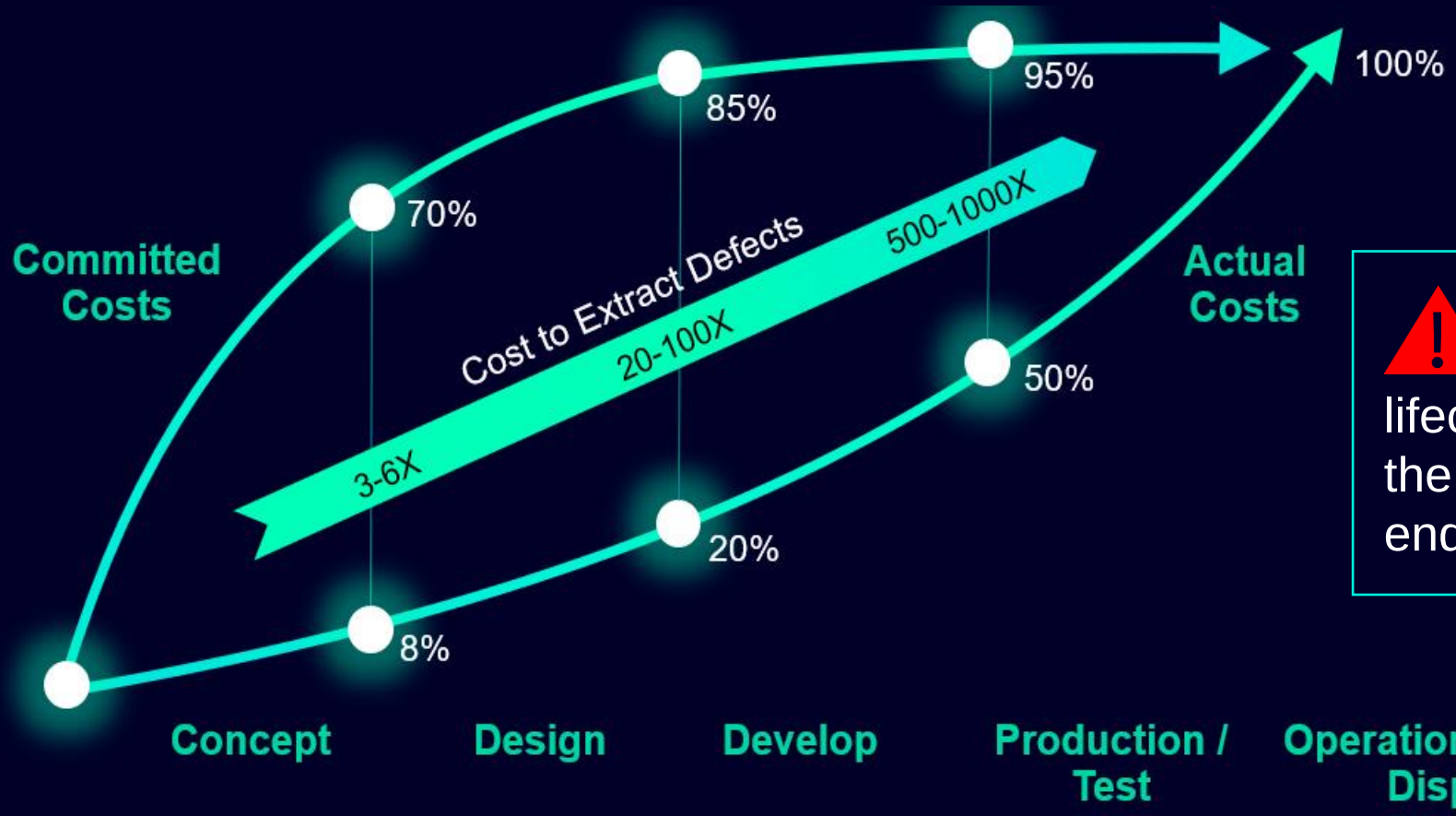
SIEMENS

SYSTEM MODELING WORKBENCH

Aligning Configurations, Enhancing Collaboration, and Improving User Experience

Albino PEREIRA
MBSE Product Management

MBSE Enables Shifting-Left



70% of the project/program lifecycle costs are committed during the first **8%** expended cost, by the end of the concept design phase

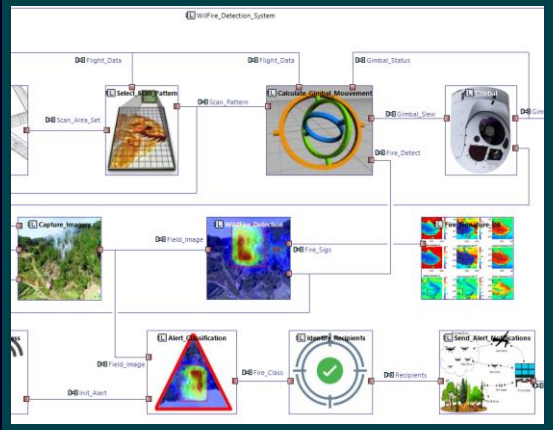
Source: INCOSE

SIEMENS

MBSE Strategy – Teamcenter as the backbone

Unified System Architecture ensures compliant interface implementation, streamlining all downstream design and development activities

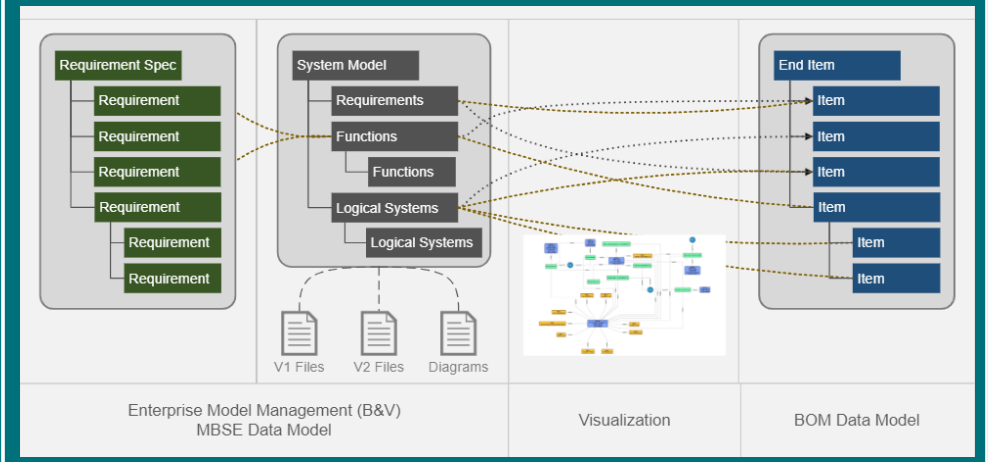
MULTI-TOOL SYSTEM MODELING



SMW · Rhapsody · CAMEO · SysML v2

MBSE SERVICES

TEAMCENTER
SYSTEM LIFECYCLE MANAGEMENT



Common architecture Information Model, Model Mgt., Traceability, Configuration, Change Mgt., MBSE Services

MBSE SERVICES

MULTI-DOMAIN ENGINEERING

SOFTWARE — Polarion

ELECTRICAL — Capital

ELECTRONICS — Xpedition

MECHANICAL — NX

SIMULATION — Simcenter

RAMS — MADE

"Shift-Left" strategy enables to identify and rectify issues before implementation using early system architecture verification and optimization

Verification & Validation Physical and digital simulation / test

MULTI-DOMAIN MODEL MANAGEMENT Branch & Merge, Version control

ONE PLATFORM common traceability, change, configuration, libraries, collaboration, safety, cybersecurity

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Teamcenter MBSE

A comprehensive Tier Solution Packaging for SaaS / Teamcenter X and On-Premises

	Pre-packaged MBSE Solutions			Tailored Solutions
	ESSENTIALS	**STANDARD**	**ADVANCED**	**PREMIUM**
Digital Thread Navigation	✓	✓	✓	Any MBSE products “a la carte”
Requirements Management	✓	✓	✓	
Test & Verification Management		✓	✓	
Parameter Management		✓	✓	
System Lifecycle Management			✓	

Supplemental add-on capabilities
(contact Siemens for the complete list of add-ons)

- Requirement Integrator
- PHM MADE and integration
- Polarion direct integration
- MBSE integration services

- Teamcenter Simulation
- Integration to Simcenter HEEDS
- Integration to Simcenter AMESIM
- Parameter integration to NX

- System Modeling Workbench
  - System Modeling with IBM Rhapsody
  - Integration to Cameo
  - Integration to Capital System

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Let’s Explore SMW

1. Integrate Product Configurator to System Architecture
2. Integrate with Teamcenter Supplier Collaboration
3. Early Architecture Optimization and Verification
4. Multi-Domain Engineering Integration

Integrate Product Configurator to System Architecture

Enable product configuration (150%) aligned with system architecture for seamless and consistent transition to detailed design

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Teamcenter Product Configurator Integration

Variability

Product Lines | Families | Constraints | Variants
Models | Features | Conditions | Buildable Combinations

Systems (150%)

- Requirements
- Features
- Architecture

SMW

Design (150%)

- Geometry Design
- HW Design
- SW Architecture

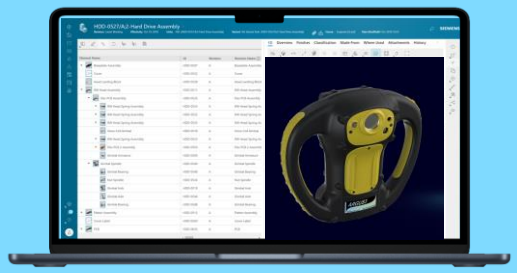
Parts (150%)

- Mechanical
- Electrical
- Electronics
- Software

Manufacturing

- Production & ERP
- Plant BOP
- Process

100% Configured Product



Sellable
Validated
Buildable
Visual

Change & Lifecycle Control

Open Configurator Service

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runtime-runtime with spaces - platform:/resource/In-Flight%20Entertainment%20System/In-Flight%20Entertainment%20System.aird/[LAB][CTX] Watch Imposed Video on Cabin Screen FC - System Modeling Workbench

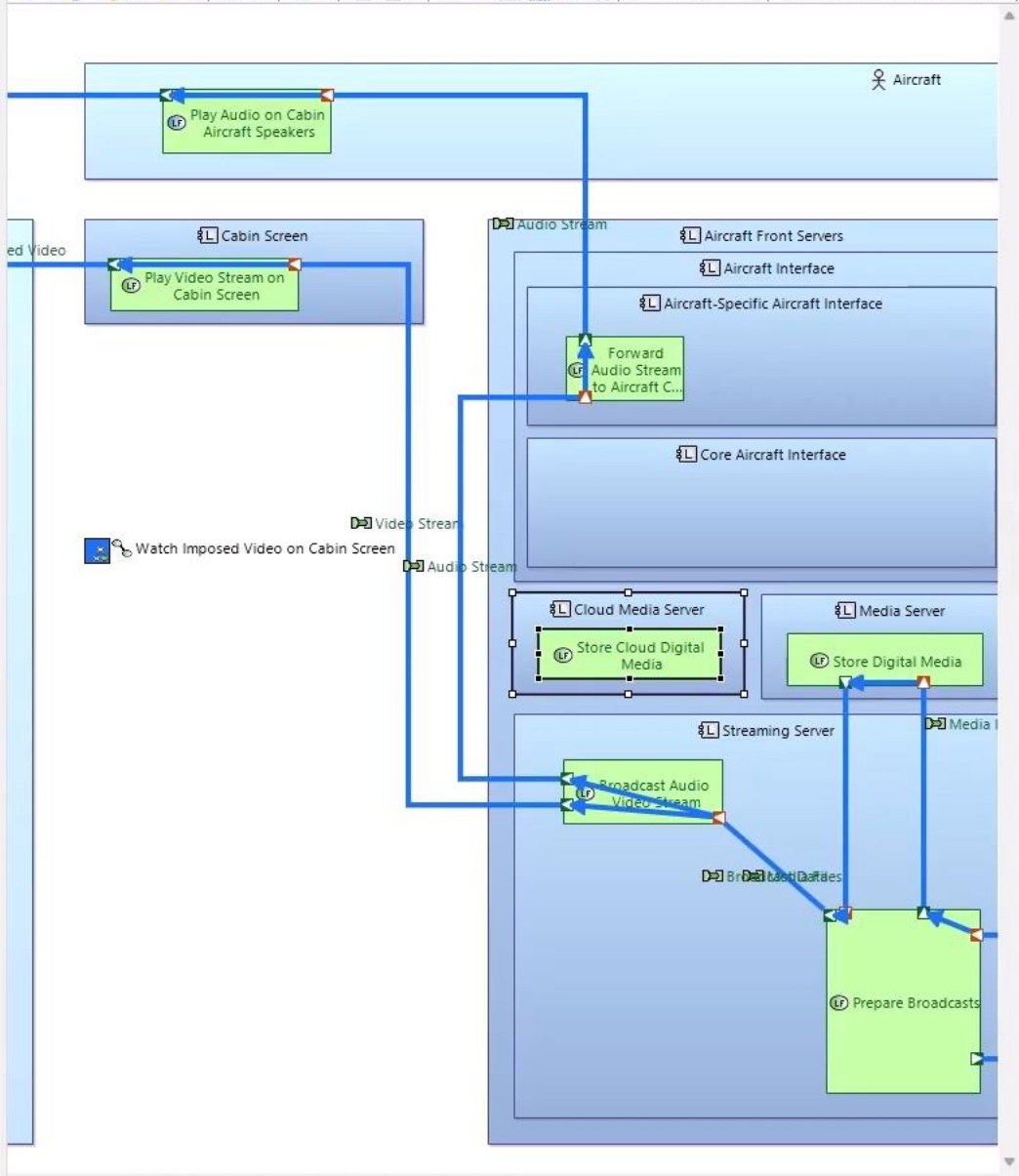
File Edit Diagram Navigate Search Project Run Releng Window Help

Project Explorer

* = any string, ? = any character, \ = escape for literals: *?\

- 001761/A - In-Flight Entertainment System
  - In-Flight Entertainment System.aird
    - In-Flight Entertainment System
    - Representations per category
    - platform:/resource/In-Flight%20Entertainment%
  - DefaultCapellaToSysml1.4Conversion.cfg
  - DefaultSysml1.4ToCapellaConversion.cfg
  - images
  - In-Flight Entertainment System.afm
  - In-Flight Entertainment System.capella
- 001314/A - testVariants

In-Flight Entertainment System | [LAB][CTX] Watch Imposed Video on Cabin Screen FC



Teamcenter Product Configurator

Variant Conditions | Variant Configuration

Revision: Any Status; Working (Modified) | Effectivity: All Dates | Rule Date: 06-Mar-2025 15:41

Show All... | Validate All | Edit

Object	Cloud Media Server	Store Cloud Digital Me...
Aircraft Type		
Long-haul	✓	✓
Short-haul		
Flight Type		
Domestic		
International	✓	✓
Transoceanic	✓	✓
Internet Connectivity		
Air-to-ground	✓	✓
High-speed satellite	✓	✓
Not connected		
Media Type		
BYOD	✓	✓
Live TV		
On-demand Streaming		
Transport Type		
Cargo		
Government	✓	✓
Military		

In-Flight Entertainment System/In-Flight Entertainment System.aird

983M of 3588M

Integrate with Teamcenter Supplier Collaboration

Integrate systems modeling tools to enhance traceability, collaboration, and change management across the supply chain

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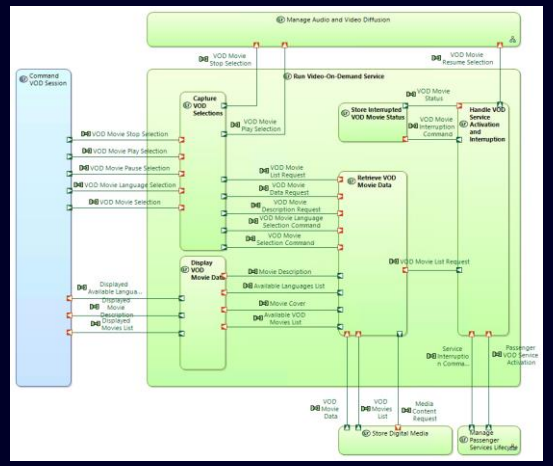
Secure and seamless collaboration with any supplier

OEM

System Architect



Partner Connect

Live edit

Supplier Connect

Teamcenter site 2

Direct edit or Offline edit

Native CAD or JT

Suppliers & Partners

Supplier 1

Safety Analyst, EE architect …

Supplier 2

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Early Architecture Optimization and Verification

Early identification and resolution of concept design issues, reducing risks, lowering costs, and accelerating development cycles

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Integration to HEEDS Multidisciplinary Design Analysis and Optimization

Quickly iterate on 1000's of concepts to optimize product architectures

Conceptual Design

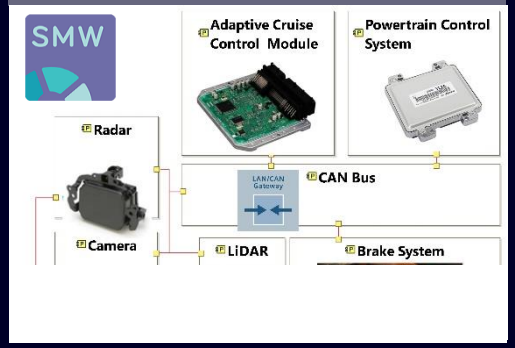
Requirements

1.3.1.1.2 VTR-000285-Pedestrian Protection

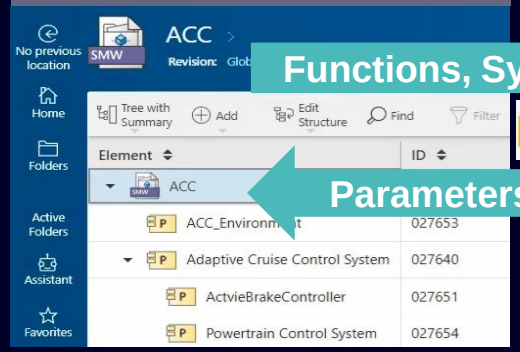
A PAEB system is a crash avoidance system that uses information from forward-looking sensors to automatically apply or supplement the brakes when the system determines a pedestrian is in danger of being hit by a vehicle. PAEB systems typically use cameras, but some also use a combination of cameras and radar sensors.

Missions Scenario Modeling

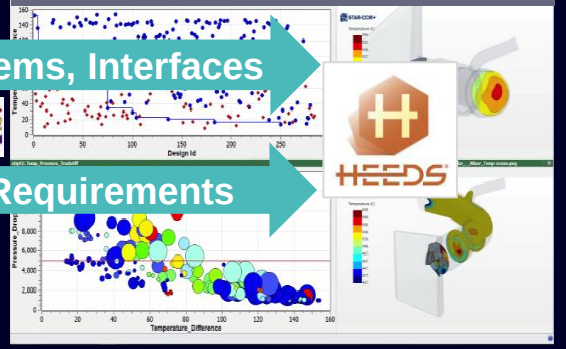
Functional System Models



System of Systems Arch.



Architecture Exploration & MDAO



Functions, Systems, Interfaces

Parameters, Requirements

Preliminary Design

Product Design

Test & Cert

Production

Sustainment

Optimized Product Architecture and Design that satisfies full mission set drives the full lifecycle

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HEEDS MDO - Braking disc optimization of holes.heeds *

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File | Home | Discover | Plot | Investigate | Plot View Tools | Animation Controls

mdo | post

Step Back | Play | Stop | Step Forward | Record

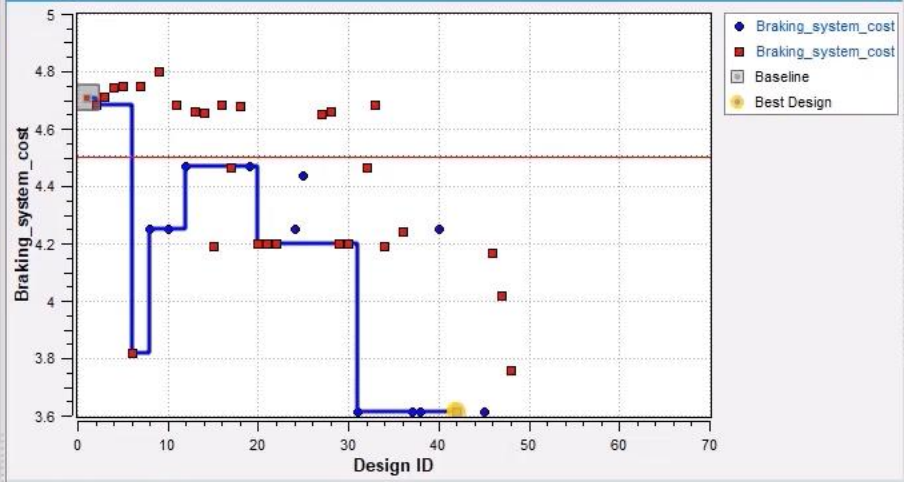
Speed: 79% | Loop animation | Total time: 35 seconds | Design ID: 48

Animate design appearance | Animate design selection

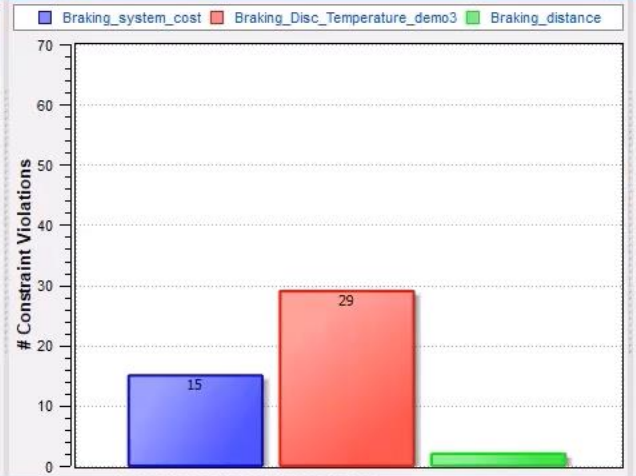
Animation | Options

- Braking disc opti... *
  - Study_1_report
  - SingleOpt_2
  - Study_1
    - Design Sets
    - Plots
      - Objective History
      - Parallel Data
      - Design Table
      - Thermal...
      - Performance Hist...
      - Braking_Disc_hole
      - Objective_temper...
      - Objective cost
      - Cost
      - Model_11
      - Model_12
      - 2D_Constraints
      - Relation3D_14
      - Design Space
      - Constraint Violati...
      - BrakingDistance
      - Constraints_Braki...
      - Constraints_Braki...
      - Constraints_Braki...
      - History_Cost_Only
    - Plot Views
      - View_1
      - View_2

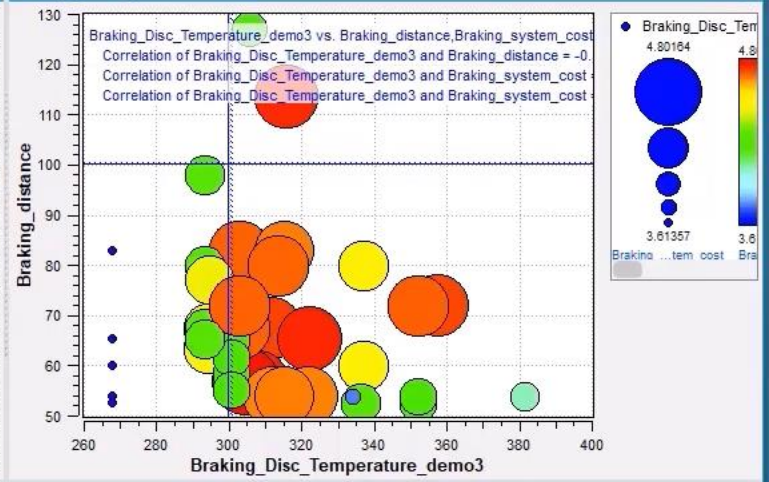
Study_1: Cost



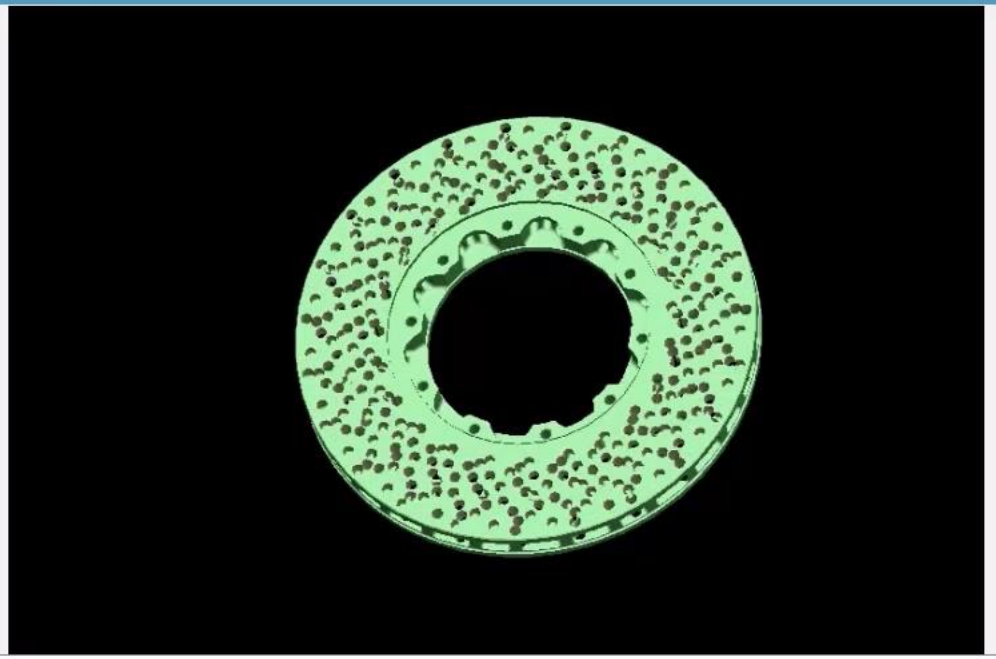
Study_1: Constraint Violations



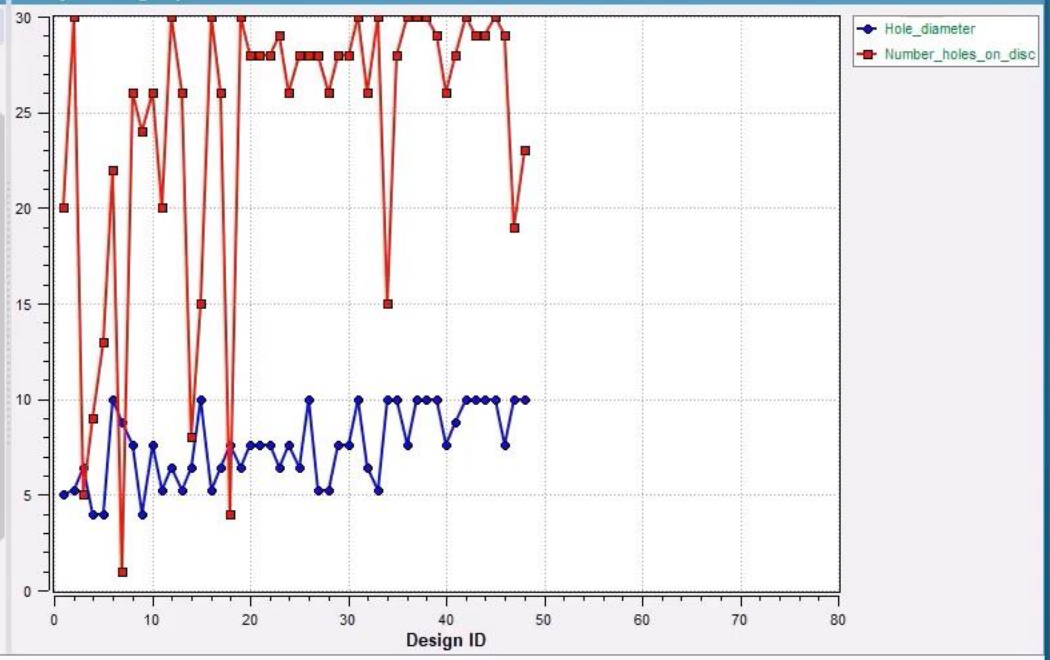
Study_1: 2D_Constraints



Study_1: Model_12



Study_1: Design Space



Start the animation.

Multi-Domain Verification with Integrated Simulation

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REQUIREMENTS, PARAMETERS, TEST CASES

5.28 REQ-000050- Refuel Fill Time

The maximum fuel fill time for aircraft shall not exceed [specify time] from the initiation of fueling to the completion of the process. This time includes all necessary procedures, such as fueling equipment setup, fuel transfer, and any required safety checks.

Rationale:

- Operational Efficiency: Efficient fuel fill times are crucial to minimize ground time for aircraft, allowing for optimal utilization of resources and maintaining on-time departures.
- Cost-effectiveness: Shorter fuel fill times reduce the labor and equipment costs associated with fueling operations, contributing to cost-effectiveness for operators.
- Passenger Convenience: Faster fueling times help minimize delays for passengers and improve overall travel experience.
- Safety Considerations: While efficiency is important, it should not compromise safety. Fueling procedures and equipment must adhere to safety protocols to ensure the process is conducted without any incidents or hazards.

Compliance: Aircraft manufacturers shall design aircraft fueling systems and fuel ports to accommodate fueling equipment capable of meeting the specified fuel fill time. Fueling infrastructure providers, including airports and airfields, should ensure that fueling equipment and procedures are designed and maintained to support the specified fuel fill time. Operators and fueling personnel shall be trained on efficient fueling practices, ensuring adherence to established procedures to achieve the specified fuel fill time. The refueling fill time must be less than 2000 seconds for single side refueling.

5.29 REQ-000058- Hydrogen Tank Temperature

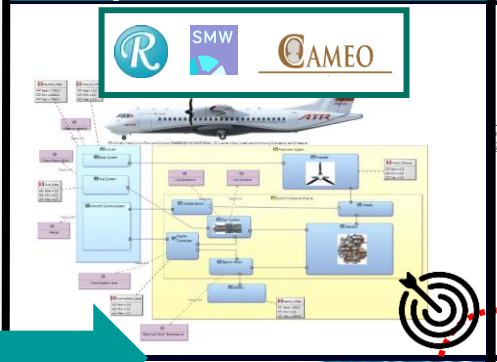
Liquid hydrogen ($H_{2(l)}$) is the liquid state of the element hydrogen. Hydrogen is found naturally in the molecular H_2 form.

To exist as a liquid, H_2 must be cooled below its critical point of 33 K. However, for it to be in a fully liquid state at atmospheric pressure, H_2 needs to be cooled to 20.28 K (−252.87 °C; −423.17 °F).

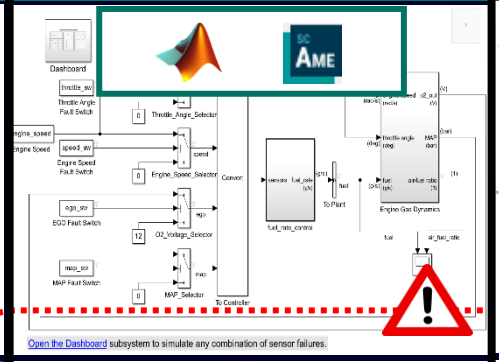
A dedicated thermal management system needs to be design to ensure that the hydrogen Tank Temperature must stay at -253°C during refueling, take-off-cruise and landing. This creates different scenarios to be validated, with temperature ranges

MULTI-DOMAIN VERIFICATION WITH SIMULATION

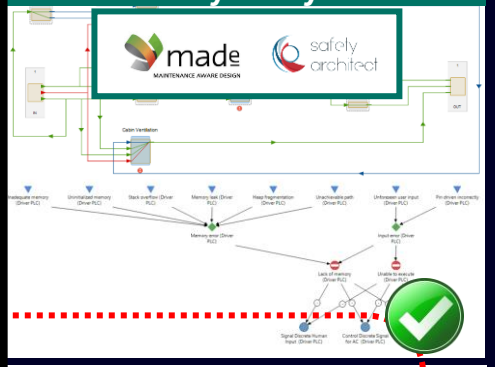
System Architecture



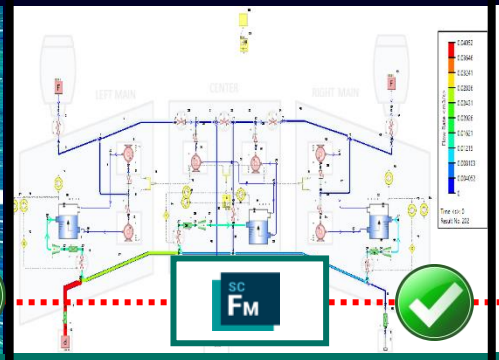
Cooling Control



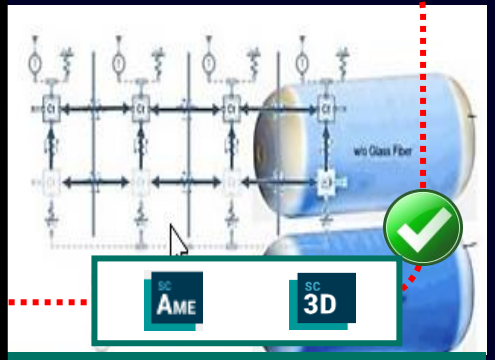
Safety Analysis



Heat Management



Flow Analysis (Refueling)



Fatigue Analysis

Common traceability, change, configuration, libraries

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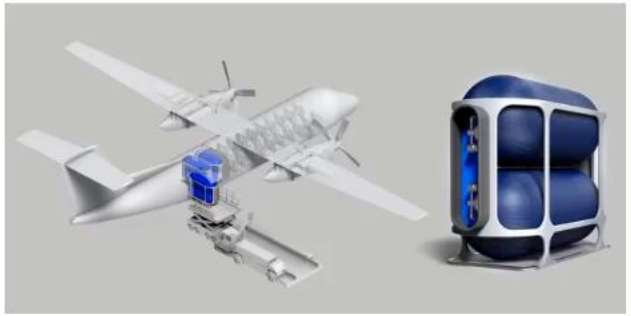
5.5 Power source
5.6 Noise Level
5.7 Cruise Altitude
5.8 Propulsion System
5.9 Electrical Motor Power
5.10 Electrical Motor Rotational Speed
5.11 Electrical Motor Torque
5.12 Electrical Motor Temperature
5.13 Conventional Jet Engine
5.14 Cruise Velocity
5.15 Operating cost
5.16 Cost of acquisition
5.17 Cost of maintenance
5.18 Range
5.19 Rate of climb
5.20 Fly control System
5.21 Design
5.22 Aircraft Weight
5.23 Payload
5.24 Battery weight
5.25 Fuel Weight
5.26 Empty weight
5.27 Maximum Take Off weight
5.28 Refuel Fill Time
5.29 Hydrogen Tank Temperature
6 Performance Evaluation Test Methods
7 Annex A

5.28 REQ-000050- Refuel Fill Time



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A dedicated thermal management system needs to be design to ensure that the hydrogen Tank Temperature must stay at -253°C during refueling, take-off-cruise and landing. This creates different scenarios to be validated, with temperature ranges from +50 to -20.

To achieve this an electrical engine will be controlled and shall have the proper rotational speed and torque.

SMW029145/A;2-In-Flight Entertainment System

No Active ECN

SIEMENS

In-Flight Entertainment System > Root Logical Function > IFE System > Manage Audio and Video Diffusion > Display Video and Play Audio > Display Imposed Video Playing Status on Cabin Terminal

Revision: Global (Latest Working) | Date: Today | Units: None | Variant: No Variant Rule | Expansion: No Rule | Owner: Jagtap, Dipti (dipti) | Date Modified: 15-Jun-2020 | Release Status: | Type: Project Model Revision

Reset View | Filter | Configure | Configuration Settings | New | Merge Bars

Add | Edit Structure | Find | Expand | Duplicate | Selection Mode | Select All | Show or Hide... | Edit

Element	ID	Revision	Revision Name
Run Services	SMW029345	A	Run Services
Provide Aircraft Interface	SMW029353	A	Provide Aircraft Interface
Provide Access to Digital Media	SMW029310	A	Provide Access to Digital Media
Manage Audio and Video Diffusion	SMW029368	A	Manage Audio and Video Diffusion
Manage Passenger Services Lifecycle	SMW029312	A	Manage Passenger Services Lifecycle
Manage Audio and Video Diffusion	SMW029368	A	Manage Audio and Video Diffusion
Display Video and Play Audio	SMW029366	A	Display Video and Play Audio
Process Audio Announcement	SMW029315	A	Process Audio Announcement
Broadcast Stored Audio and Video	SMW029317	A	Broadcast Stored Audio and Video
Process Audio Video Requests	SMW029360	A	Process Audio Video Requests
Display Video and Play Audio	SMW029366	A	Display Video and Play Audio
Receive Imposed Video Playing Status	SMW029348	A	Receive Imposed Video Playing Status
Play Audio-Video Stream on Seat TV	SMW029342	A	Play Audio-Video Stream on Seat TV
Display Audio Interruption Screen on Seat TV	SMW029367	A	Display Audio Interruption Screen on Seat TV
Display Imposed Video Playing Status on Ca...	SMW029343	A	Display Imposed Video Playing Status on Cabin Term...
Play Video Stream on Cabin Screen	SMW029373	A	Play Video Stream on Cabin Screen
Receive Imposed Video Playing Status	SMW029348	A	Receive Imposed Video Playing Status
Display Audio Interruption Screen on Seat TV	SMW029367	A	Display Audio Interruption Screen on Seat TV
Play Video Stream on Cabin Screen	SMW029373	A	Play Video Stream on Cabin Screen
Display Imposed Video Playing Status on Ca...	SMW029343	A	Display Imposed Video Playing Status on Cabin Term...
Play Audio-Video Stream on Seat TV	SMW029342	A	Play Audio-Video Stream on Seat TV
Root Physical Function	SMW029190	A	Root Physical Function

Details

Display Imposed Video Playing Status on Cabin Terminal

Name: SMW029343/A;1-Display Imposed Video Playing Status on Cabin Terminal

More...

Edit

Overview | RAM Data | Diagrams | Requirements | FHA | Parameters | Interfaces | Relations | Where Used | Documents

Progress

Draft | To be discussed | To be reviewed | Rework Necessary | Under Rework | Reviewed OK

Properties

ID: SMW029343
Revision: A
Revision Name: Display Imposed Video Playing Status on Cabin Terminal
Description:
Occurrence Name:
Type: Logical Function Revision
Find Number: 40
Quantity:
Unit Of Measure: each
Kind: Function

Release Status:
Date Released:
Release Effectivity:
Element Effectivity ID:
Element Effectivities:

Owner: Jagtap, Dipti (dipti)
Group ID: Engineering

Last Modifying User: ed (ed)
Parent: SMW029366/A;1-Display Video and Play Audio

Documentation

SMW029343-Display Imposed Video Playing Status on Cabin Terminal

This function is responsible for displaying the status of the currently running imposed movie (ETA, etc.) on the Cabin Management Terminal.

actions

Multi-Domain Engineering Integration

Single-source-of-truth System Architecture to drive consistency in detailed design across all domains and ensure end-to-end traceability

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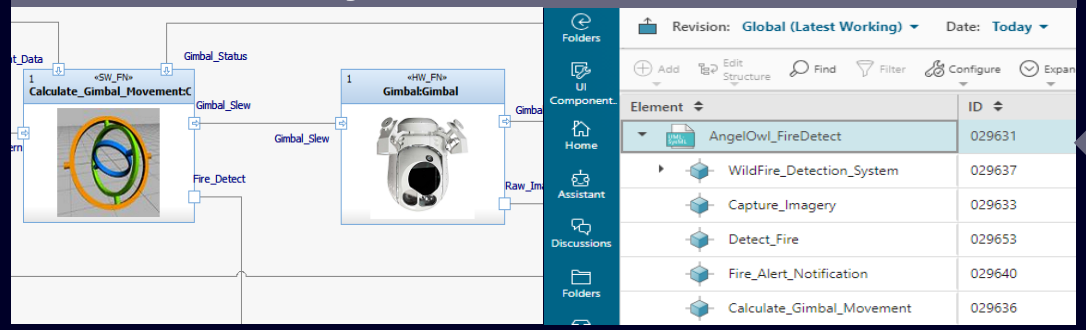
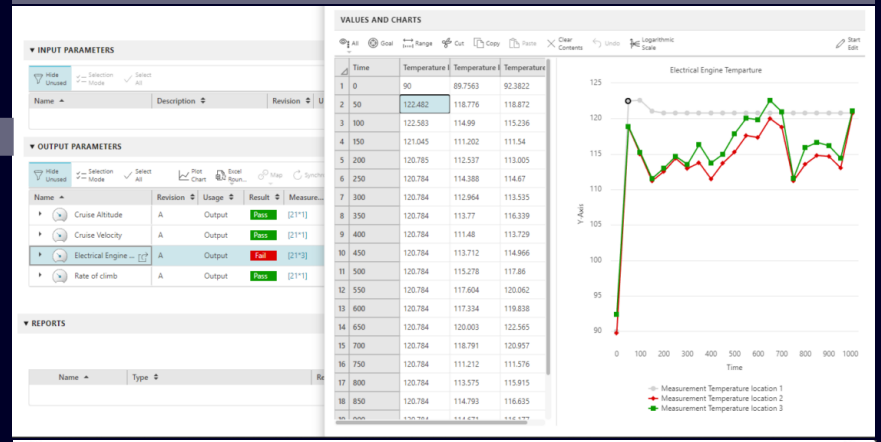
Consistent, Closed loop implementation across all domains

Digital Thread Shifts Left

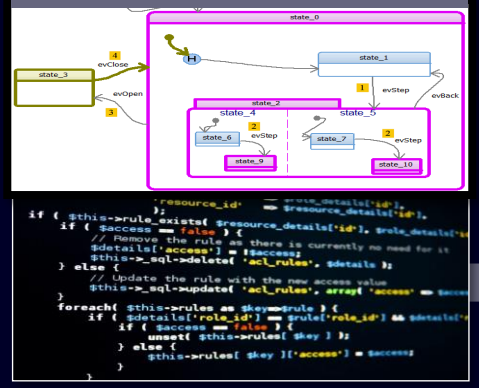
System Architecture



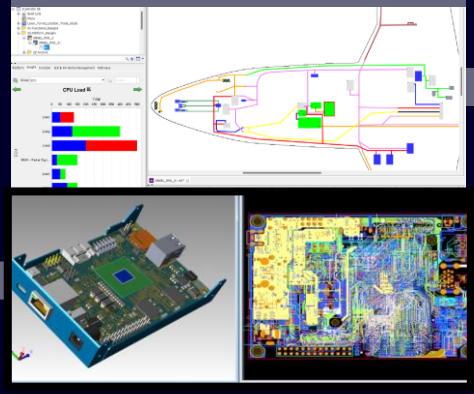
Multi-Domain Verification

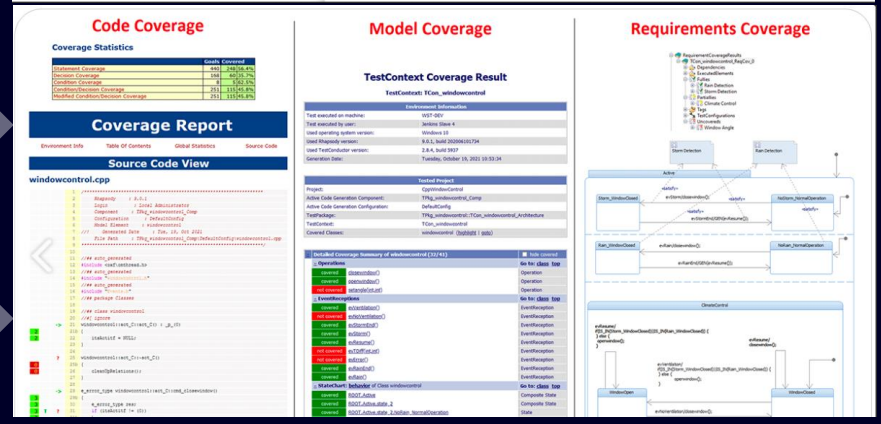


Software



Electrical

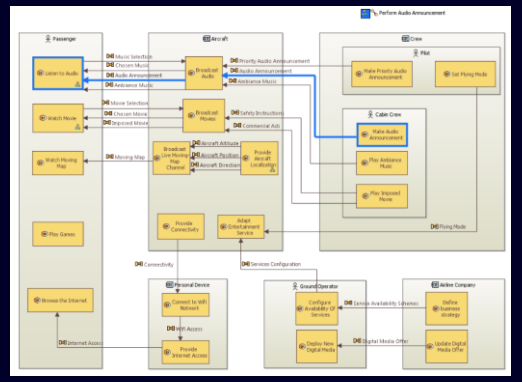




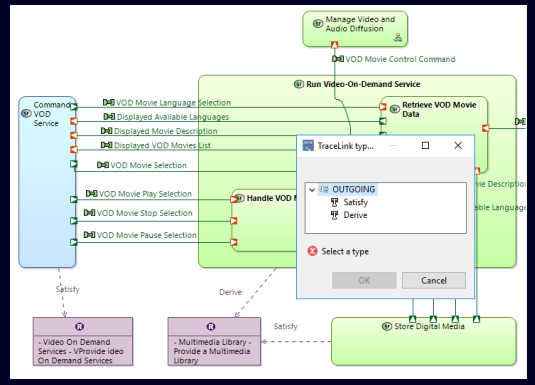
Test Conductor

SIEMENS

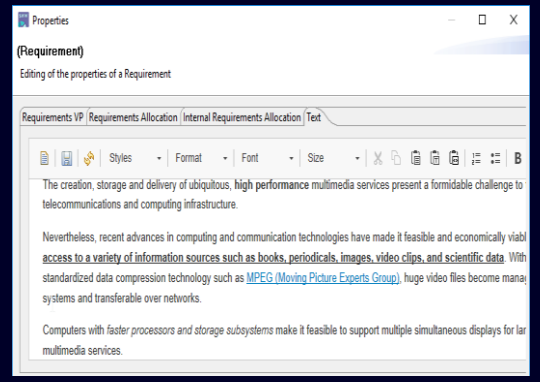
User Experience



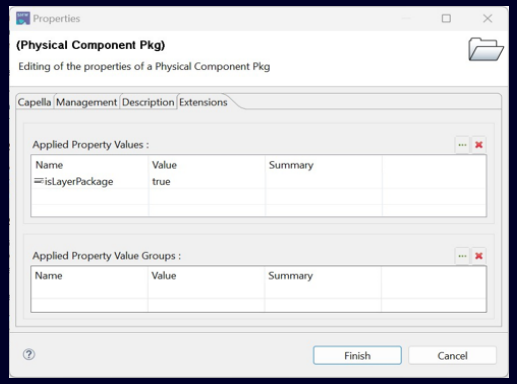
Operational Analysis (OA) layer to the digital thread (2406)



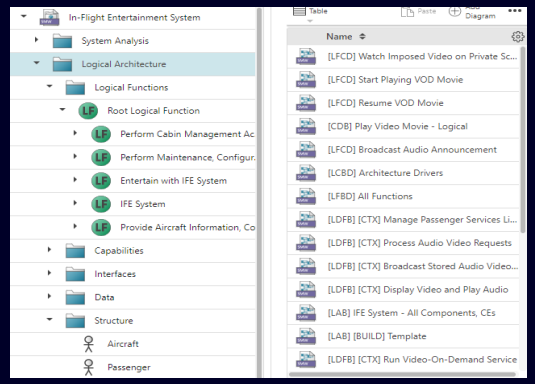
custom requirements links and directions (2312)



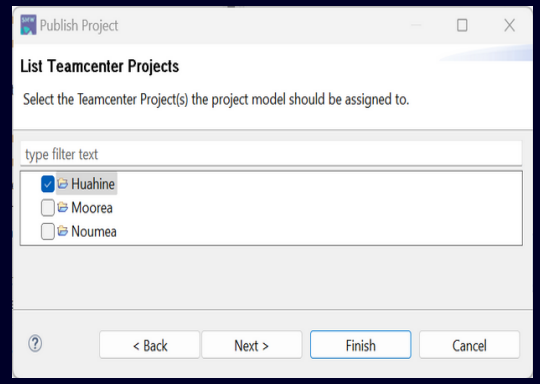
Preserve requirements text formatting (2312)



Customer Properties Mapping (2312)



Model Packages Diagrams (2312)



Assign Teamcenter Project (2312)

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About the new SysML V2 Standard…

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Questions ?

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Thank You

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