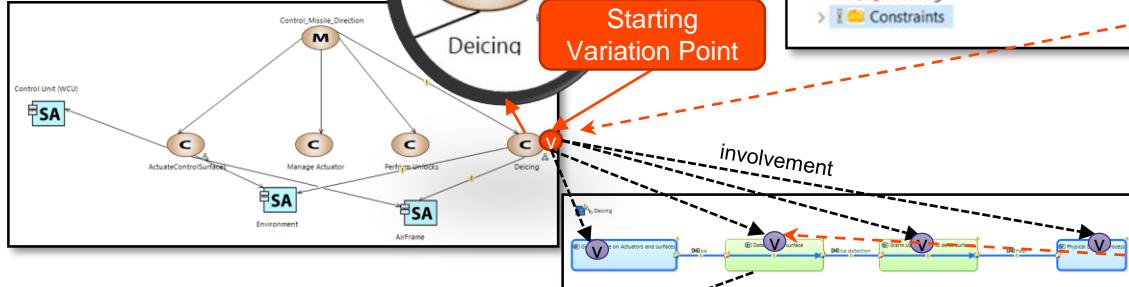
Capella

pure variants
from plc



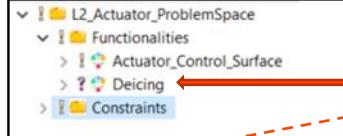
MBSE Model /

Feature catalogue

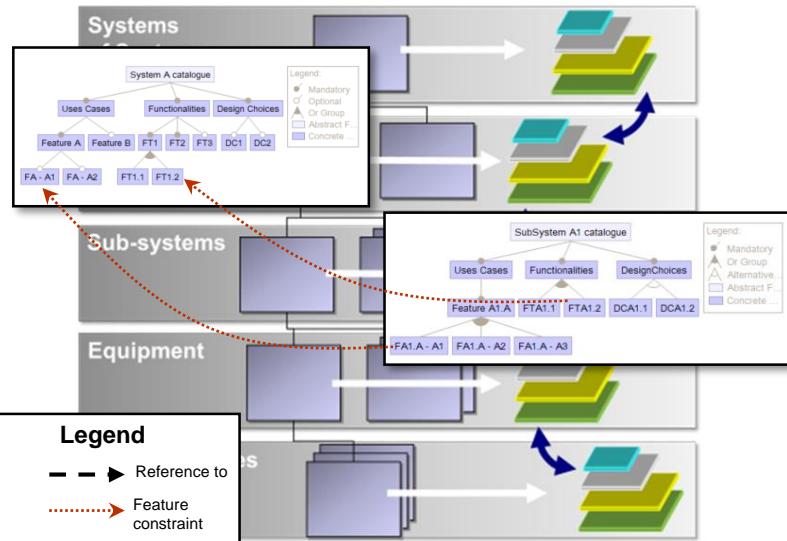


Variation point

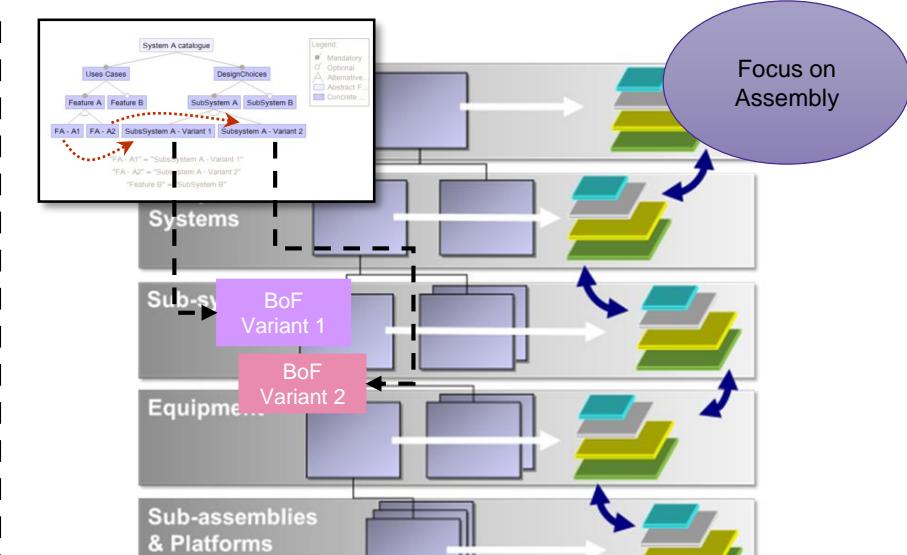
Feature Catalogue



Mapping view between Features & Capella Model Elements (VP)

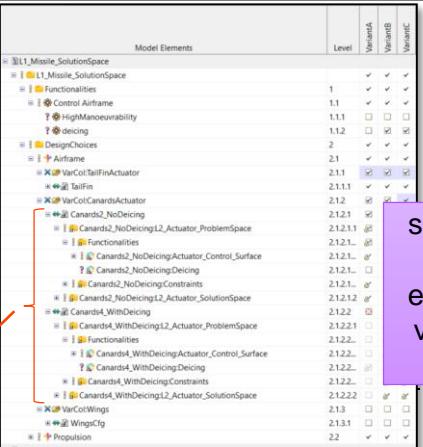
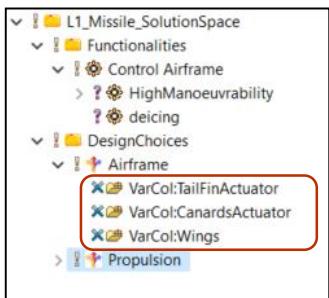
Product breakdown approach (top-down)

High level features are defined at the upper level and refined at the next level following traditional breakdown cycle -> Generally used for new products

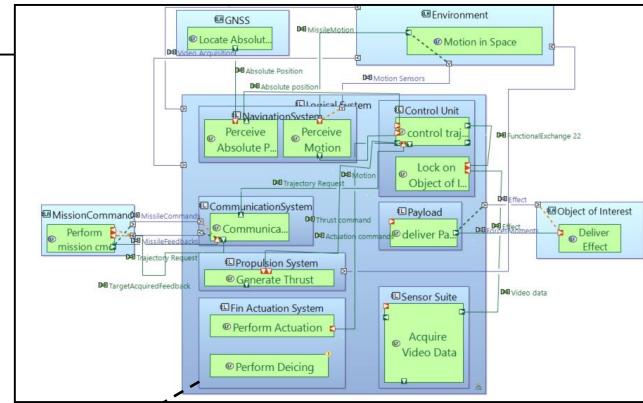
Products Assembly approach (bottom-up)

High Level product integrates existing products in the catalogue.
 In this, case feature catalogue or the system specifies which existing products to assemble -> Generally used for companies which has existing products / perform currently large reuse of existing products.

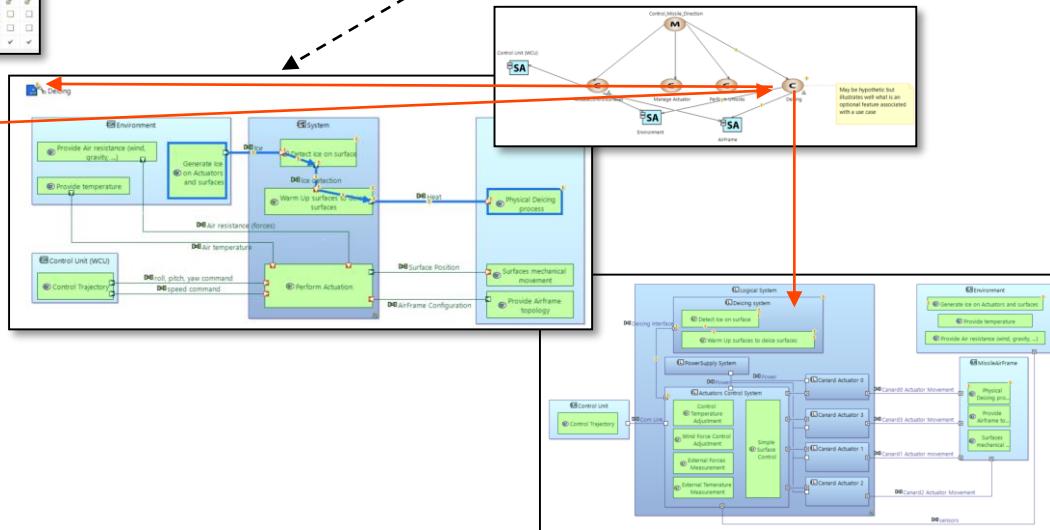
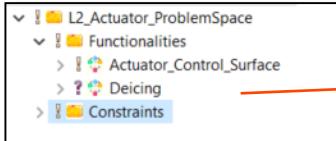
Assembly Strategy - Relations between Capella Models and Feature Catalogue



system level refers
to collection of
existing equipment
variants (products
instances)



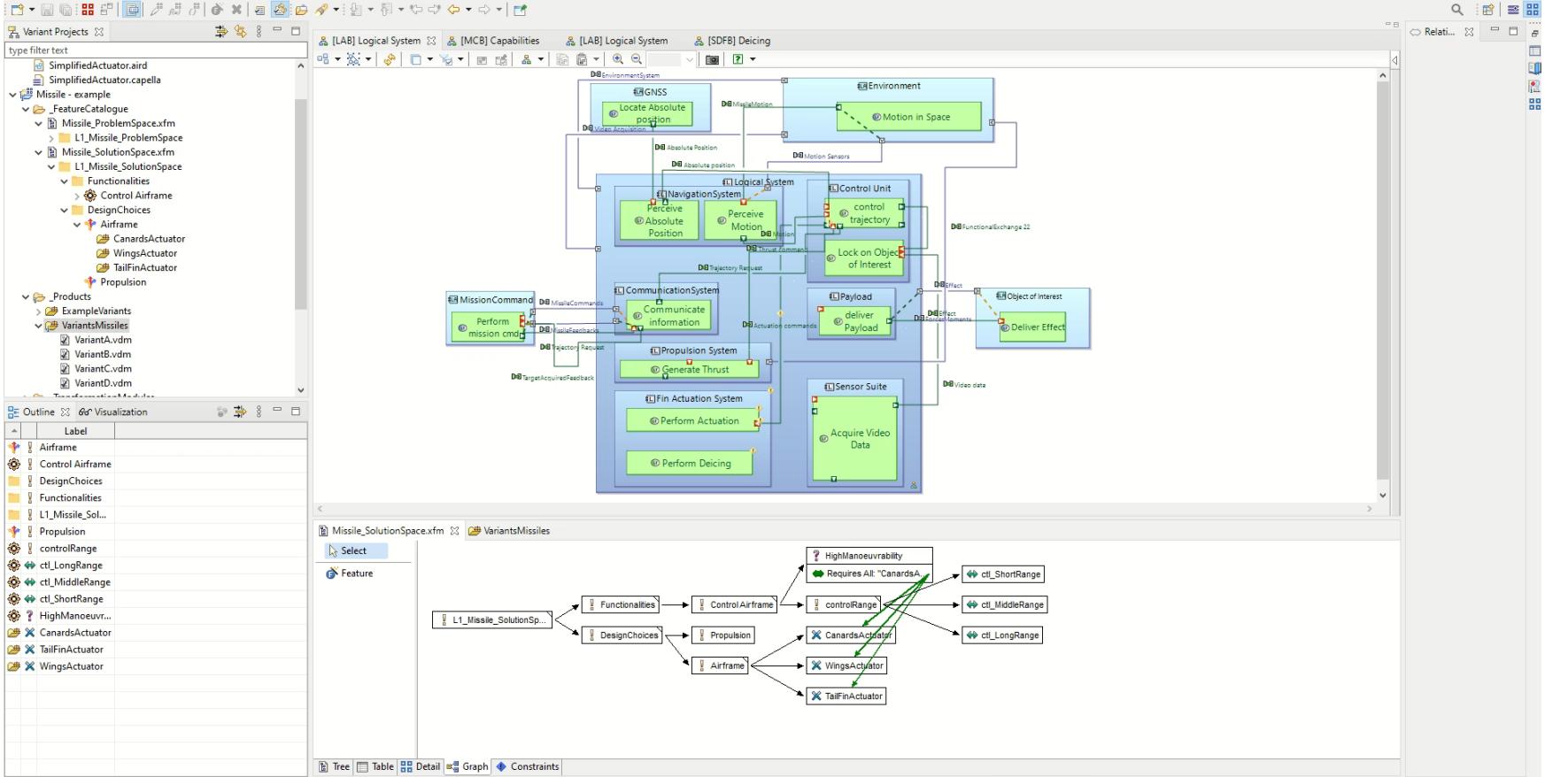
Capella



/ Demo using Capella & Pure Variants – Missile Model

workspace_capella_days - Missile - example/_FeatureCatalogue/Missile_SolutionSpace.xfm - Capella

File Edit Navigate Search Project Run Window Help



/ Demo using Capella & Pure Variants – Actuator Model

workspace_capella_days - platform:/resource/Actuator%20-%20example/SimplifiedActuator.aird/[MCB] Capabilities - Capella

File Edit Diagram Navigate Search Project Run Window Help

Project Explorer [LAB] Logical System [MCB] Capabilities [LAB] Logical System [SDFB] Deicing

SimplifiedActuator.capella

Actuator - example

- SimplifiedActuator.aird
- Actuator - example
 - REC Catalog
 - Operational Analysis
 - System Analysis
 - System Functions
 - Capabilities
 - ActuateControlSurfaces
 - Manage Actuator
 - Perform Unlocks
 - Deicing
 - Interfaces
 - Data
 - Structure
 - Missions
 - Logical Architecture
 - Physical Architecture
 - EPBS Architecture
 - Representations per category
- Missile - example
 - _FeatureCatalogue
 - _Product
 - _TransformationModules
 - Questionnaire_L1_Missile
- Missile - example
 - MissileExample.aird
 - MissileExample.capella

Control Unit

Control_Direction

M

SA

C

AirFrame

SA

C

Deicing

Environment

ActuateControlSurfaces

May be hypothetic but illustrates well what is an optional feature associated with a use case

Missle_SolutionSpace.xfm VariantsMissles L2_Actuator_ProblemSpace.xfm CanardsActuatorCfg

Matrix

Properties Information Semantic Browser Mappings

Mapping Model: capella_actuator Assigned Variant:

type filter text

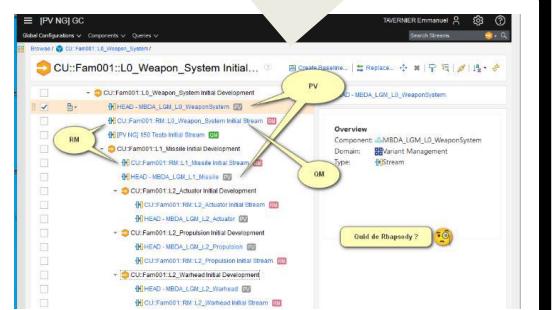
- BRUSHLESS_DC
- ControlledCanards_4
- DC
- WithDeicing

SimplifiedActuator::Actuator - example::System Analysis::Capabilities:[MCB] Capabilities (Synchronized)

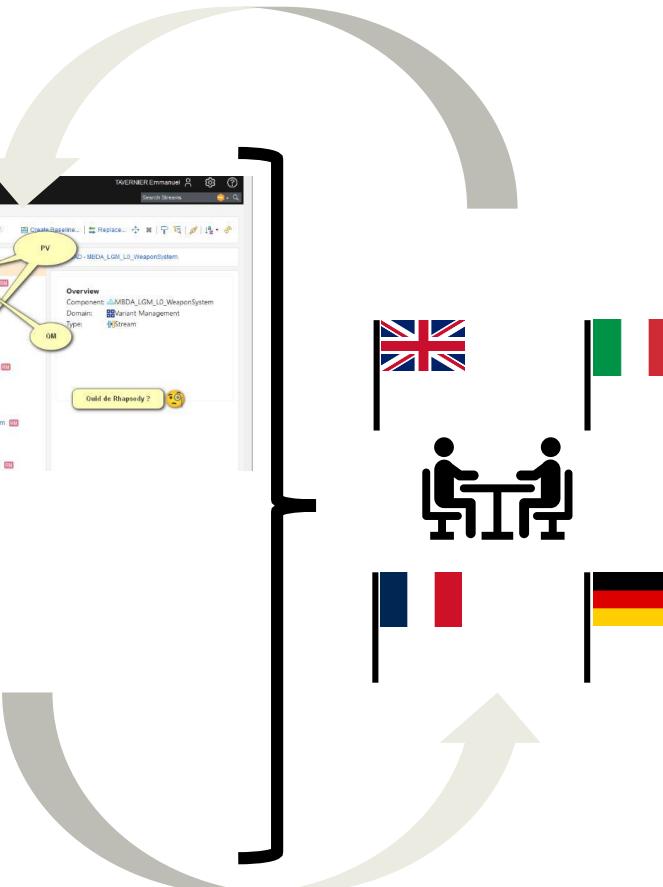
828M of 1000M

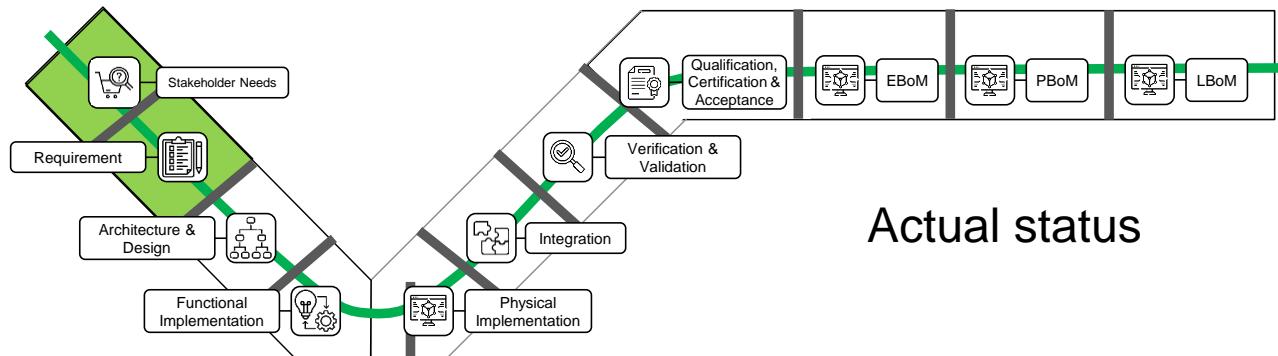
```
graph TD; CU((Control Unit)) -- "Control_Direction" --> M((M)); CU -- "ActuateControlSurfaces" --> SA1[SA]; CU -- "Deicing" --> SA2[SA]; AirFrame((AirFrame)) -- "AirFrame" --> SA1; AirFrame -- "Deicing" --> SA2; Environment((Environment)) -- "Environment" --> SA1; C1((C)) -- "SA" --> SA1; C2((C)) -- "SA" --> SA2;
```

- Enhance the process with :
 - Configuration management
 - Additional Engineering practices e.g. common questionnaire

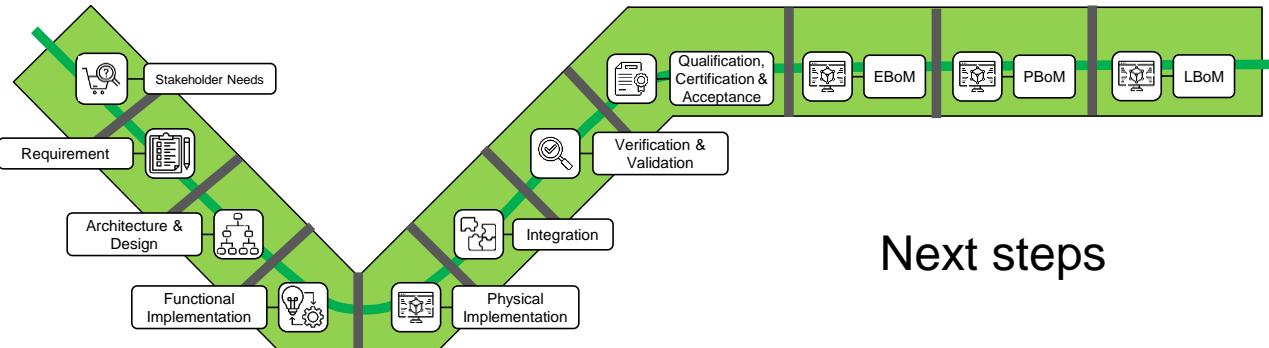


- Guiding Change Management :
 - Guidelines :
 - PLE Concepts
 - PLE MBSE (Rhapsody/Capella/DNG)
 - PLE Factory
 - Illustrated Examples based on MBDA tools
 - E-learning supports :
 - PLE
 - Tools





Actual status



Next steps

- MBPLE is a key enabler for efficient reuse by providing a strong governance
- Setup PLE in Organization requires appropriate definition set of Processes, Methods & Tools
- Need a mindset change and organizational changes to increase efficiency
- Configuration Management Process and strategy for Product assets instances and Product Line Assets Change Management is crucial



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