

How MBSE can make real the Digital Thread through System Modeling Workbench

Etienne Juliot, CSDM 2018

An open System Modelling Workbench for MBSE

- Leverage Capella and SysML to a next level
- Model lifecycle management and requirement integration
- Enable system model reuse in downstream applications (Mentor, Polarion, SimCenter)

SIEMENS

Press

Phoenix, AZ, June 4, 2018

Siemens PLM Connection Americas 2018 – Phoenix, Arizona, June 4-7

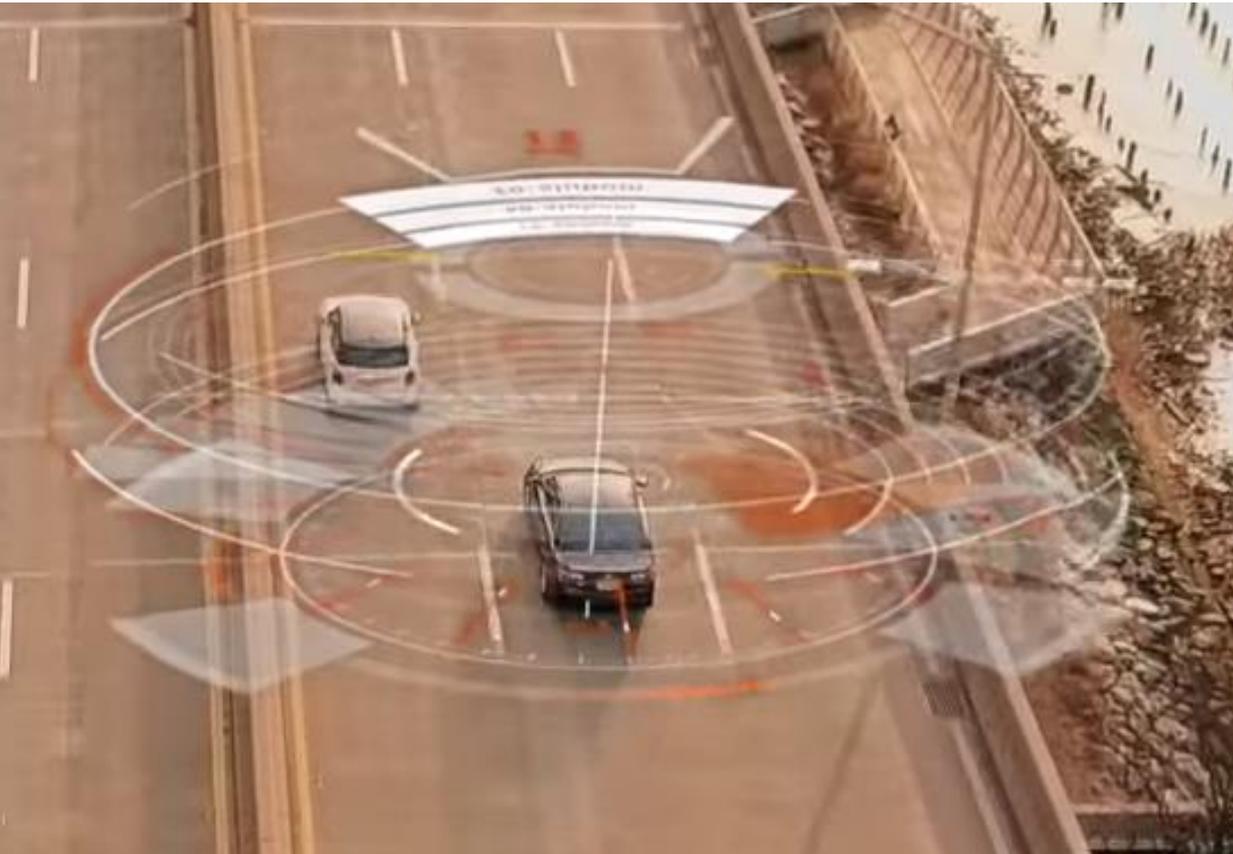
Siemens' extended Model Based Systems Engineering portfolio enhances innovation

- Uniquely enables multi-disciplinary solutions for Model Based Systems Engineering across all major engineering disciplines
- New partnership with Obeo open source modeling solutions to enrich Siemens' digitalization portfolio

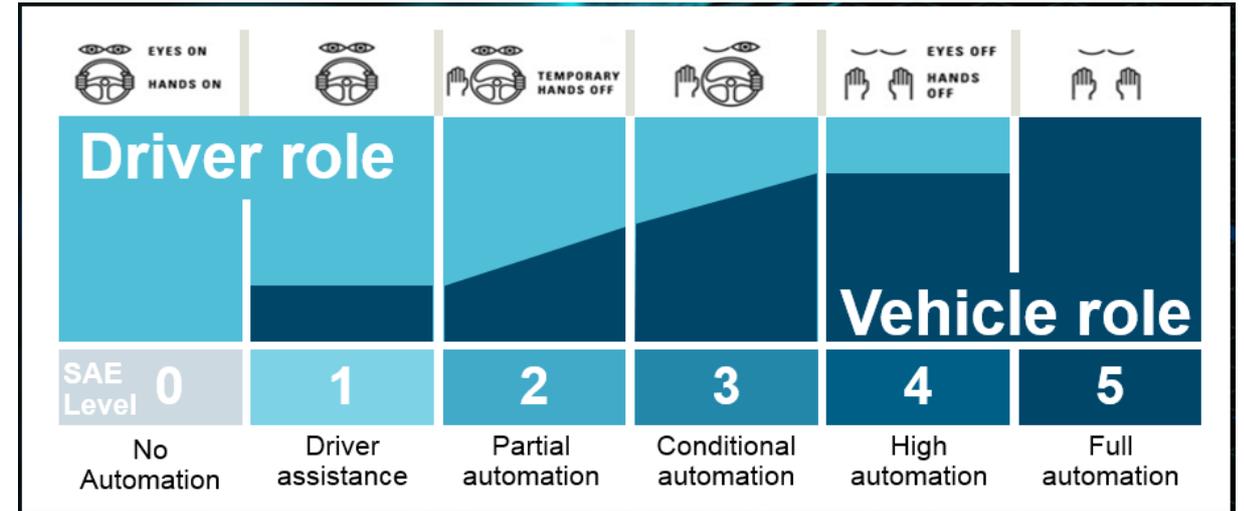
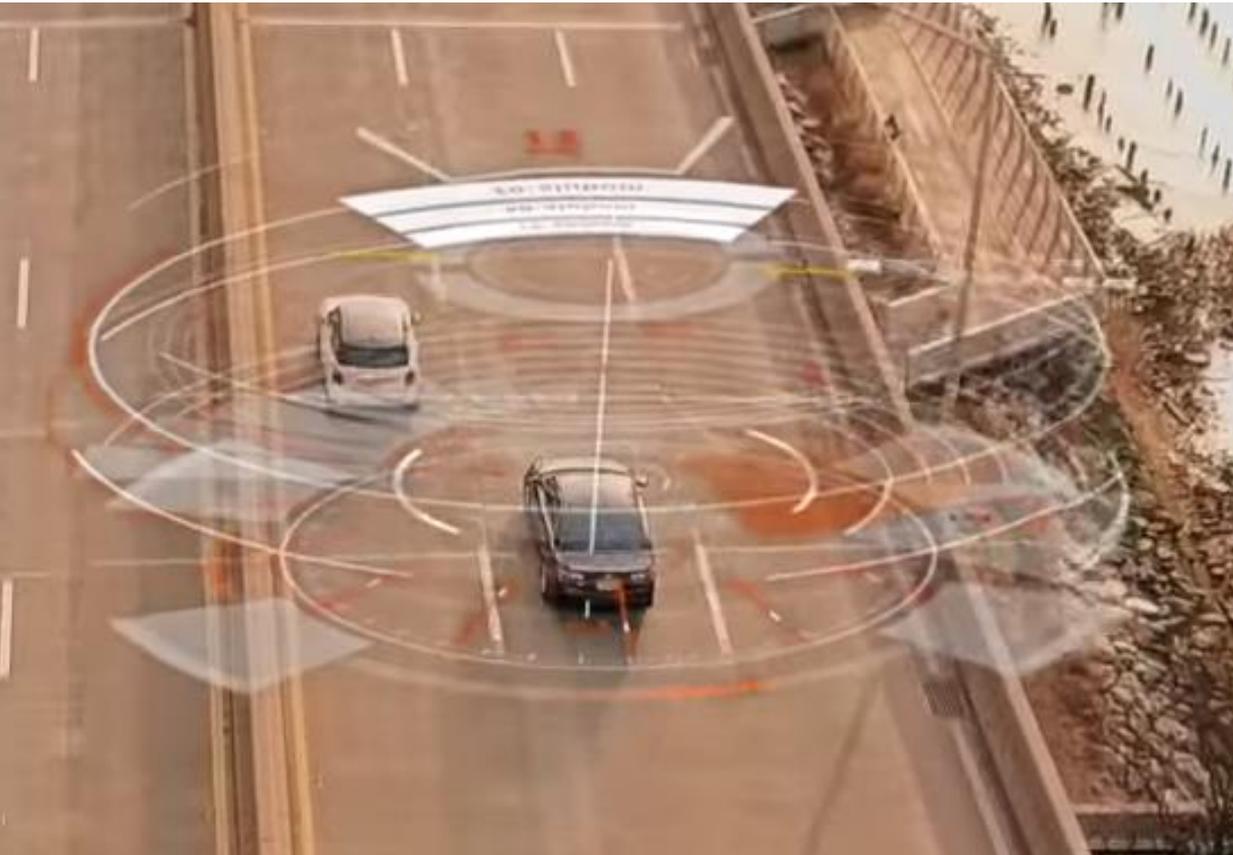
Healthcare Systems Complexity is growing...



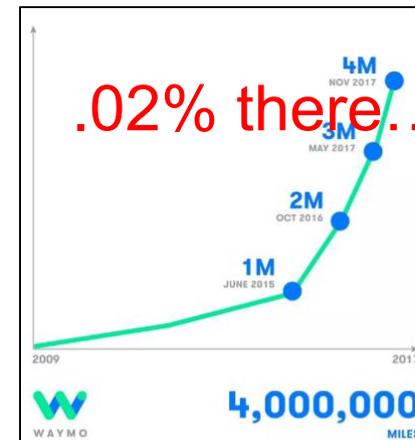
... as for Automotive with Autonomous Vehicle Validation ...



... as for Automotive with Autonomous Vehicle Validation ...



15 billion miles of physical testing to reach level 5

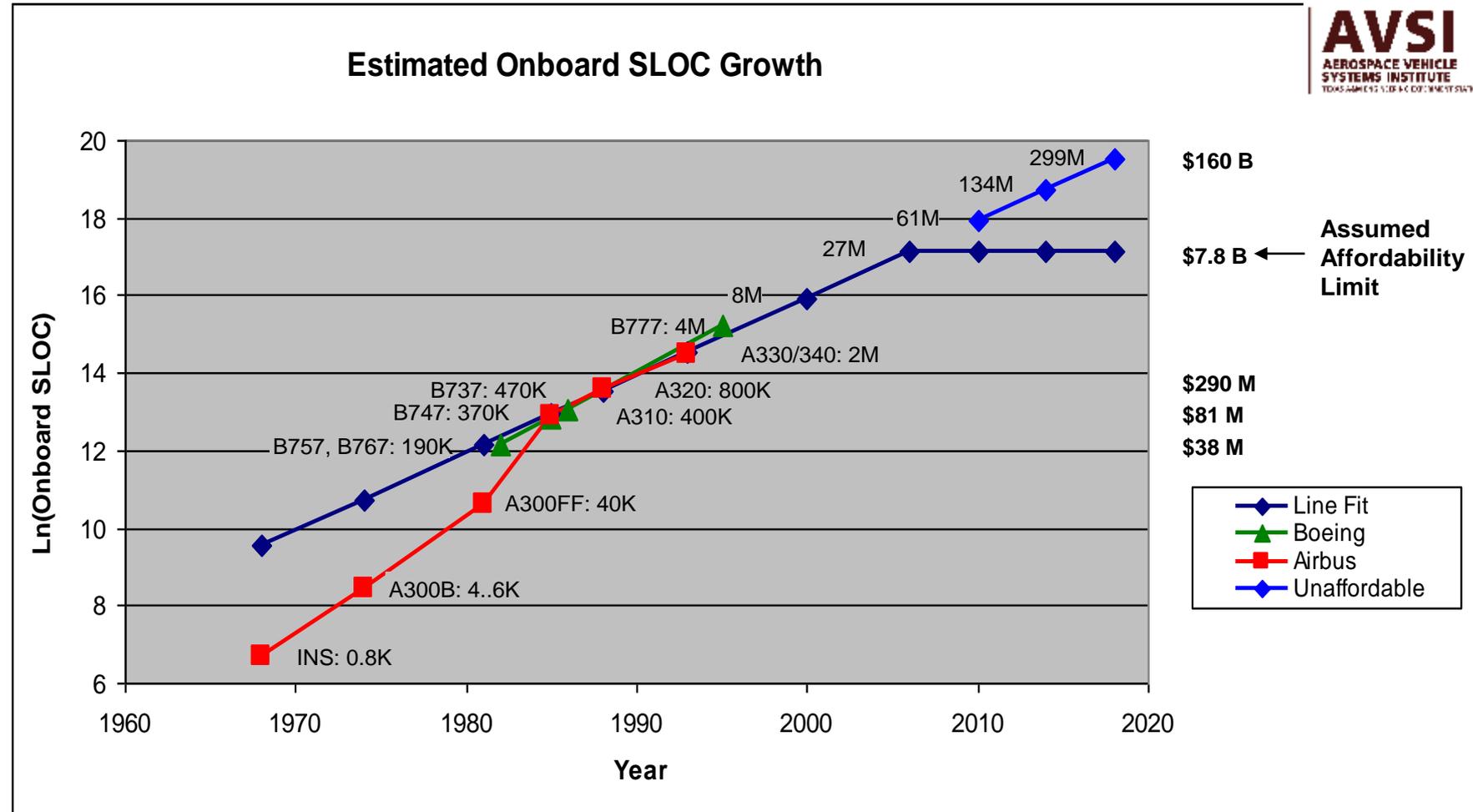


**Equivalent 'virtual' miles
may be driven in ~1
month on Digital Twins**

... as for Aeronautic



Start Integrated
Stay Integrated
AVSI





MBSE

Addressing growing complexity
of products and organizations

Model-Based Systems Engineering (MBSE)

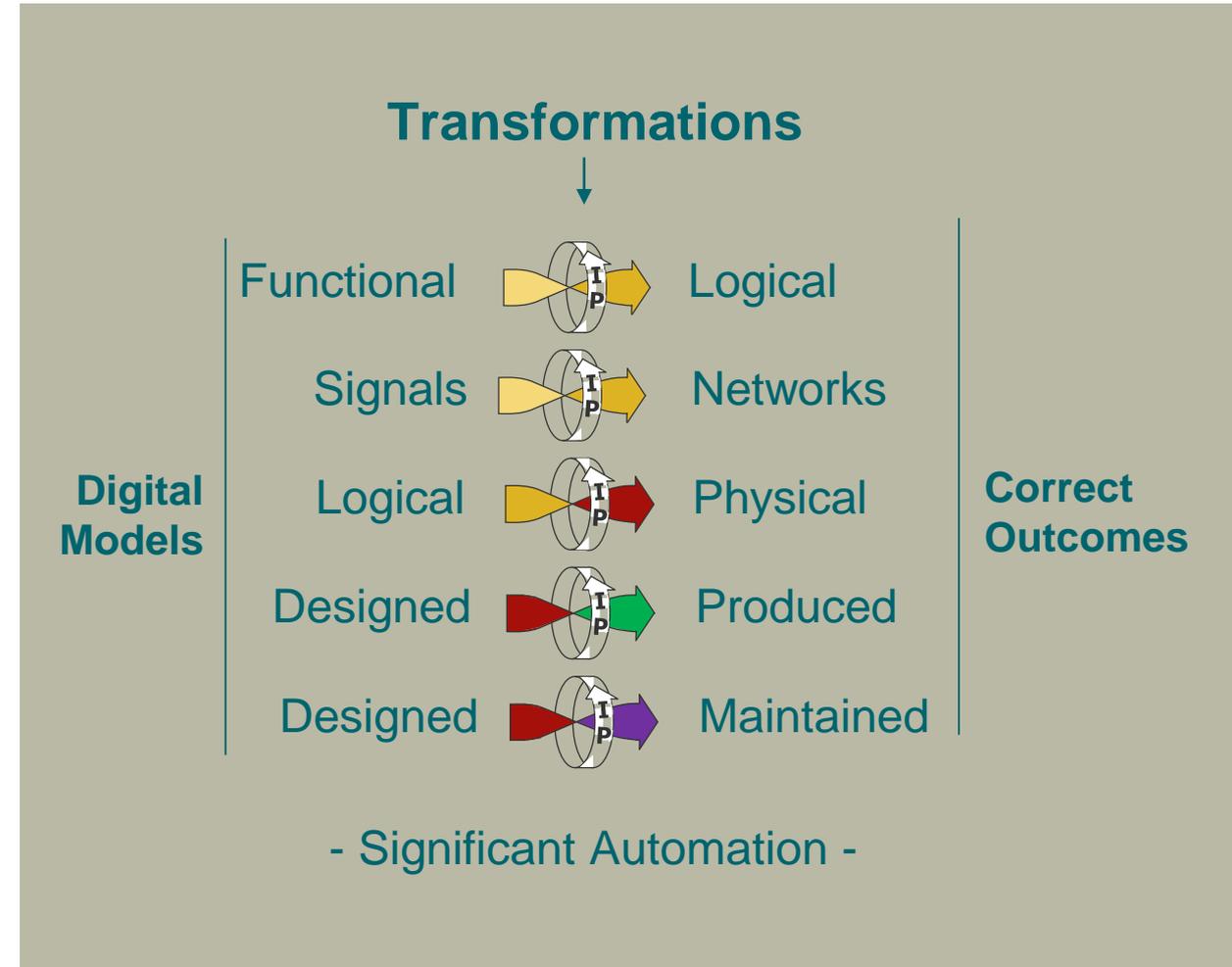
Definitions



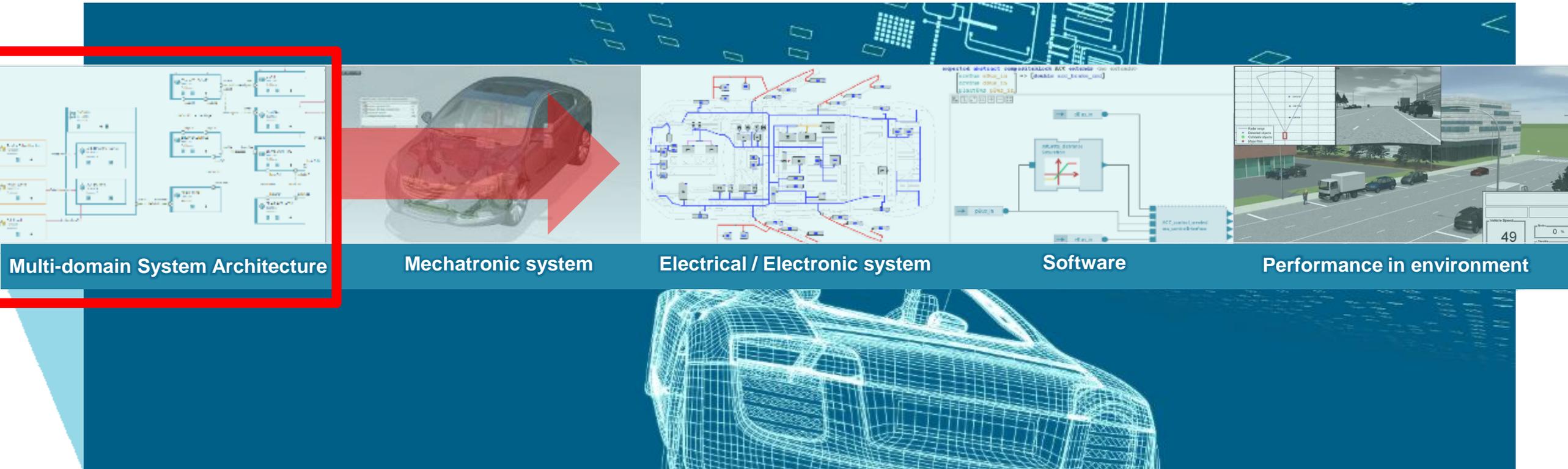
“Model-based systems engineering (MBSE) is a systems engineering methodology that focuses on creating and exploiting **domain models** as the **primary means of information exchange** between engineers, rather than on **document-based** information exchange.”

Three Key Characteristics of a Model Based Enterprise

1. Process: **Digital models** become the authoritative information source driving all downstream implementation steps
2. **Transformation** into subsequent forms is significantly automated to create **correct-by-construction outcomes**
3. A **core MBE tenet**: data created once is **reused** to the greatest extent possible by all downstream consumers



Enabling Connected Cross-Domain Engineering to drive the entire downstream development process



**“Digital Twin” of the Product – Multiple domains
“Digital Thread”**

Digital Thread

My (personal) checklist



Never break the workflow



Make engineers works together



Make tools works together

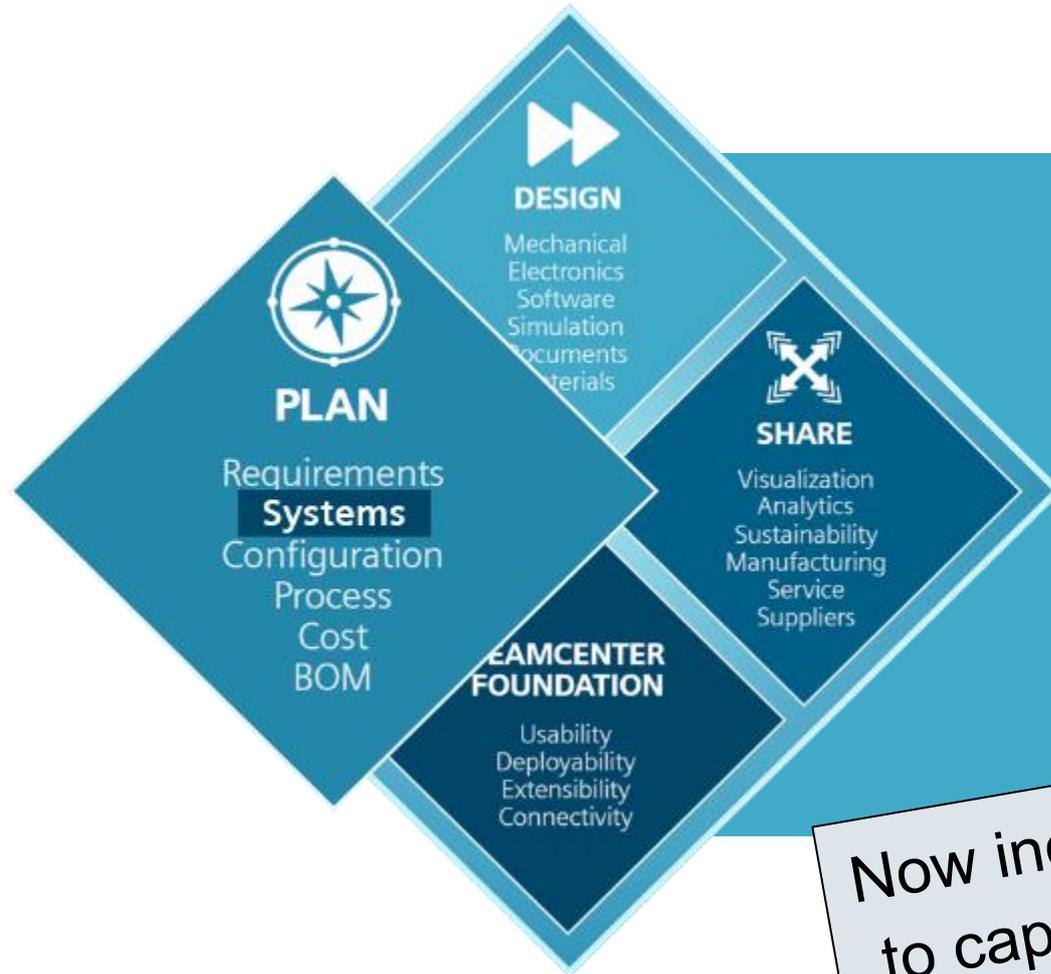


Closed-Loop



PLM

Teamcenter : keeper of all product knowledge



Adaptable, modern PLM solutions
Connecting people and processes
Across engineering and business

Now includes Systems Modeling
to capture product architecture

closed-loop model integration between
architecture and downstream engineering

Main Benefits:

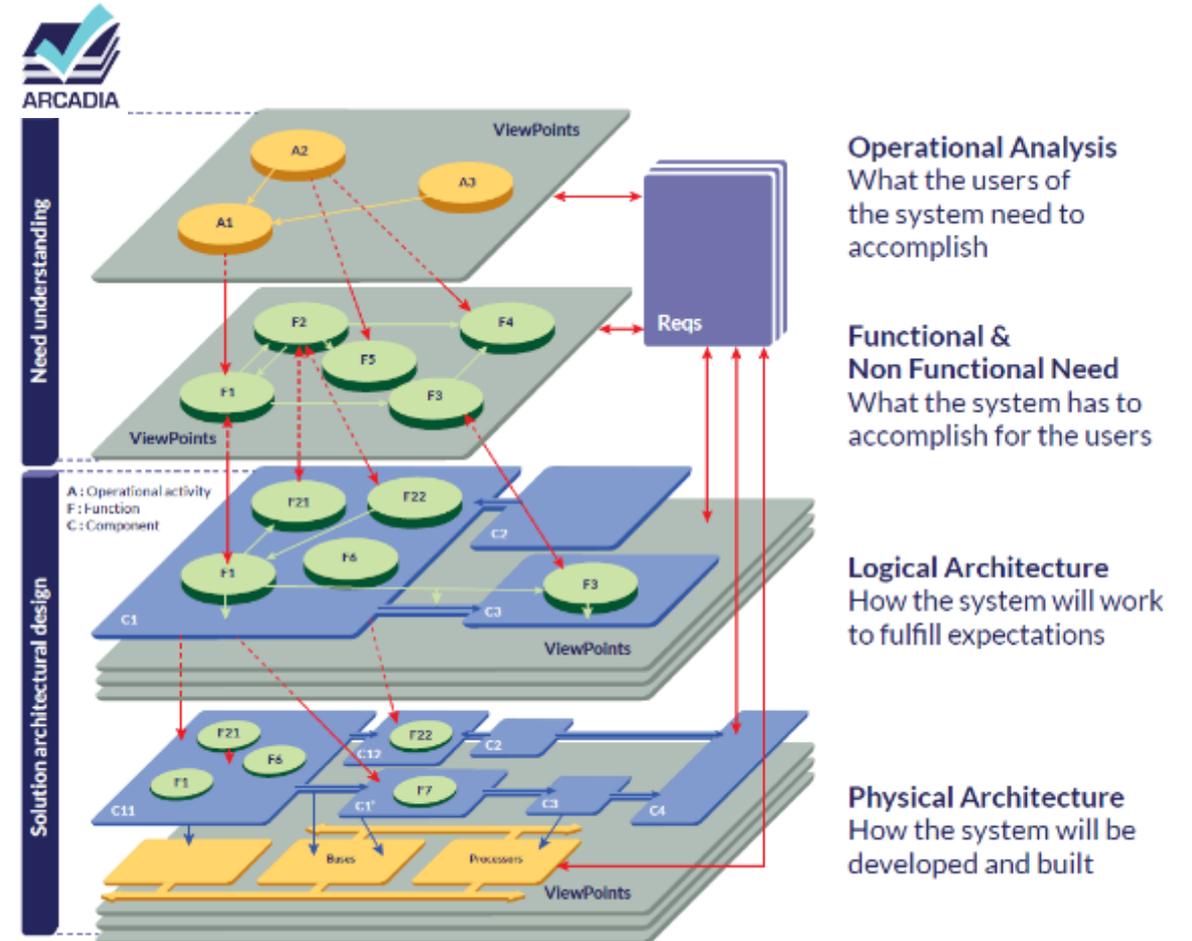
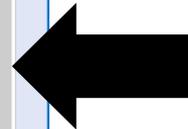
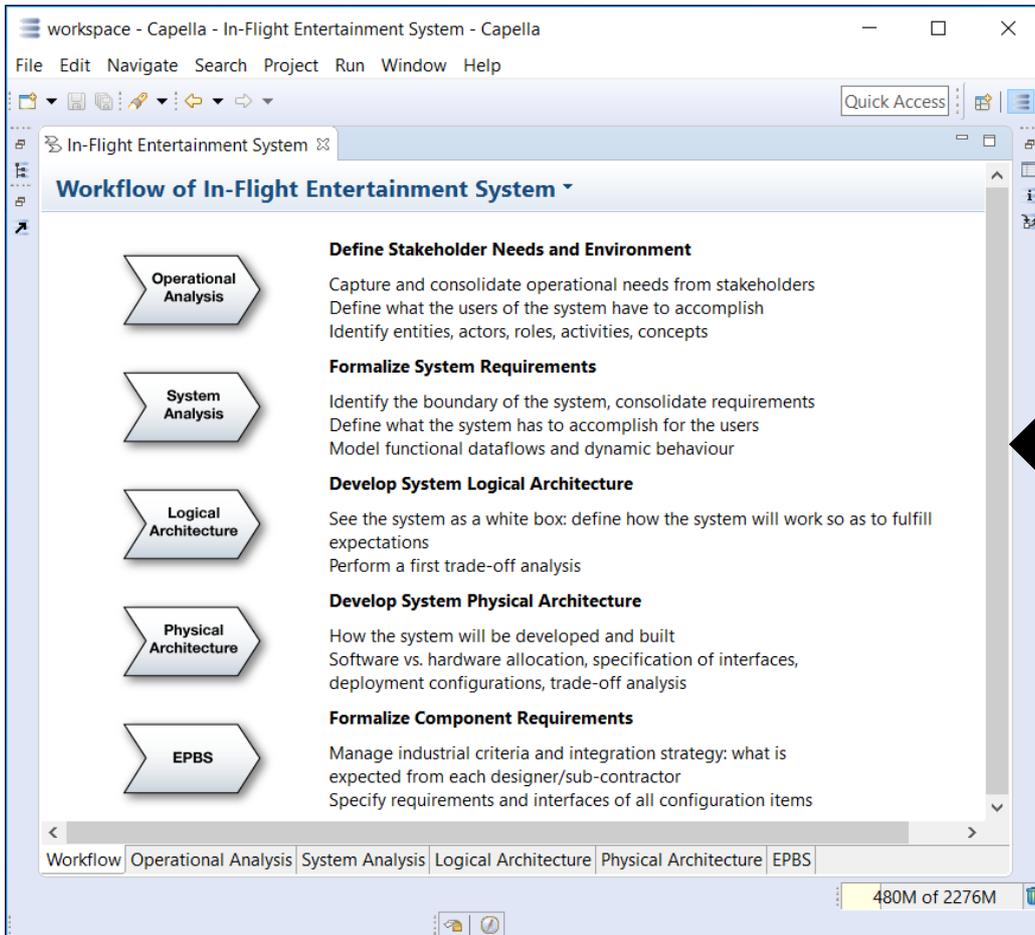
- Understand the **customer need**
- Define the **solution** while keeping the **big picture**
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- Early evaluate and justify **architectural choices**
- Identify Interfaces to master **V&V** & **prevent integration issues**
- Enable to Plan, Coordinate and Track Engineering Deliveries

closed-loop model integration between
architecture and downstream engineering

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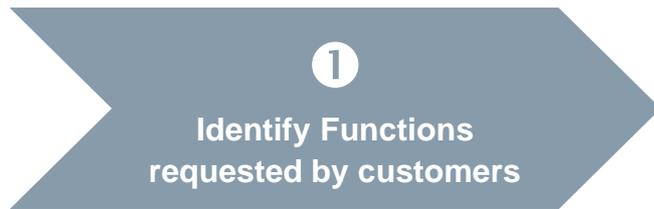
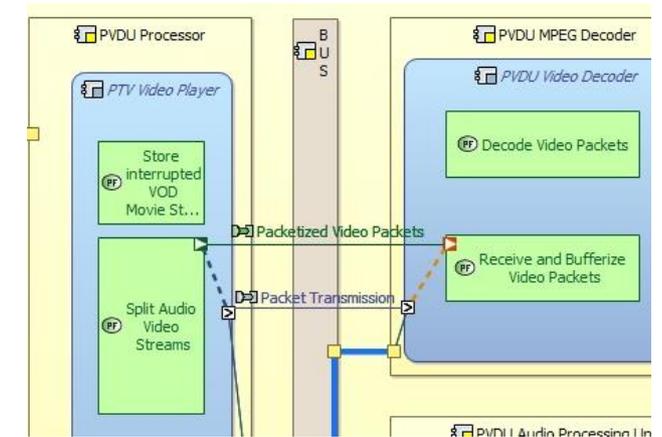
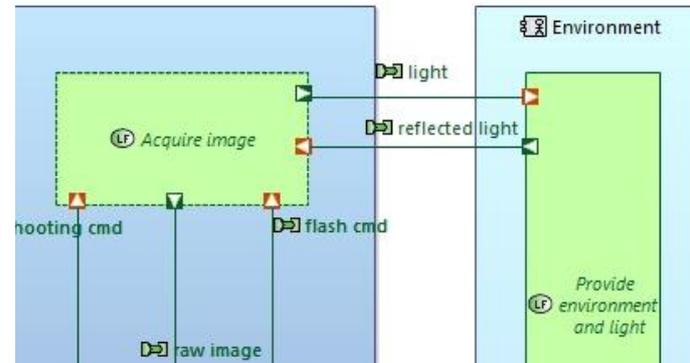
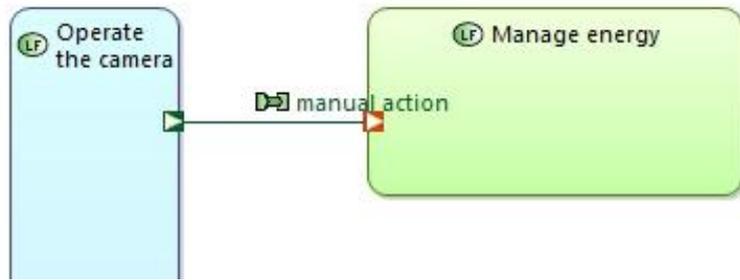
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Tooled Method to: Define, Analyze, Design & Validate System, SW, HW Architectures



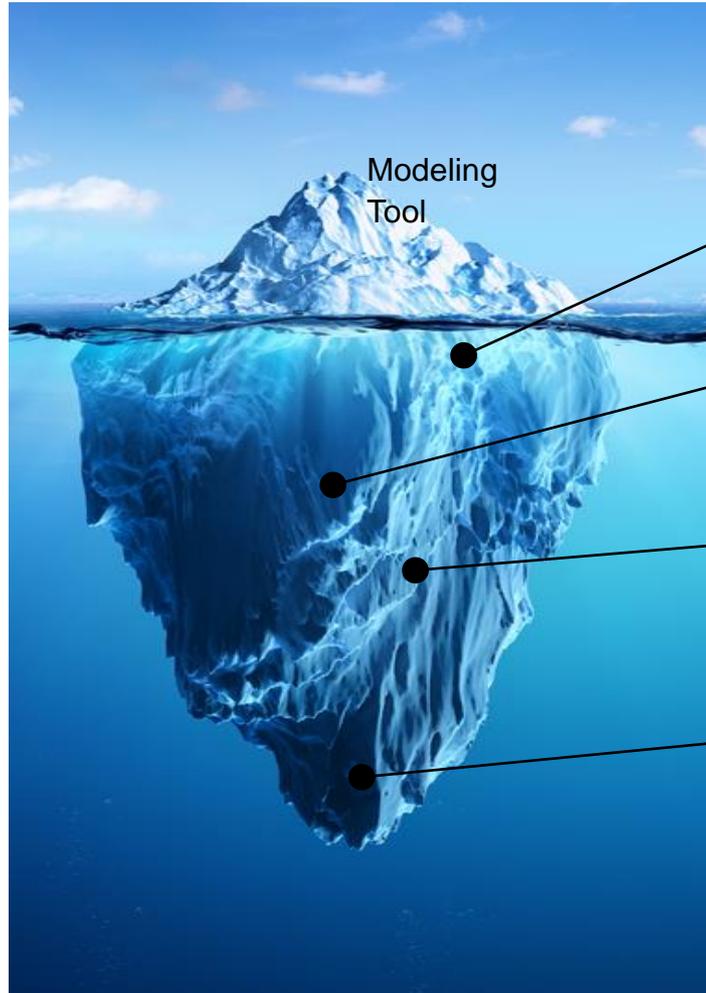
Example of added value of a methodological guidance

Understand the customer need



System Modeling in real world

Traditional Hidden Costs in Enabling the Enterprise



Methodology

OOSEM, Harmony-SE, RUP-SE, OPM

Profile Customization

Customize language constructs to work with the method

Tooling Customization

Customize the tool to be more efficient with chosen method and updated language constructs

Complex Ramp-up

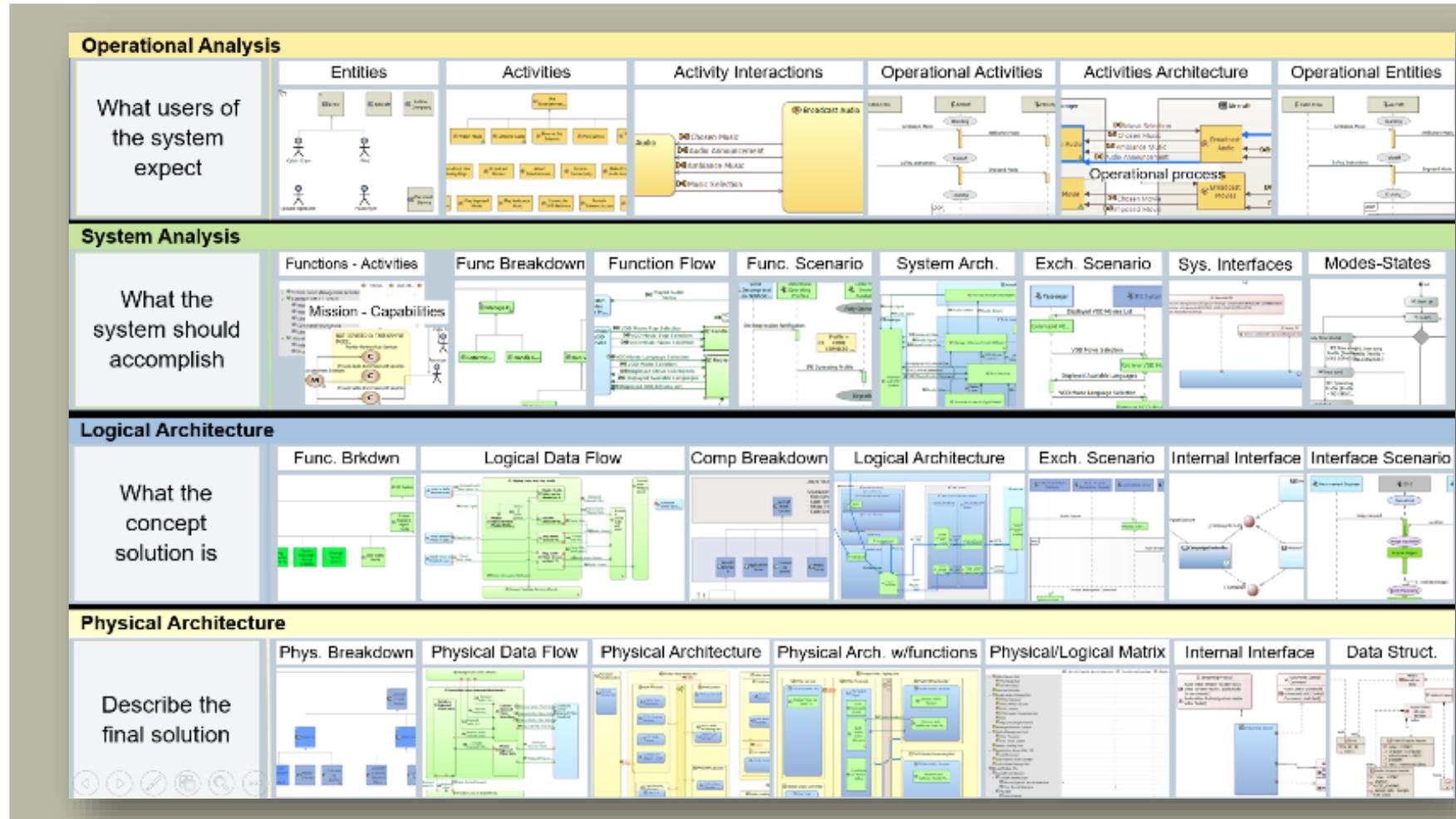
Train enterprise to learn customizations and ignore some foundational SysML aspects

Manage the complexity: Divide and Conquer

Leverage Capella

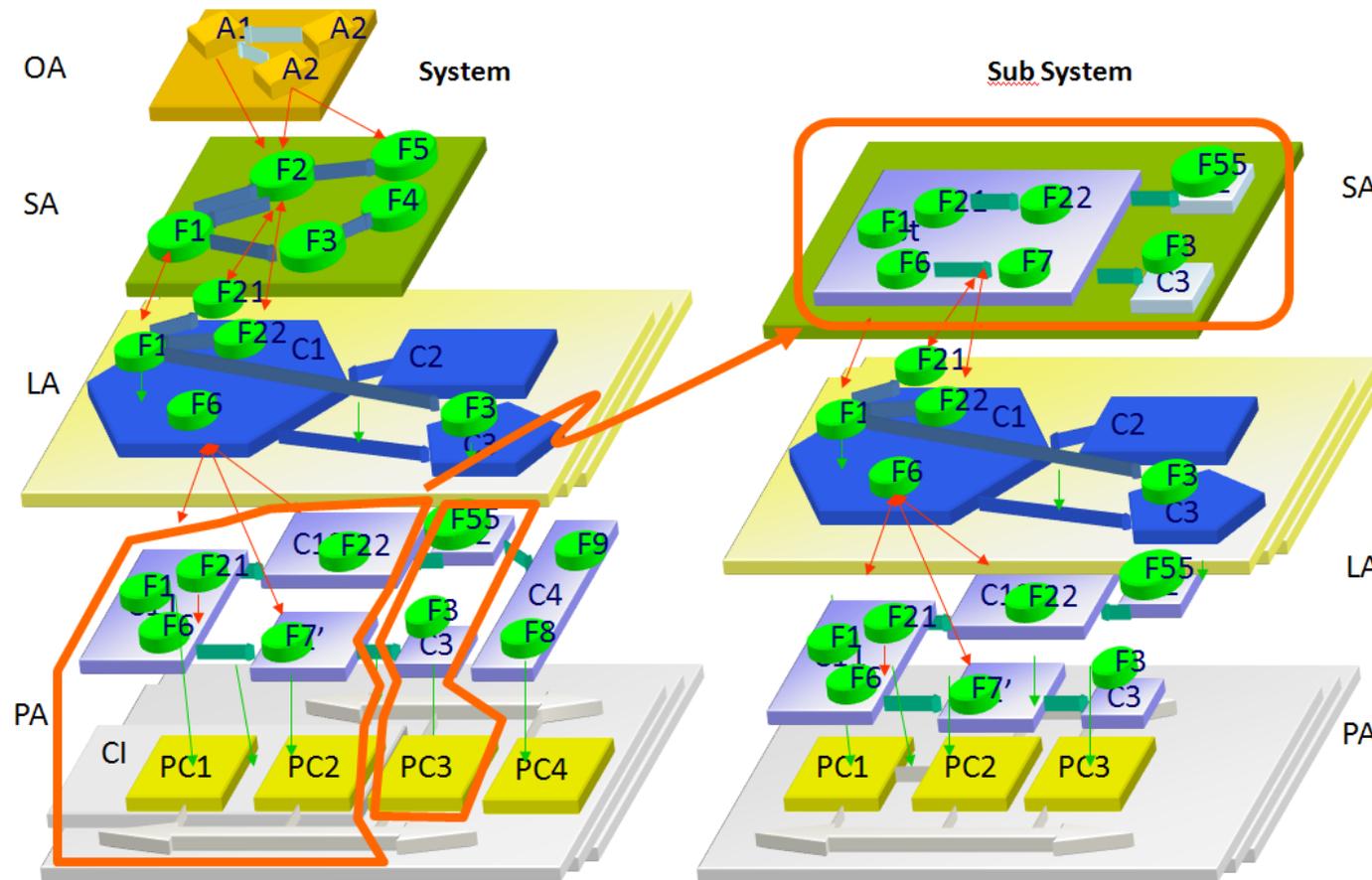


Base diagrams are extended and used in multiple **off-the-shelf** modeling views, saving precious engineering and deployment time



Define the solution while keeping the big picture

Refining Subsystem Models with Incremental Transitions

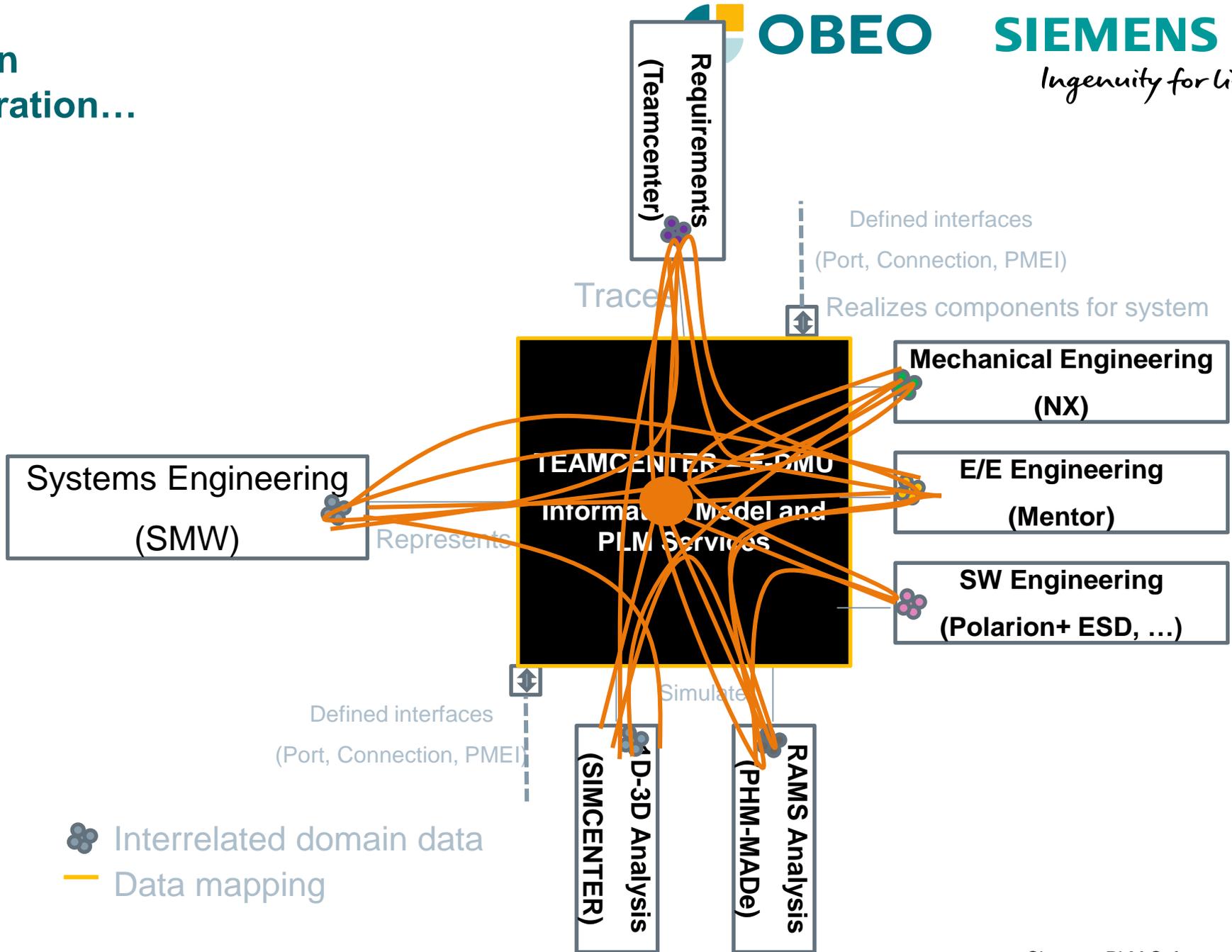


closed-loop model integration between
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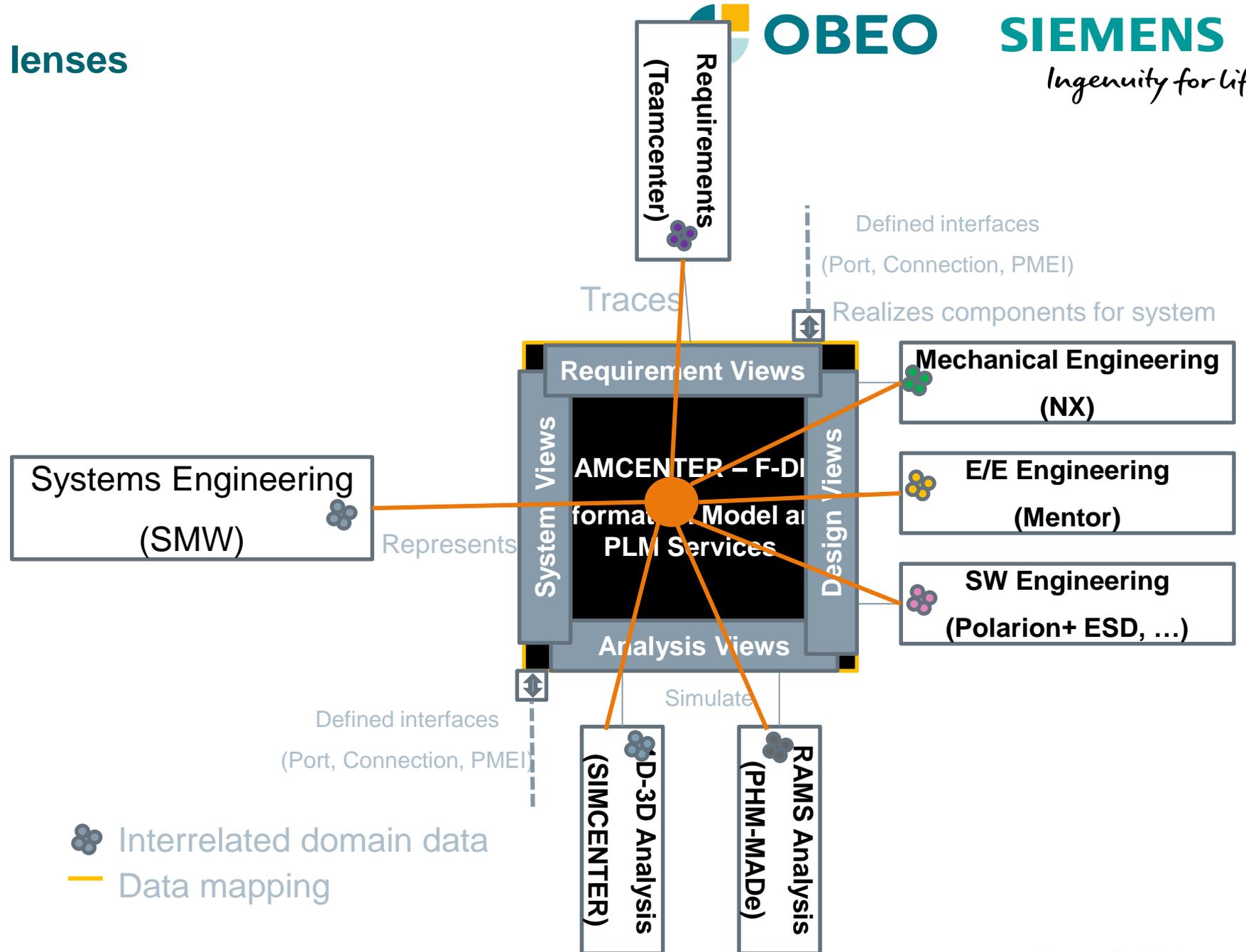
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...enabling cross-domain communication/orchestration...



Viewed through domain lenses



MBSE Vision Update

Multi-Domain Engineering

SIMCENTER 1D-3D Simulation

System Synthesis
Co-Simulation - DoE

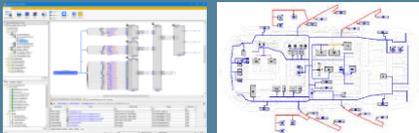


Modeling Apps

Imagine.lab NX Nastran
STAR-CCM+ HEEDS
Matlab FEMAP

MENTOR EE Design

Capital



Xpedition

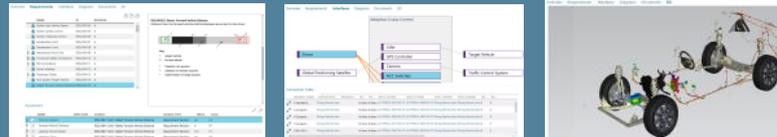


TEAMCENTER F-DMU Information Model and PLM Services



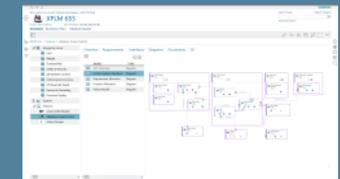
Active Workspace

“one click away” engineering data access

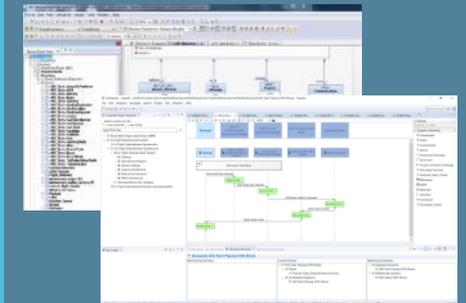


System Modeling Applications

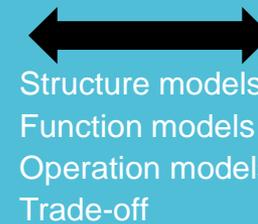
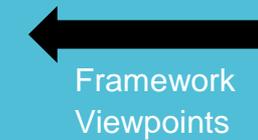
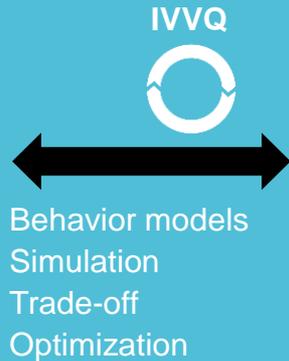
System Modeling Workbench for Teamcenter



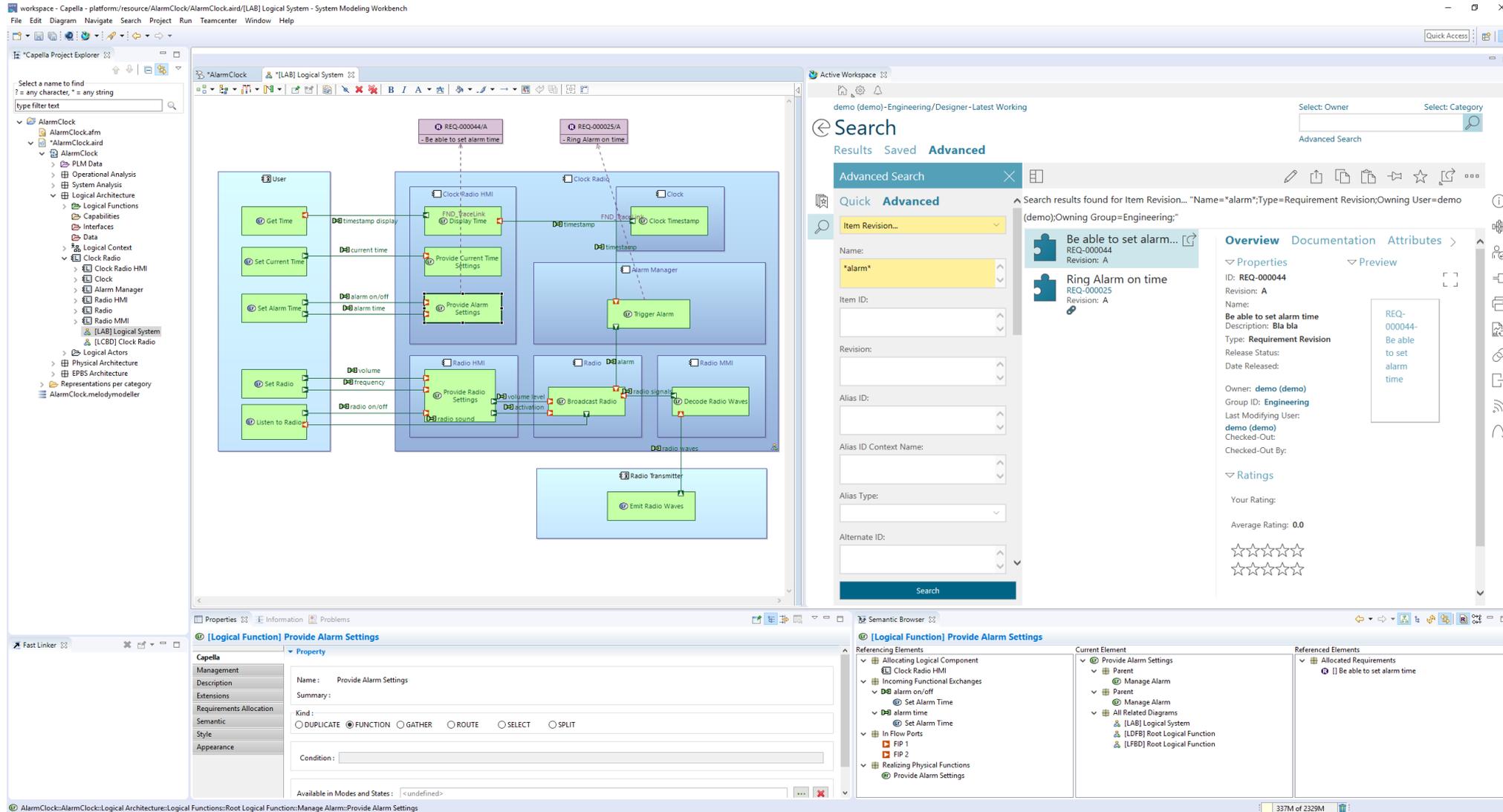
System Modeling Workbench (SMW – PE)



3rd Parties



Fluent ergonomic continuity SMW ↔ Active Workspace



The screenshot displays the Siemens PLM software interface, divided into several key sections:

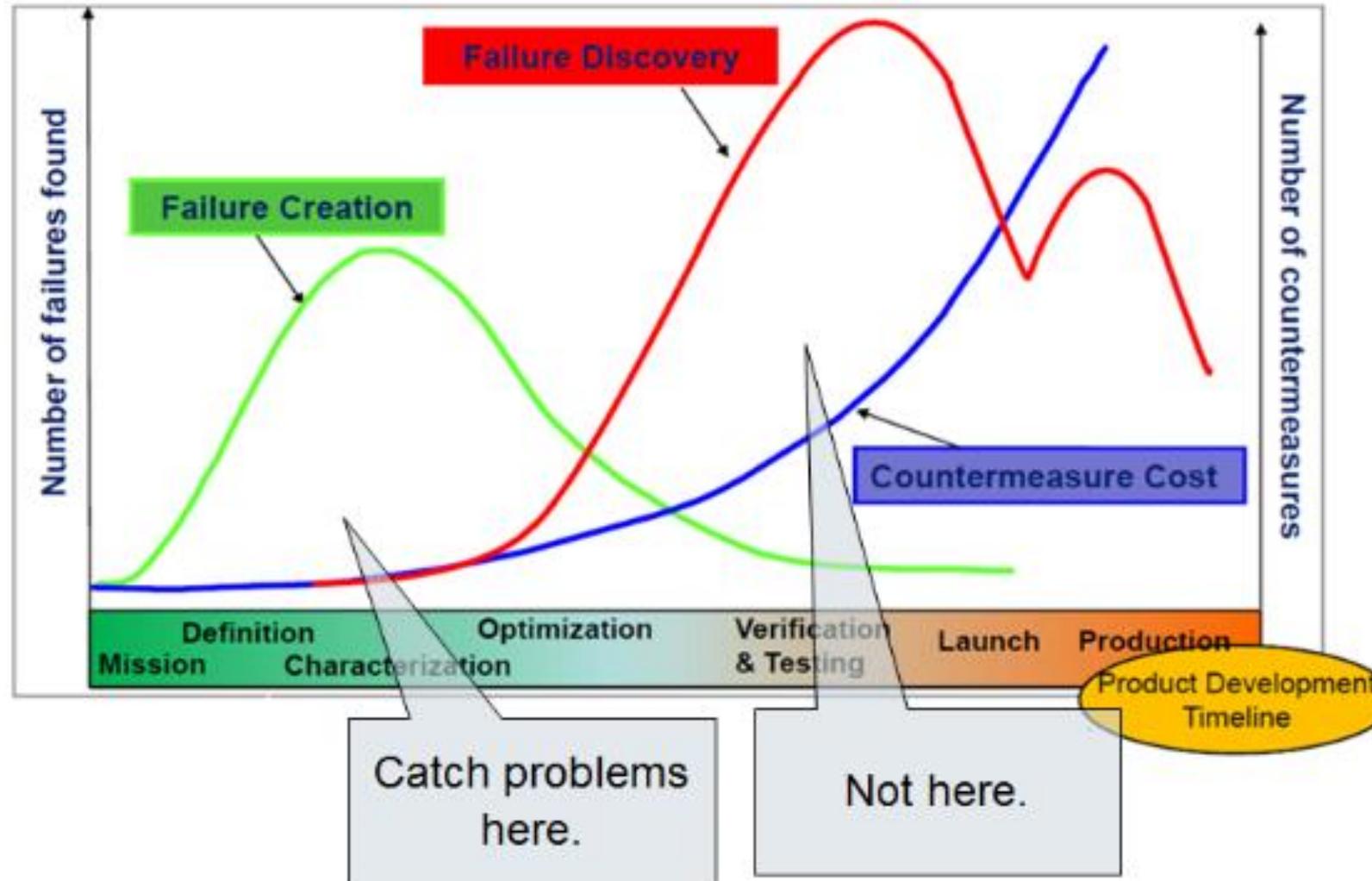
- Left Panel (Capella Project Explorer):** A tree view showing the project structure, including 'AlarmClock', 'AlarmClock.afm', 'AlarmClock.aird', and various logical functions like 'Get Time', 'Set Current Time', and 'Set Alarm Time'.
- Central Diagram:** A complex logical system diagram with interconnected components. It includes a 'User' block, 'Clock(Radio HMI)', 'Clock Radio', 'Clock', 'Alarm Manager', 'Radio HMI', 'Radio', 'Radio MMI', and 'Radio Transmitter'. Data flows are indicated by arrows between these components.
- Right Panel (Active Workspace):** A search and overview interface. It features a search bar, a 'Search' button, and a list of search results. The 'Overview' section for a selected item shows details such as ID (REQ-000044), Revision (A), Name ('Be able to set alarm time'), and Release Status.
- Bottom Panel (Properties and Semantic Browser):** The 'Properties' section shows details for the selected logical function 'Provide Alarm Settings', including its name, kind (FUNCTION), and condition. The 'Semantic Browser' shows a hierarchical view of the logical system's structure.

closed-loop model integration between
architecture and downstream engineering

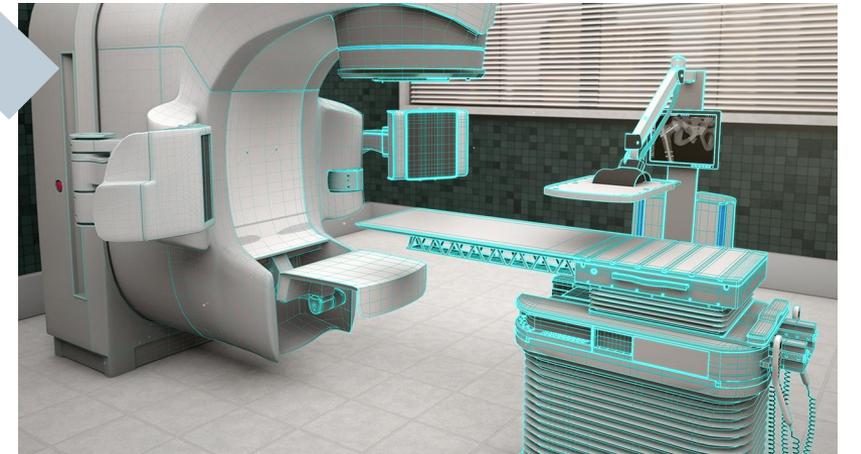
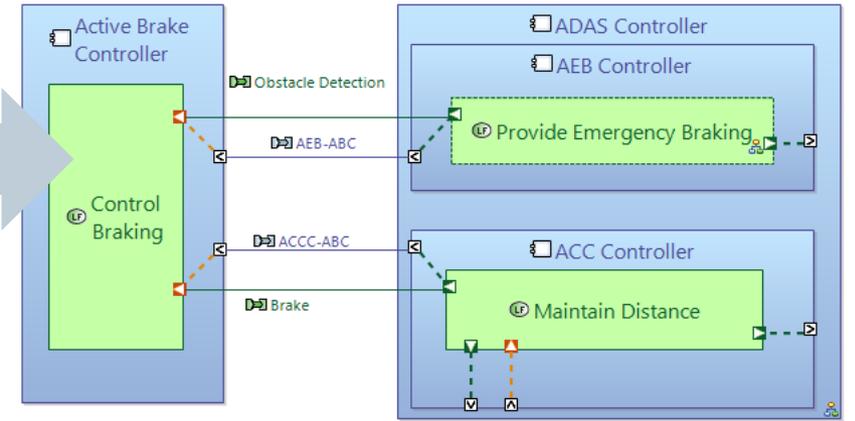
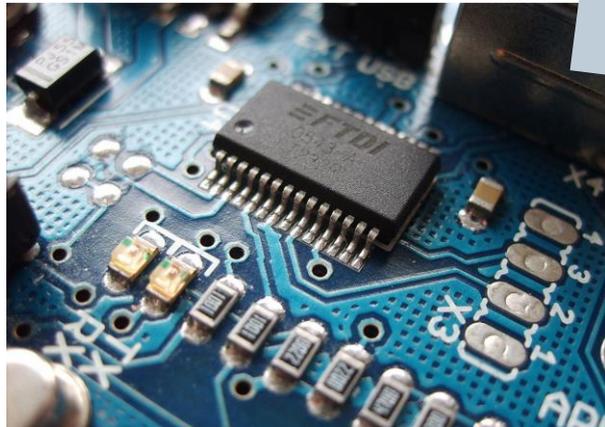
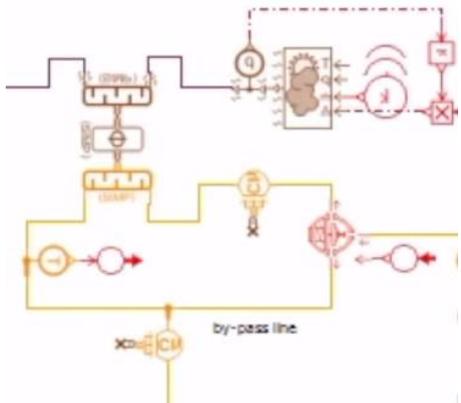
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What's missing: pre-planned, cross-product planning: Integrated Product Architecture...

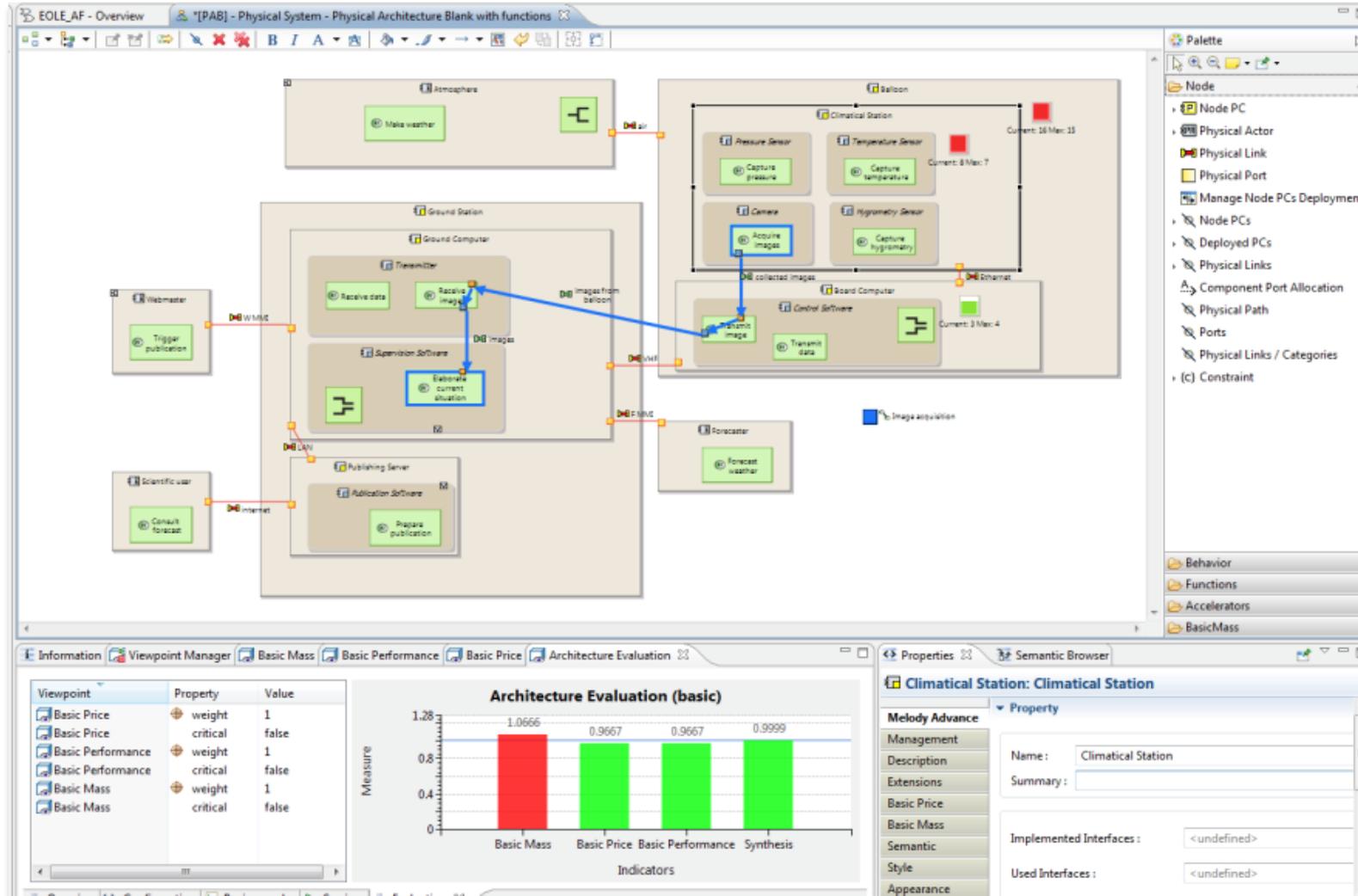


Close Loop



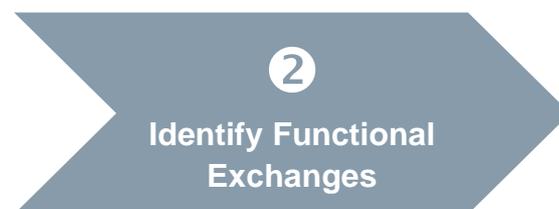
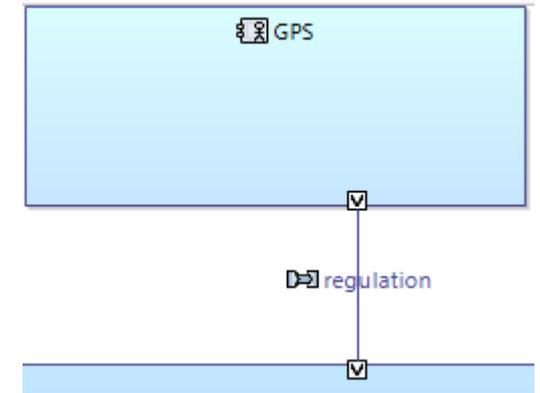
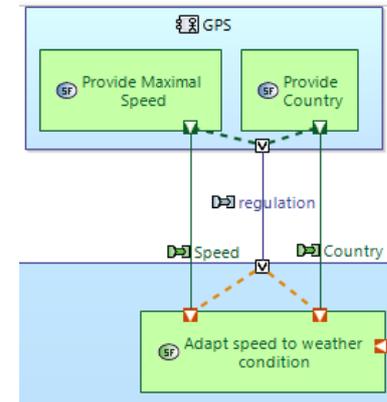
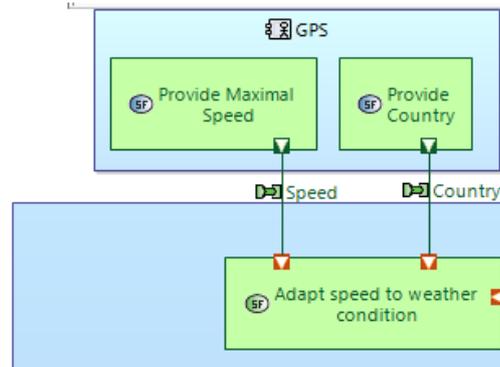
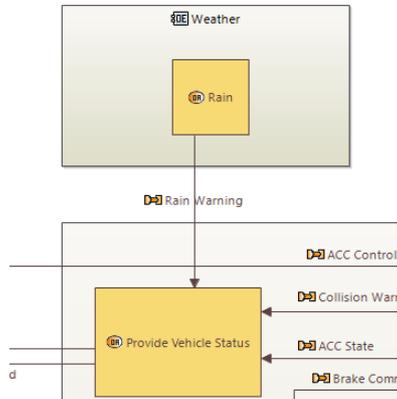
Early evaluate and justify architectural choices

Architecture Trade-Off

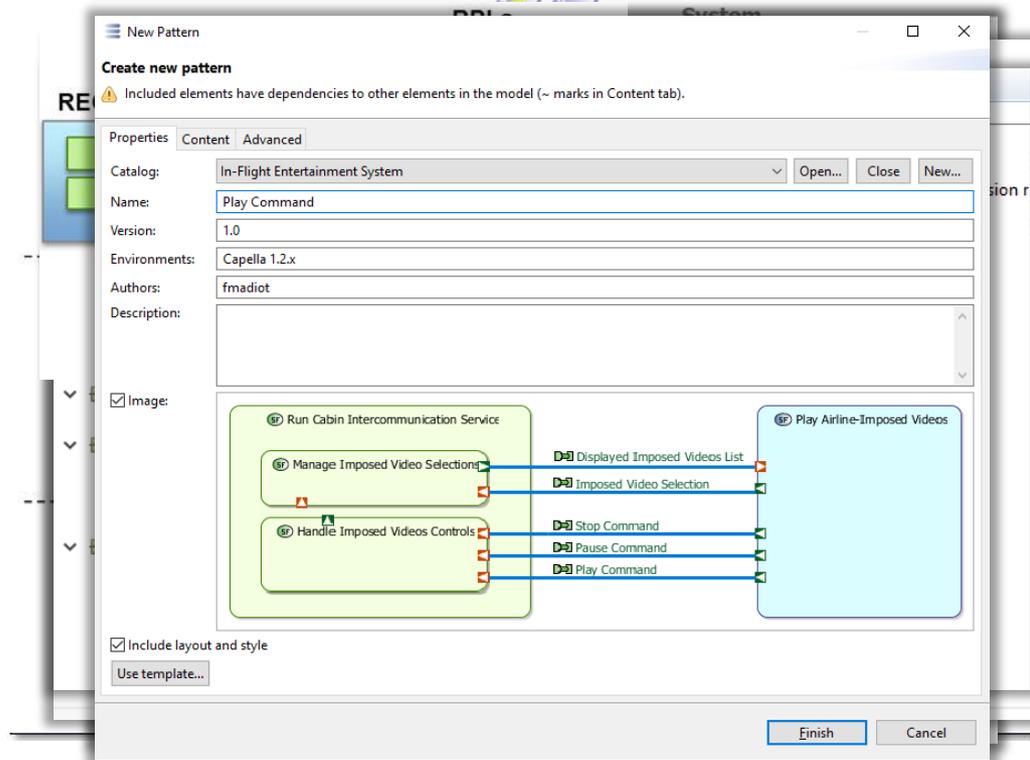


Example of added value of a methodological guidance

Identify Interfaces for Integration



Tooling to Identify Interfaces to master V&V and prevent integration issues



Scalability, Efficiency and User Experience

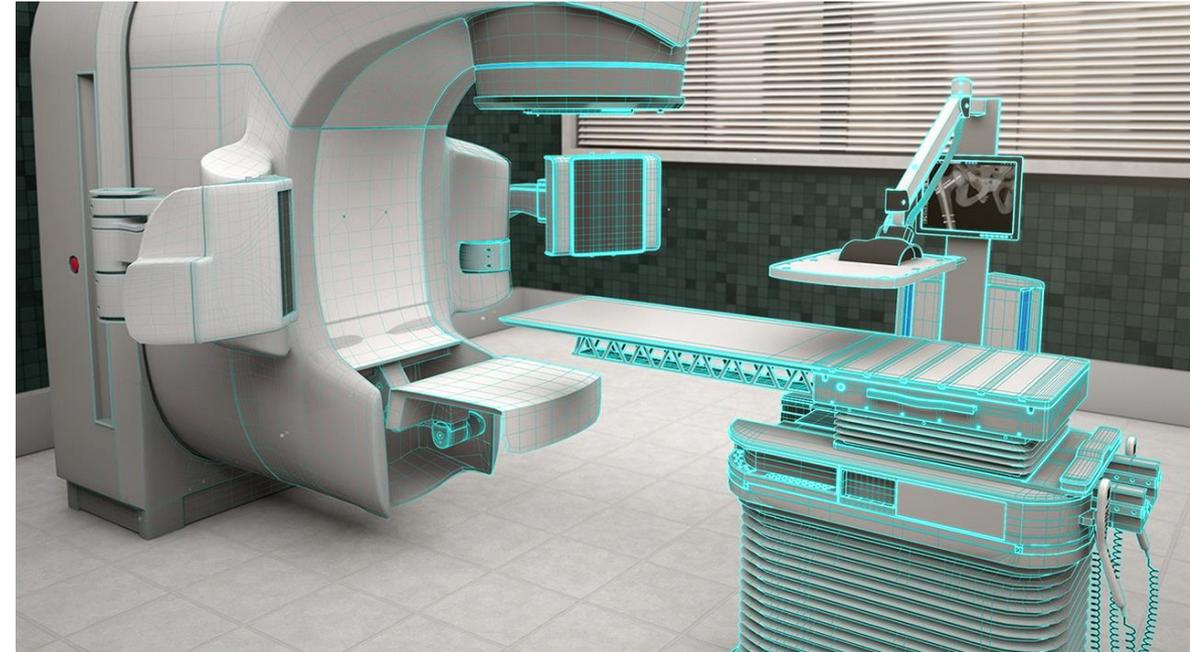
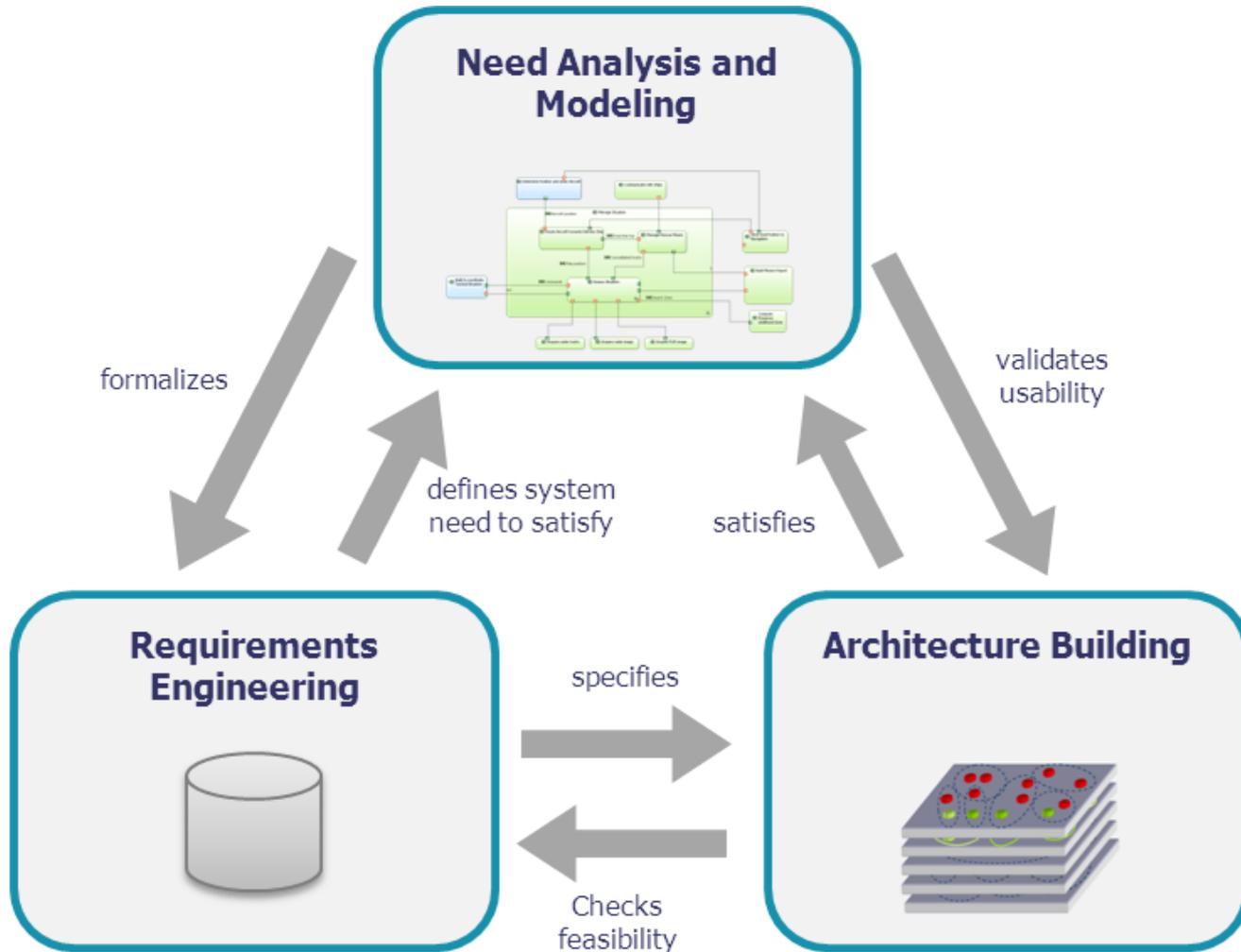
- Semantic colormap → Readability
- Computed links → Up-to-date High Level Design
- Diagram filters → Complexity management
- Model validation → Quality
- Contextual browser → Impact Analysis
- Building blocks → Reusability
- Modeling helpers → Productivity & Consistency
- Automatic subsystems transition → Subcontracting initialization
- Active Workspace Integration → Streamlined user experience

closed-loop model integration between
architecture and downstream engineering

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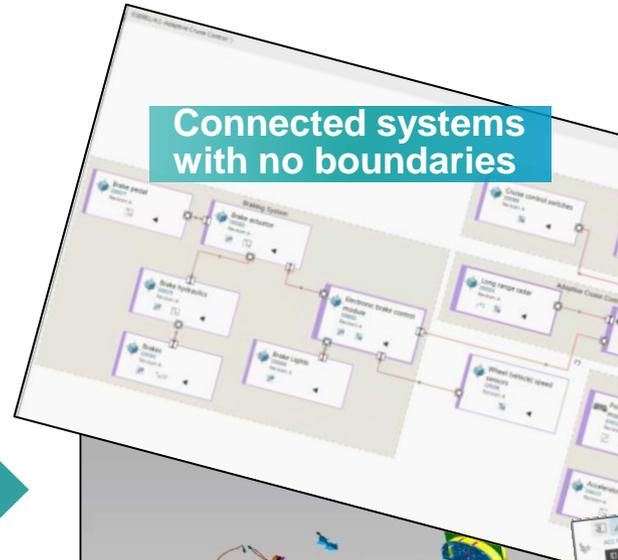
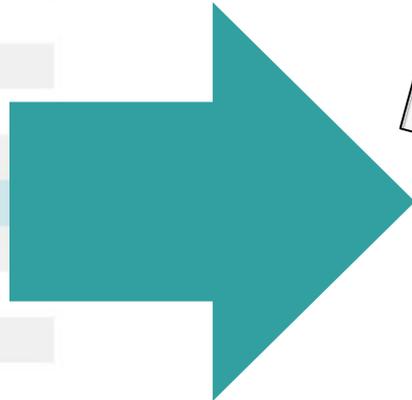
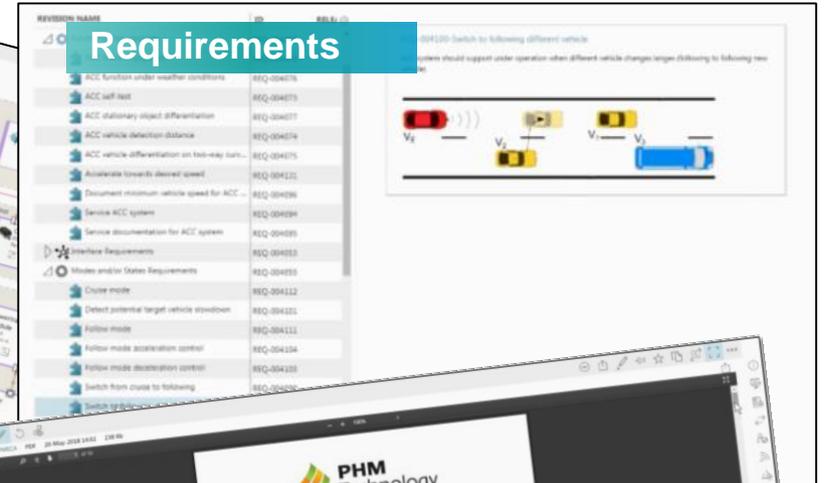
Define, Analyze, Design and Validate Architectures



“One Click Away” Views of a Multi-Domain Architecture

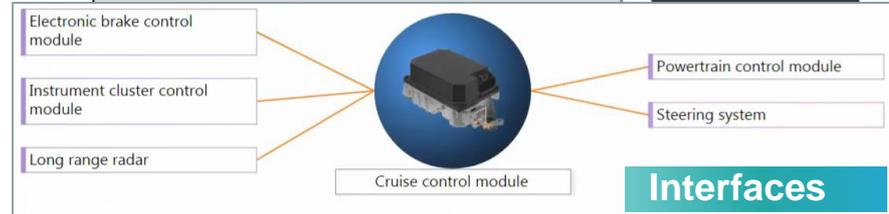
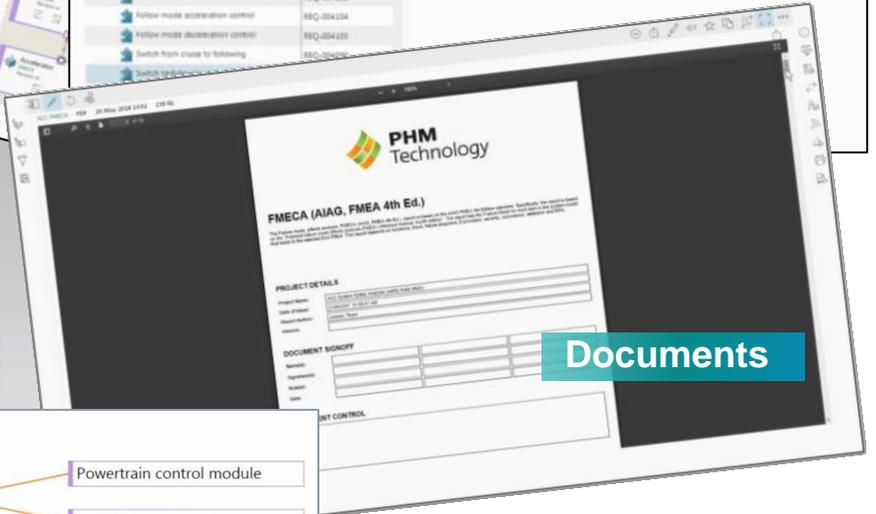
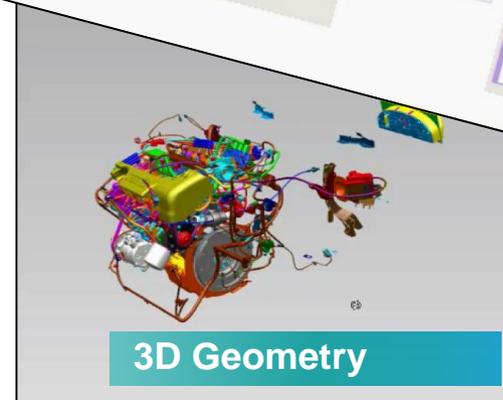
Multi-domain Architecture

- Attributes
- Features
- Safety
 - Auto Emergency Braking (AEB)
 - Electronic Stability Control
 - Antilock Braking
 - Adjustable Steering Column
 - Tyre Pressure Monitor
 - Forward collision warning
 - Adaptive Cruise Control
 - Blindspot Warning System
 - Lanekeeping Assist
- Climate
- Seats
- Entertainment
- Locks & Security
- Towing
- Fuel Economy & Emissions
- Power & Battery
- Systems
- EBOM

Requirements

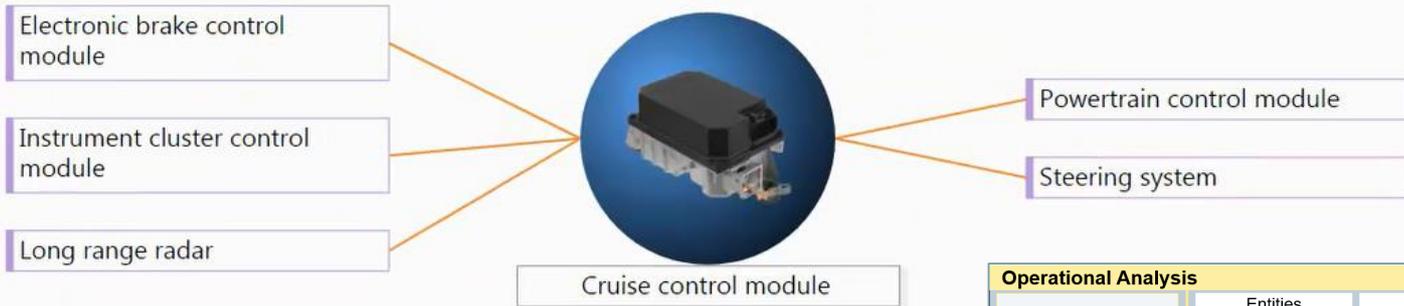
REVISION NAME	ID	REQ-004076
ACC self test	REQ-004076	
ACC stationary object differentiation	REQ-004077	
ACC vehicle detection distance	REQ-004078	
ACC vehicle differentiation on two-way traffic	REQ-004079	
Accelerate towards desired speed	REQ-004121	
Document maximum vehicle speed for ACC	REQ-004096	
Service ACC system	REQ-004094	
Service documentation for ACC system	REQ-004095	
Interface Requirements	REQ-004033	
Monitor and/or Status Requirements	REQ-004035	
Change mode	REQ-004122	
Define potential target vehicle position	REQ-004123	
Follow mode	REQ-004121	
Follow mode acceleration control	REQ-004124	
Follow mode observation control	REQ-004125	
Switch from cruise to following	REQ-004126	
Switch from following to cruise	REQ-004127	



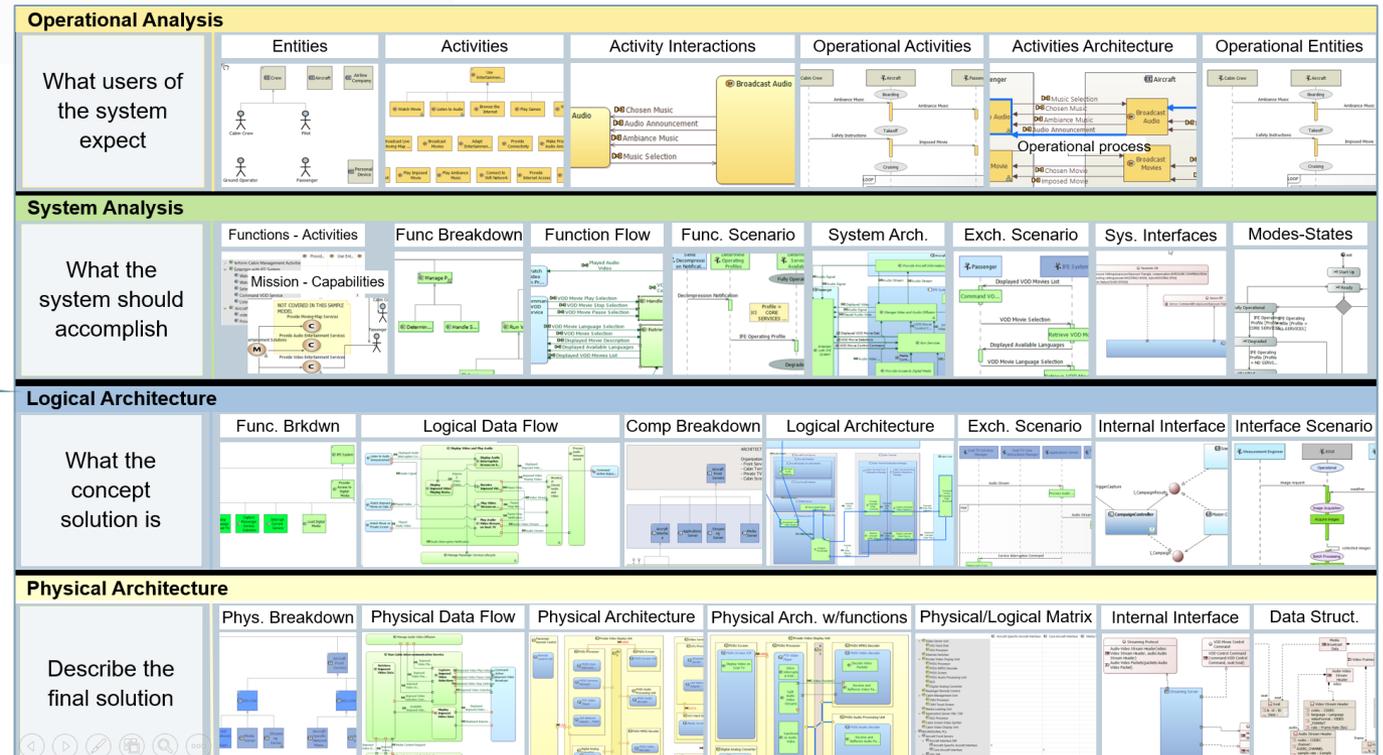
System focus and cross projects Architecture Together



Architecture View



System Model



System models having:

- More than 100 diagrams
- Both Structure and Behavior specification
- 100's dependency relations
- 1000's model elements

Traceability with Teamcenter Requirements

workspace - Capella - platform/resource/AlarmClock/AlarmClockAird/[LAB] Logical System - System Modeling Workbench

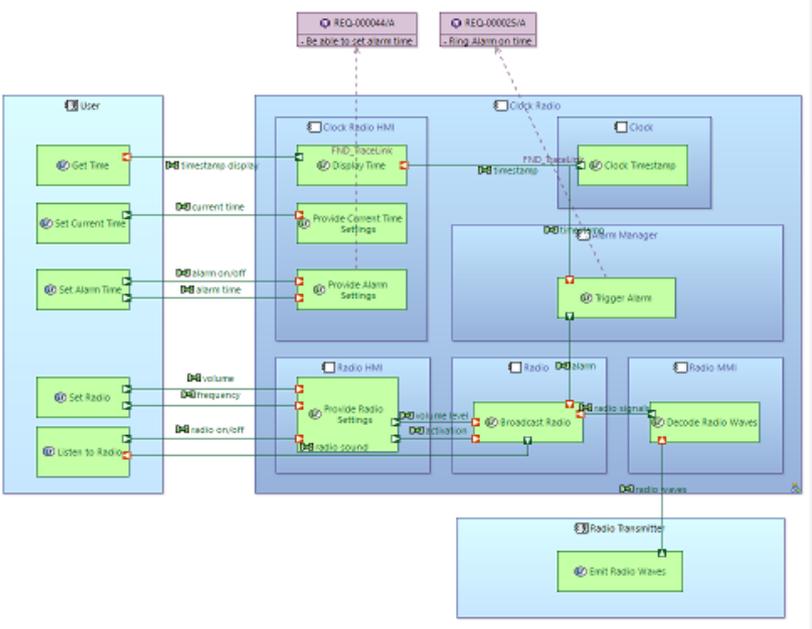
File Edit Diagram Navigate Search Project Run Teamcenter Window Help

Capella Project Explorer

Select a name to find
Type filter text

- 000204/A - AlarmClock
 - AlarmClock.afm
 - AlarmClock.aird
 - PLM Data
 - Operational Analysis
 - System Analysis
 - Logical Architecture
 - Logical Functions
 - Capabilities
 - Interfaces
 - Data
 - Logical Context
 - Clock Radio
 - Clock Radio HMI
 - Clock
 - Alarm Manager
 - Radio HMI
 - Radio MMI
 - [LAB] Logical System
 - [LCBD] Clock Radio
 - Logical Actors
 - Physical Architecture
 - EPBS Architecture
 - Representations per category
 - AlarmClock/melodymodeller
 - AlarmClock_with_Lib
 - Lib_LDE

[LAB] Logical System



Active Workspace

demo (demo)-Engineering/Designer-Latest Working

000204/A;4-AlarmClock

Owner: demo (demo) Date Modified: 16-Oct-2018 18:02 Release Status: Type: UML SysML Model

Overview Diagrams Relations Requirements

NAME	ID	...
Ring Alarm on time	REQ-000025	false
Be able to set alarm time	REQ-000044	false

Properties Information Problems

Semantic Browser

Semantic browser not available

Referencing Elements	Current Element	Referenced Elements

Fast Linker

Properties are not available

490M of 2430M

PLM Software

Multi-Domain Engineering Digital Thread

Benefits of an integrated product architecture with PLM



Create, visualize and manage systems with dependencies at the speed of thought

ONE Integrated System Specification

- Define, manage and visualize ONE integrated system specification across domains

Collaboration

- Specify, coordinate, and align, multiple engineering domains with consistent data

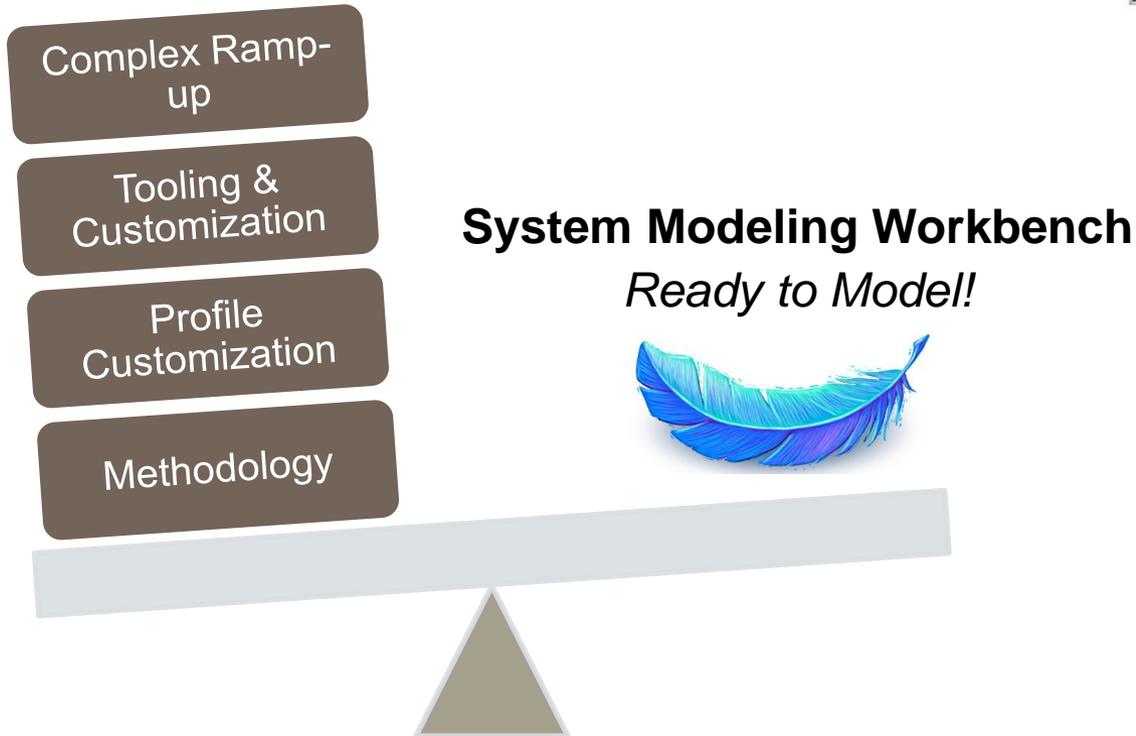
Variation

- Support complexity with multiple product variants

User Experience

- The right data at your fingertips
- Simply intuitive, walk-up usable day one





Ready Day 1

Invest in your engineering and not the tooling, ramp-up and support of customizations



Deploy in Months or Weeks

Be up and running in less time than the typical 1-2 years investment



Based-on Open Source “Truly Open”

Extend while avoiding lock-in with vendor-specific customizations upon tooling

The value of orchestration...

Product architecture and its requirements/targets/attributes specifications are the sheet music that everyone works from in their domains





Thank you.