MATLAB EXPO

Model-Based System Engineering

Cooling System Demo

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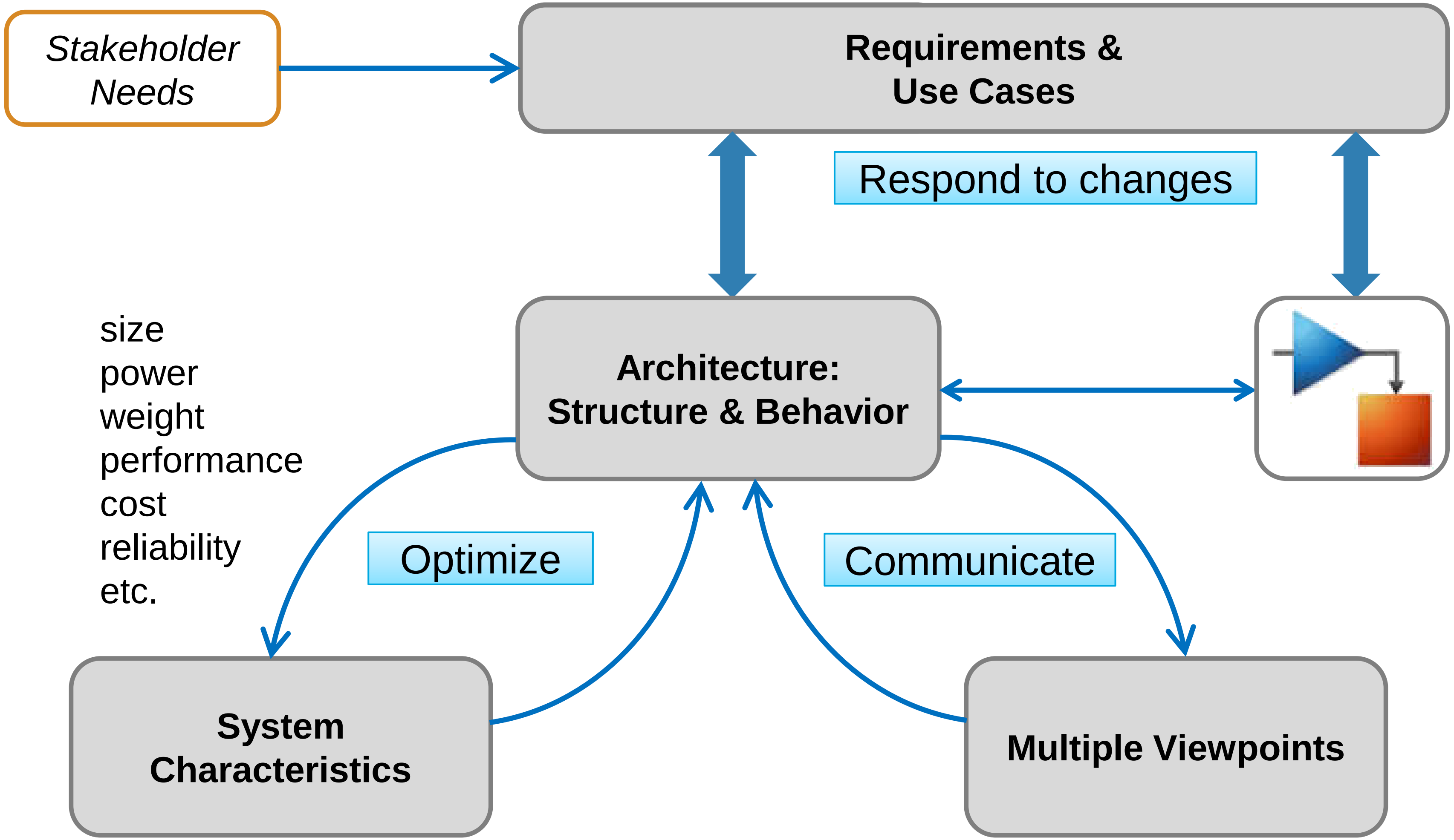
System Engineering Workflow



Highly Iterative

Highly Collaborative

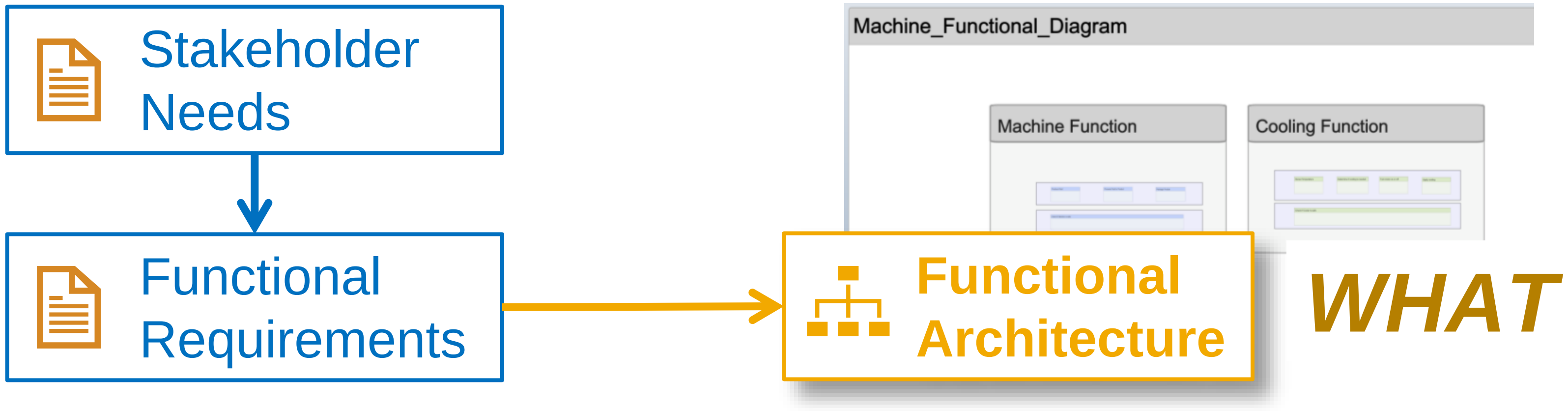
Deliverables:

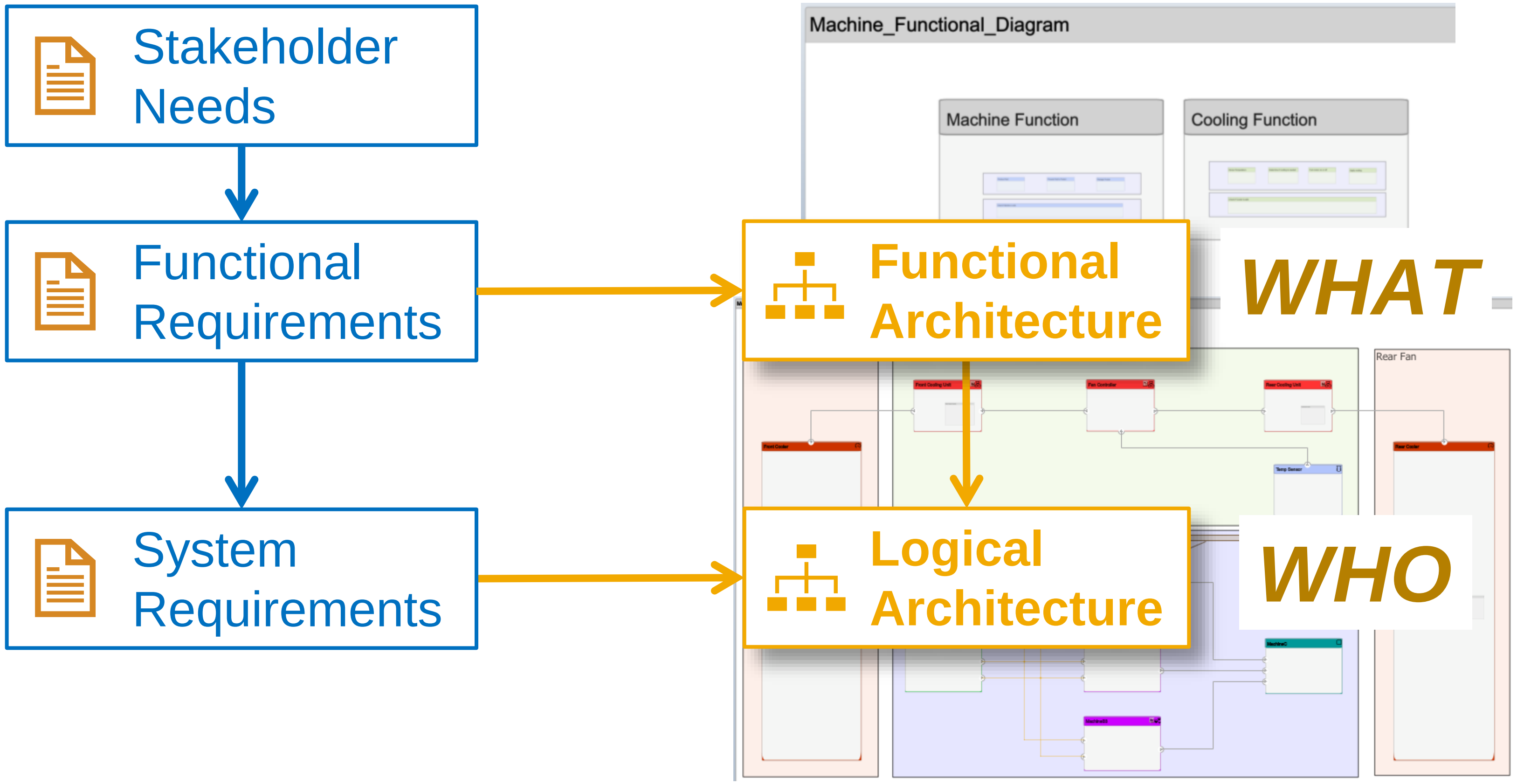
- Specifications
- ICDs
- Reports
- Code
- More….

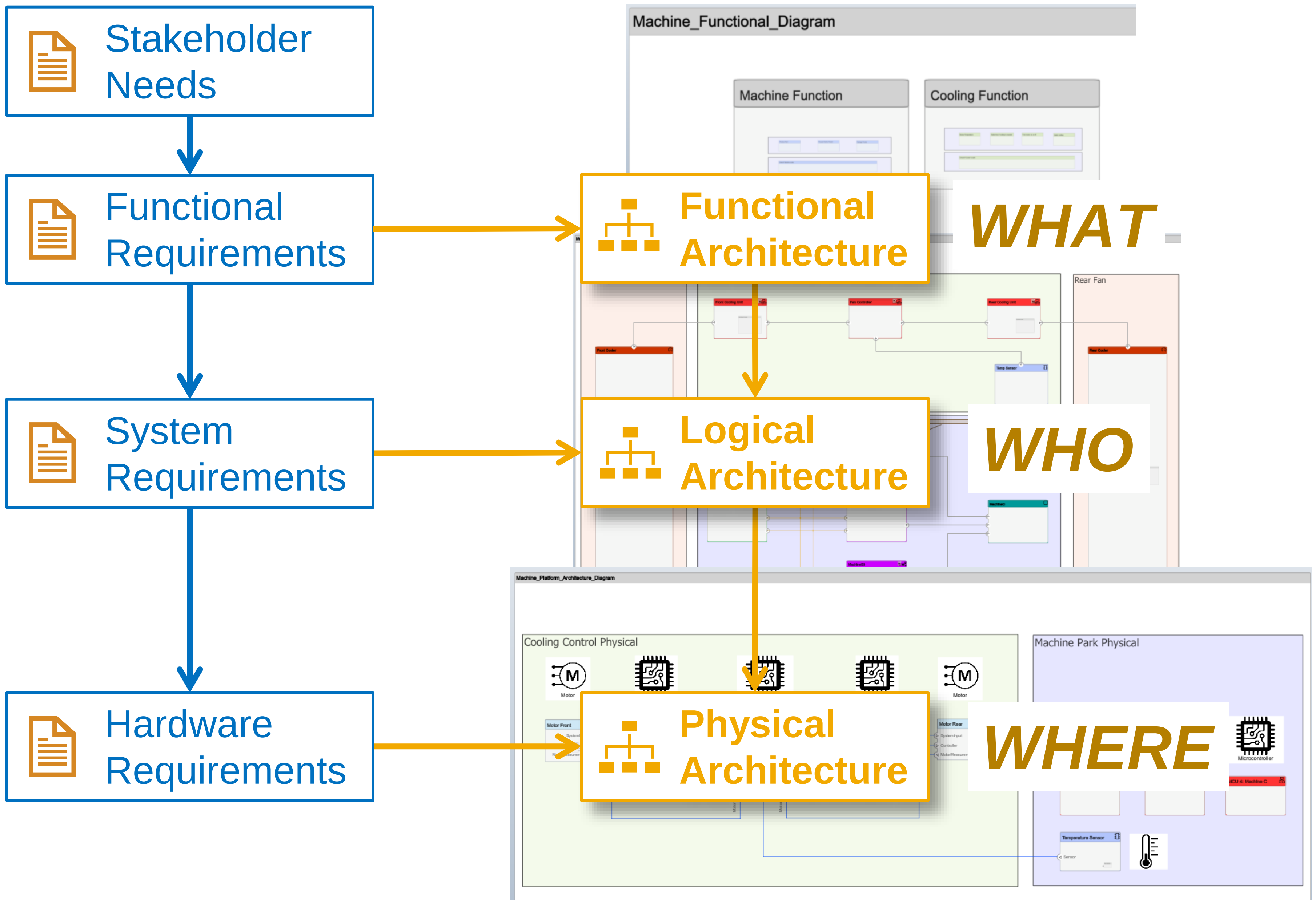
Stakeholder Needs

Requirements & Use Cases

Architecture: Structure & Behavior

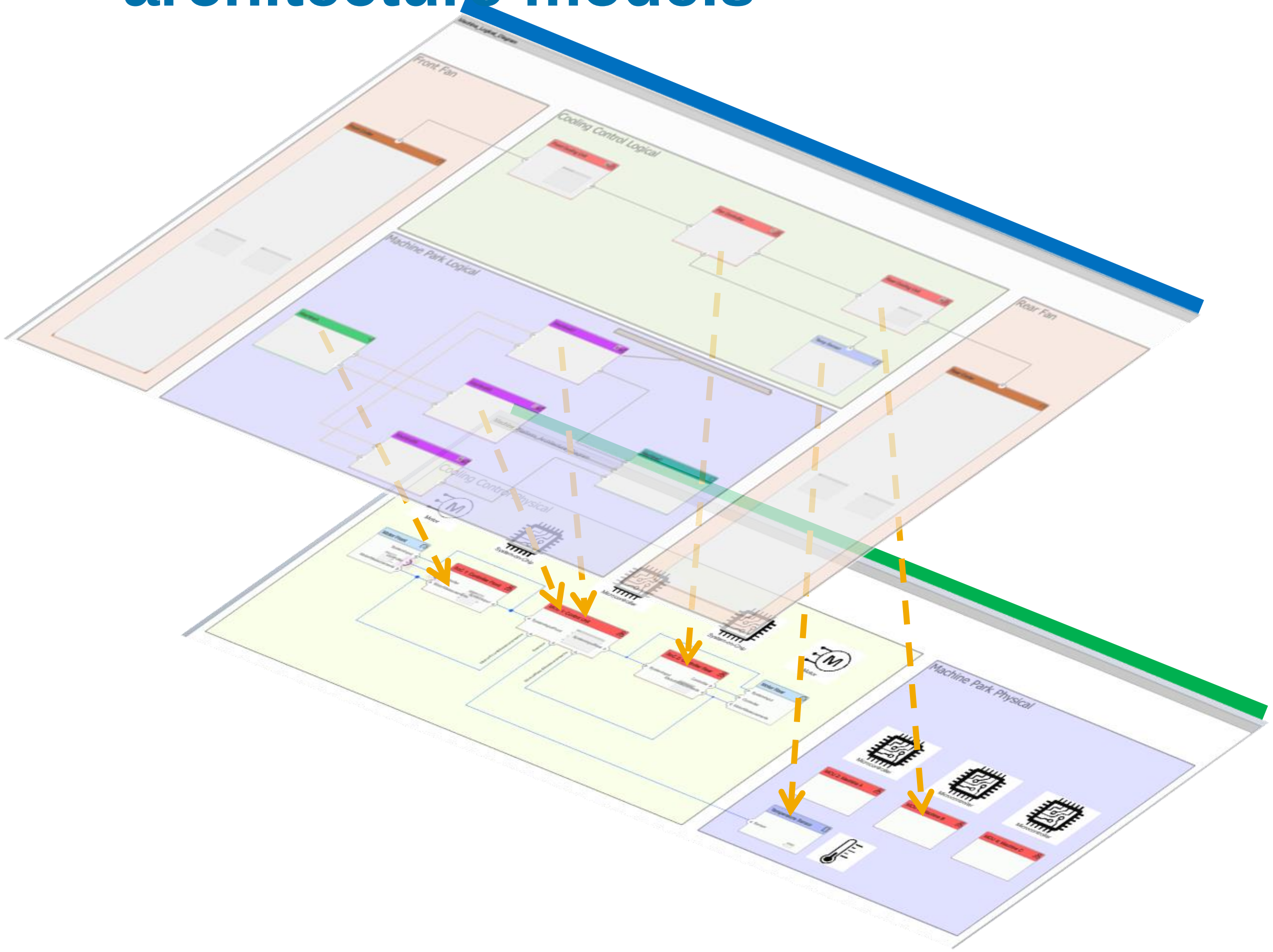

Stakeholder Needs
Functional Requirements
Machine_Functional_Diagram
Machine Function
Cooling Function
Functional Architecture
WHAT

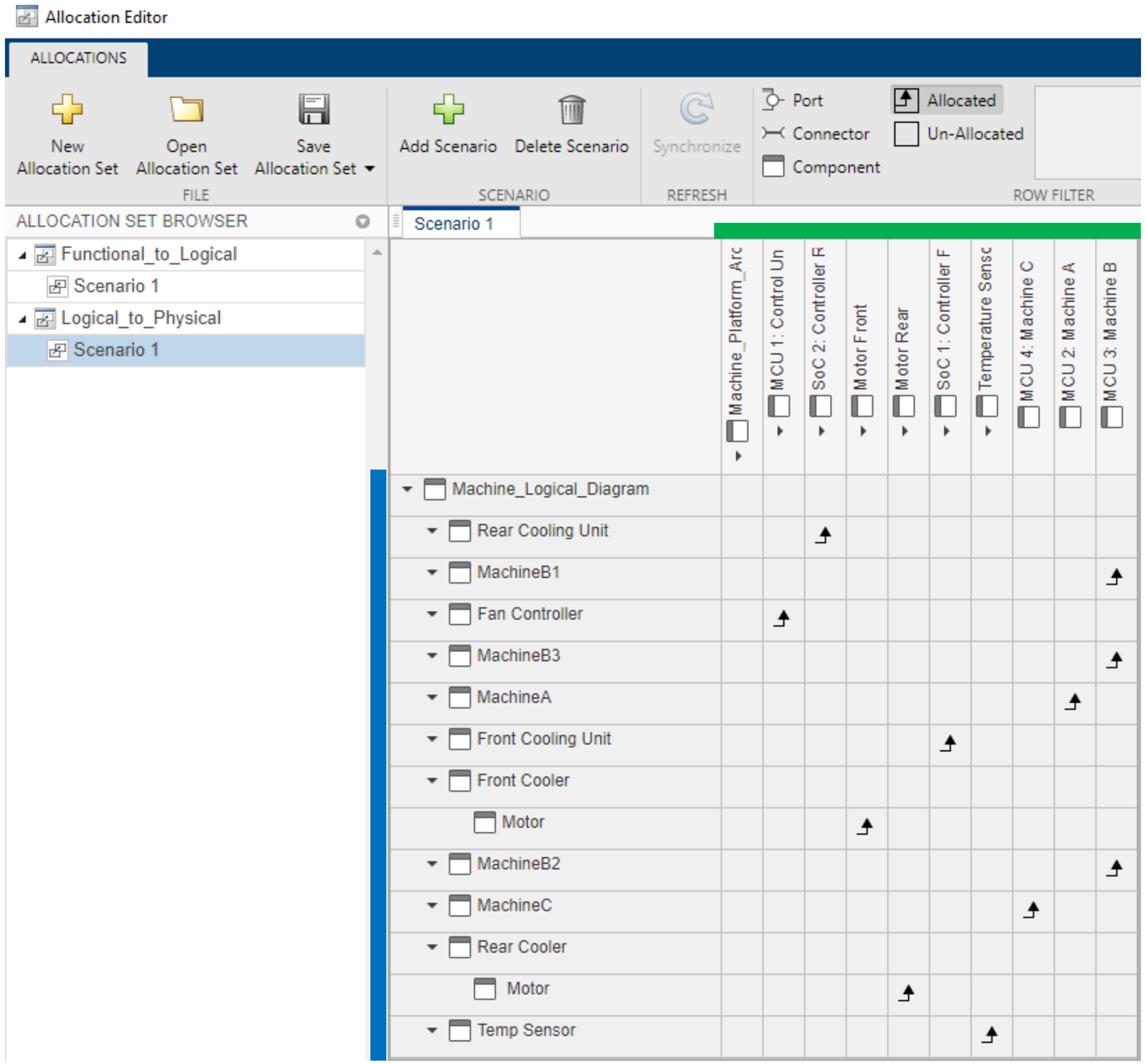

Stakeholder Needs
Functional Requirements
System Requirements
Machine_Functional_Diagram
Machine Function
Cooling Function
Functional Architecture
WHAT
Rear Fan
Logical Architecture
WHO



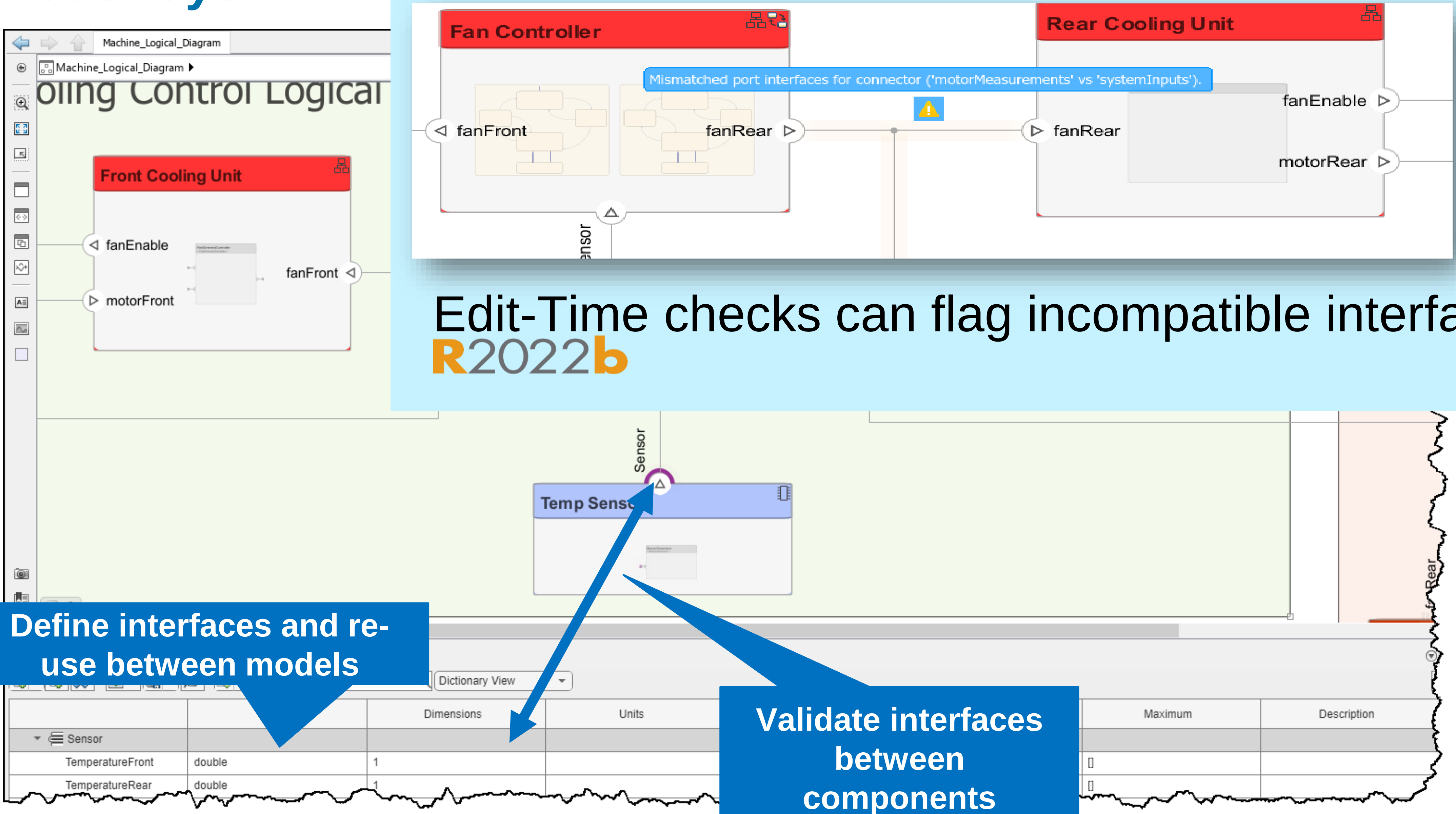
Stakeholder Needs
Functional Requirements
System Requirements
Hardware Requirements
Machine_Functional_Diagram
Machine Function
Cooling Function
Functional Architecture
WHAT
Rear Fan
Logical Architecture
WHO
Machine_Platform_Architecture_Diagram
Cooling Control Physical
Machine Park Physical
Motor
Physical Architecture
WHERE
Microcontroller

Allocate elements between functional, logical and physical architecture models





Model System Interfaces



Edit-Time checks can flag incompatible interfaces!

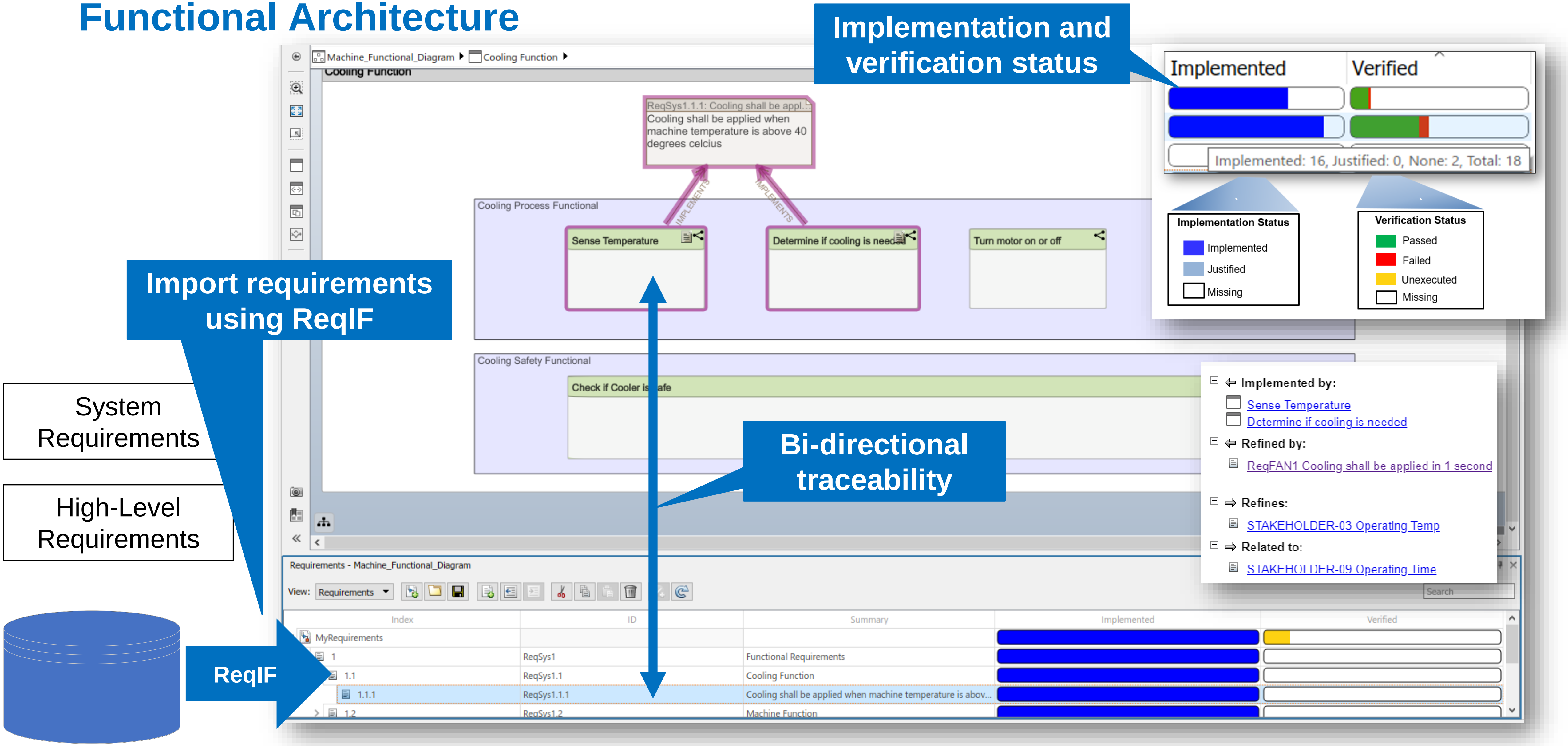
R2022b

Define interfaces and re-use between models

Validate interfaces between components

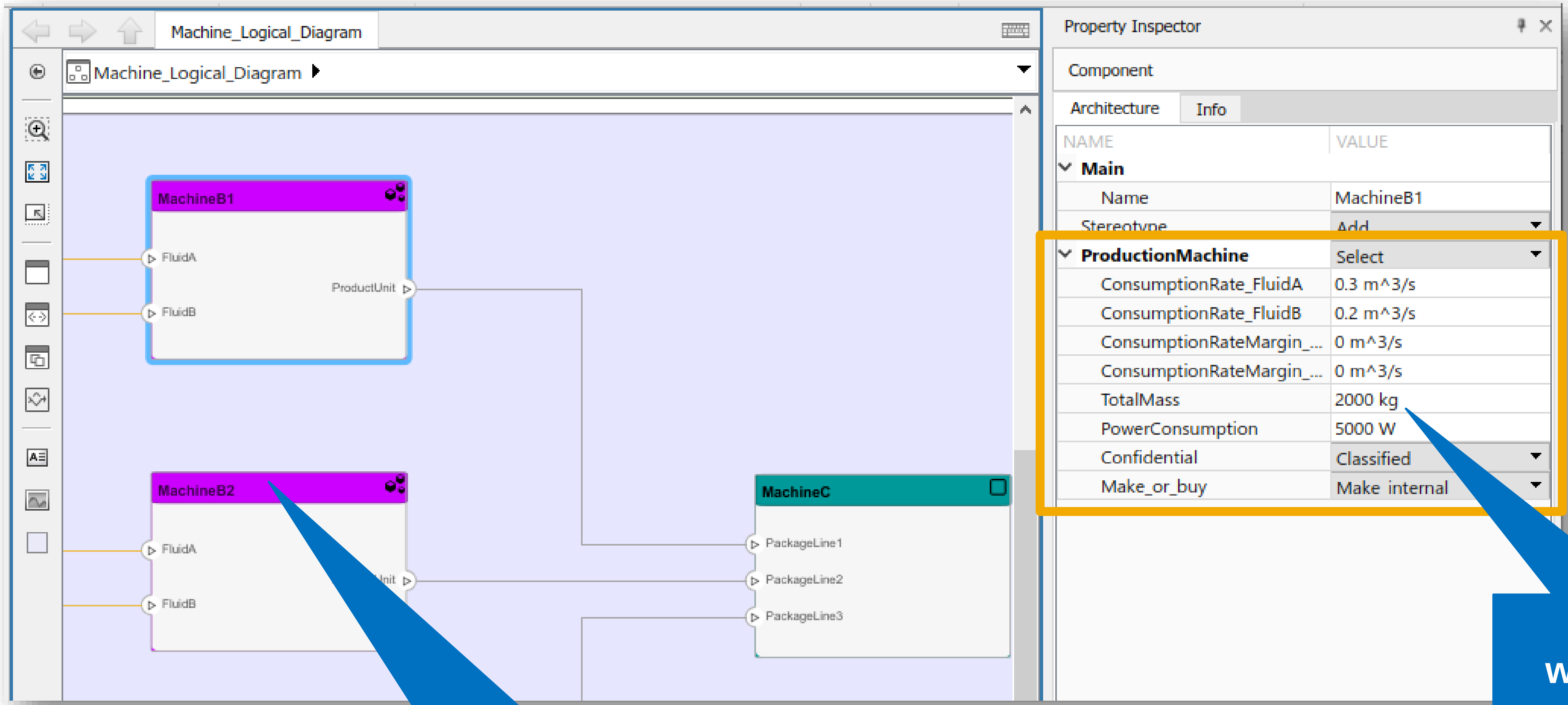
Function Decomposition and Requirements Traceability

Functional Architecture



Extend Modeling Language with Domain Specific Elements

Stereotype Properties and Profiles

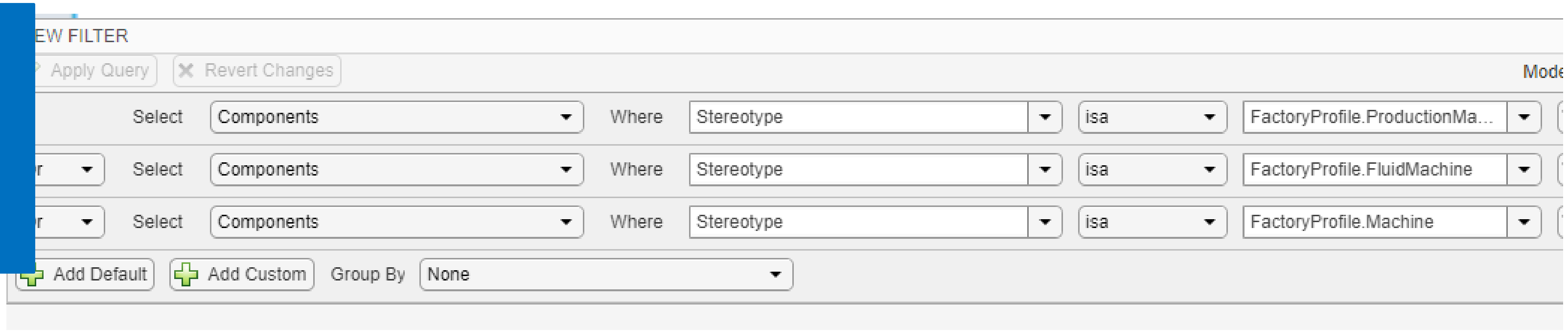


Extend graphical language with domain specific elements

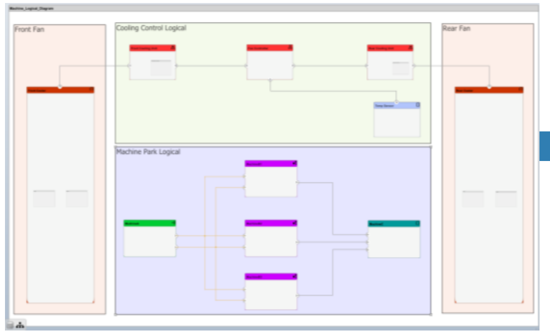
Properties with units and checking

Create custom views by defining Filters on your model

- *“Get all Software Components”*
- *“Get all Components with Mass greater than 10kg”*



ARCHITECTURE

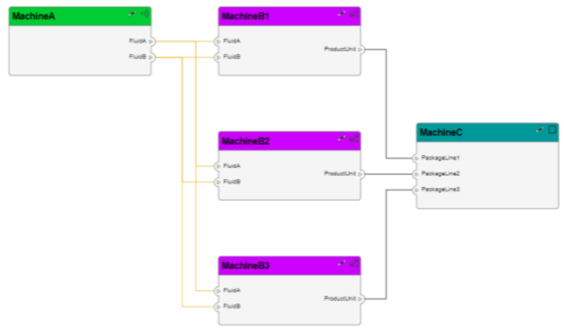


FILTER

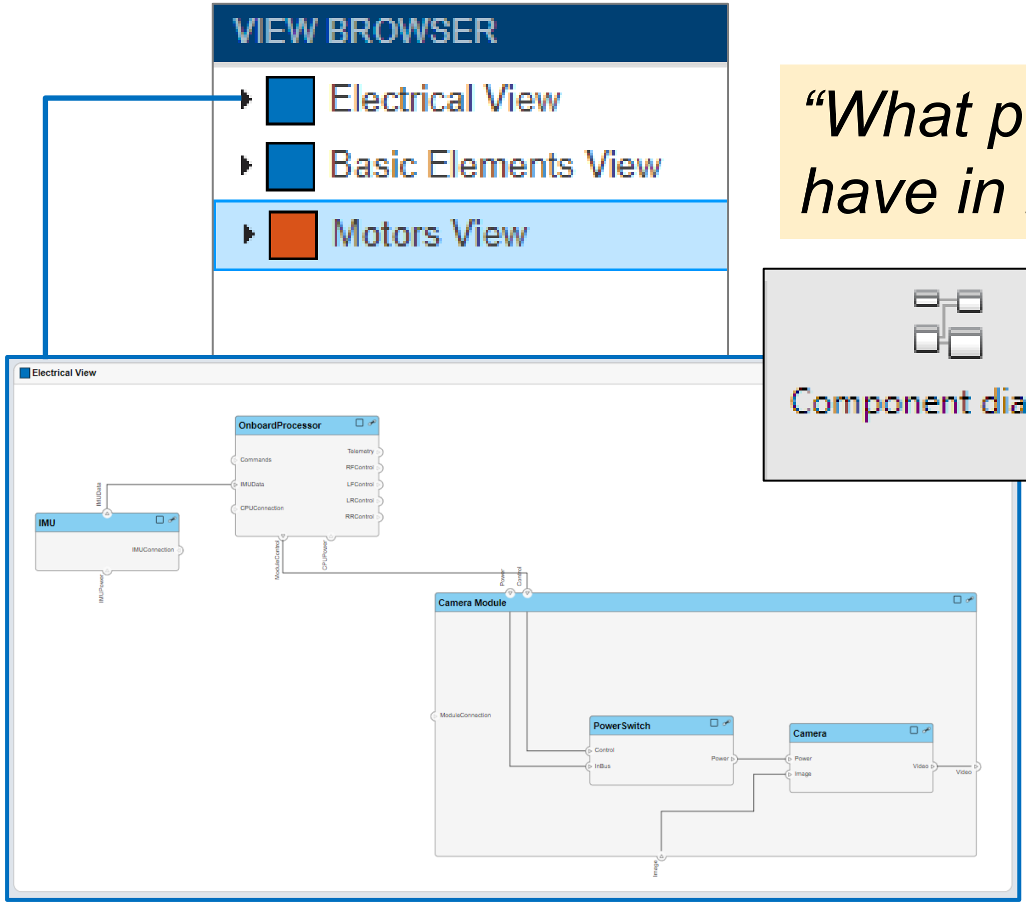
Select Components

Create Groups

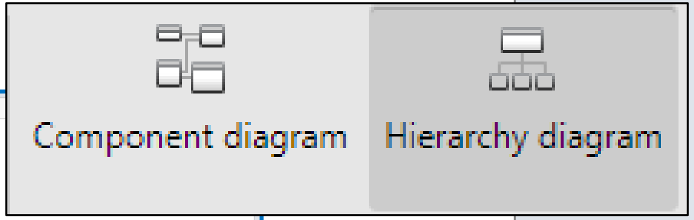
VIEW

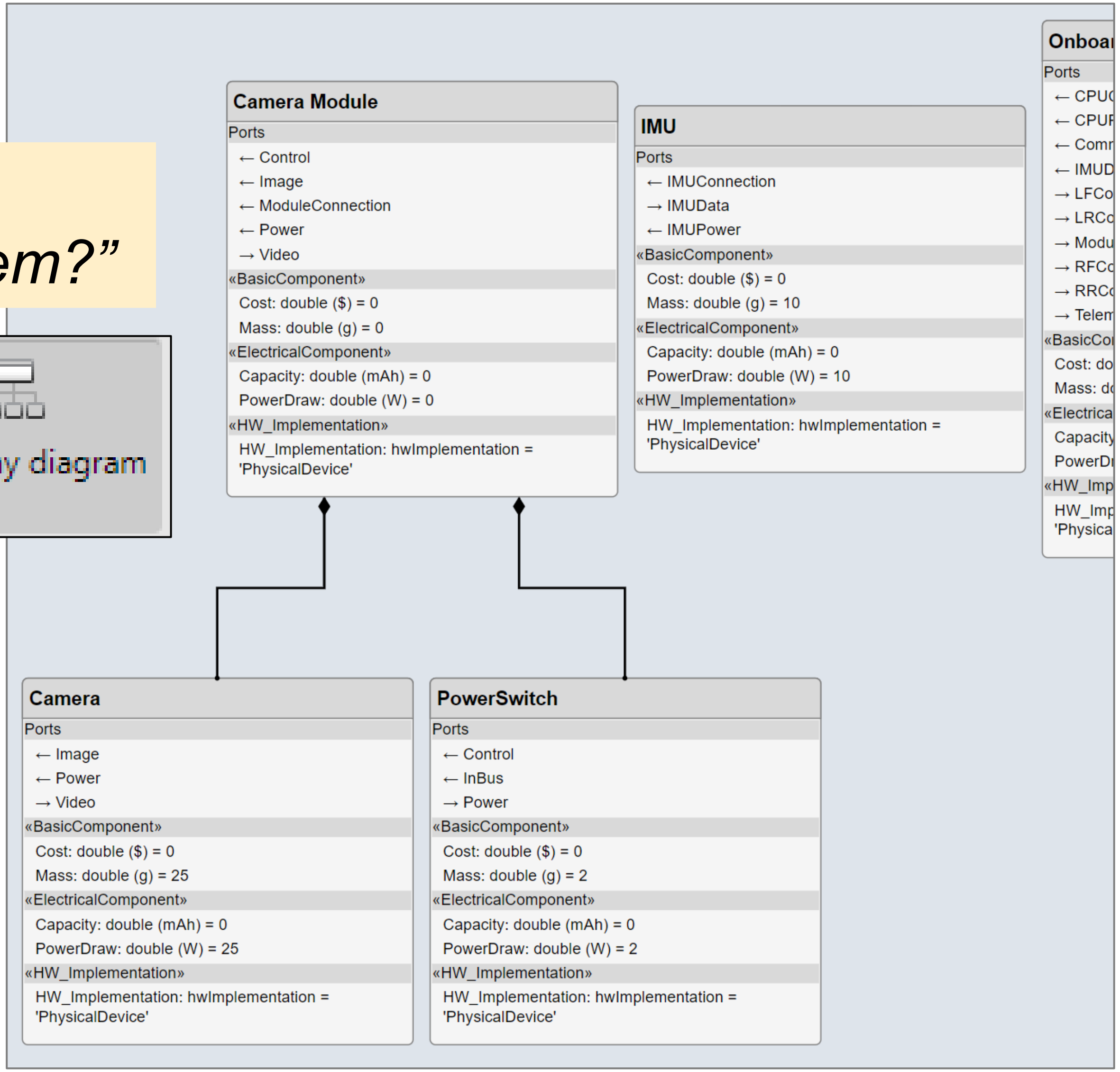


Hierarchy Diagram shows how your model is structured compositionally

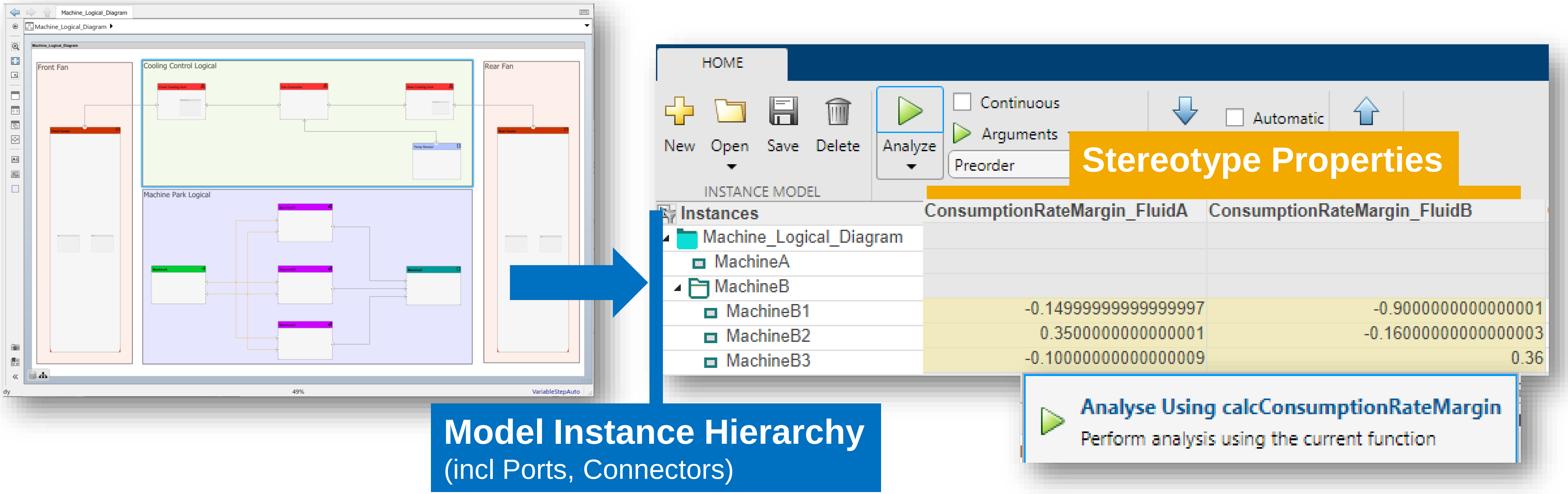


“What parts do I have in my system?”



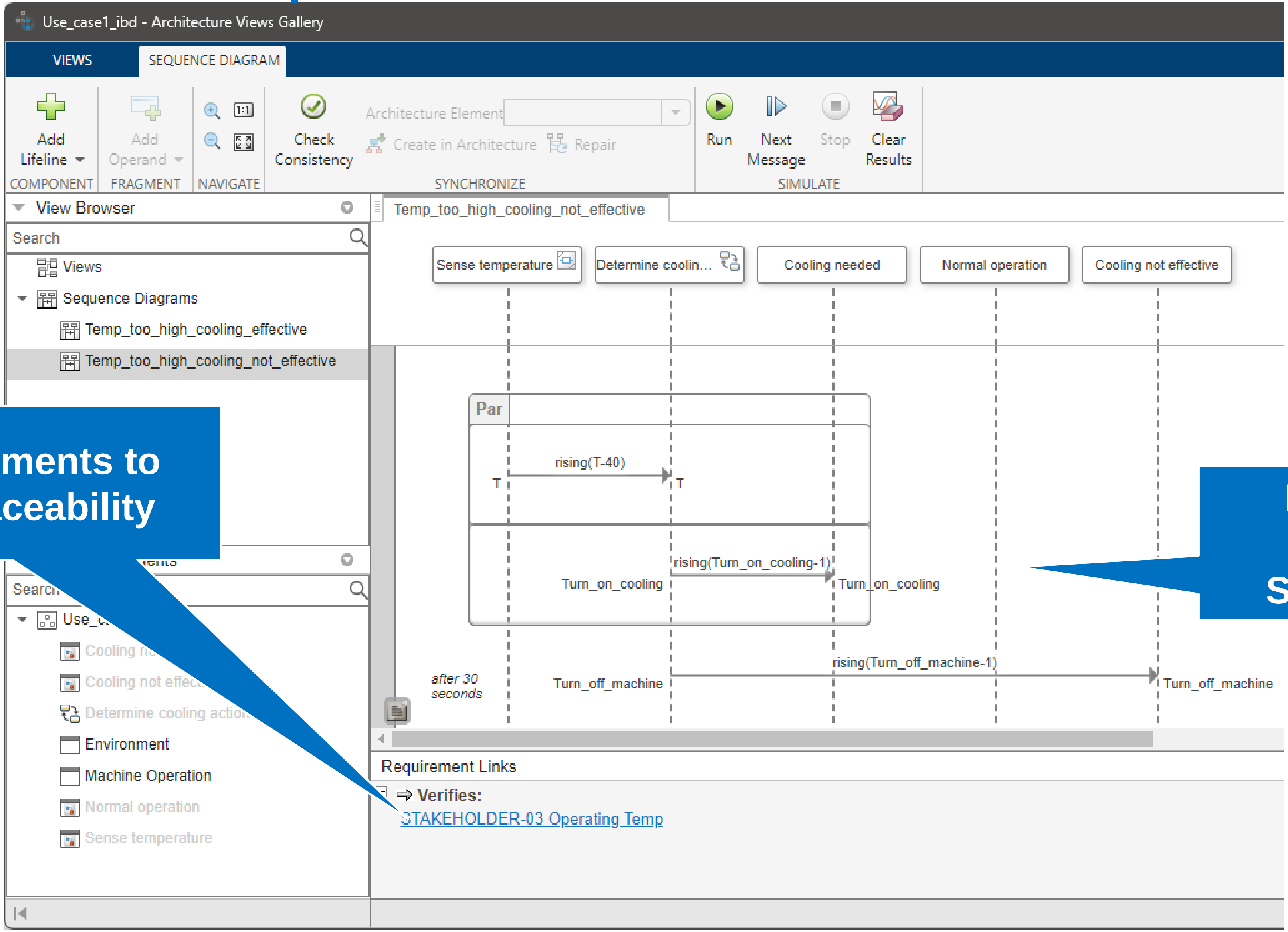


Interactive Analysis and Assess Results in the Analysis Viewer



Validate and Understand Use-Case Behaviors

By means of descriptive models

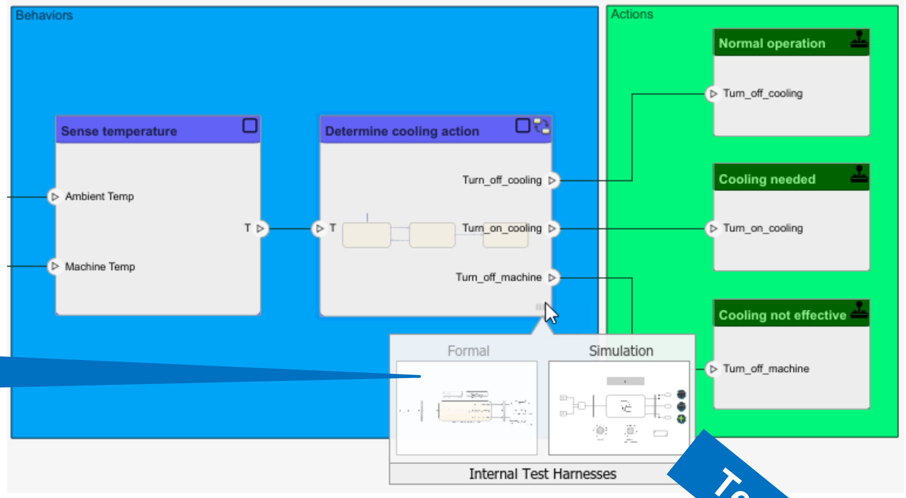


Link requirements to facilitate traceability

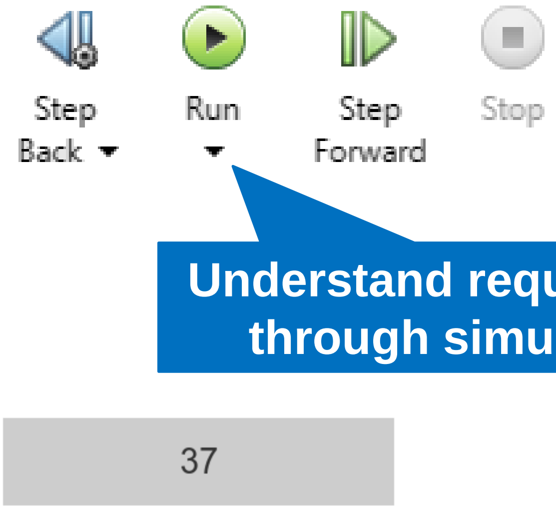
Describe complex scenarios using Sequence Diagrams

Specify Requirements with Simulation

By means of simulation models

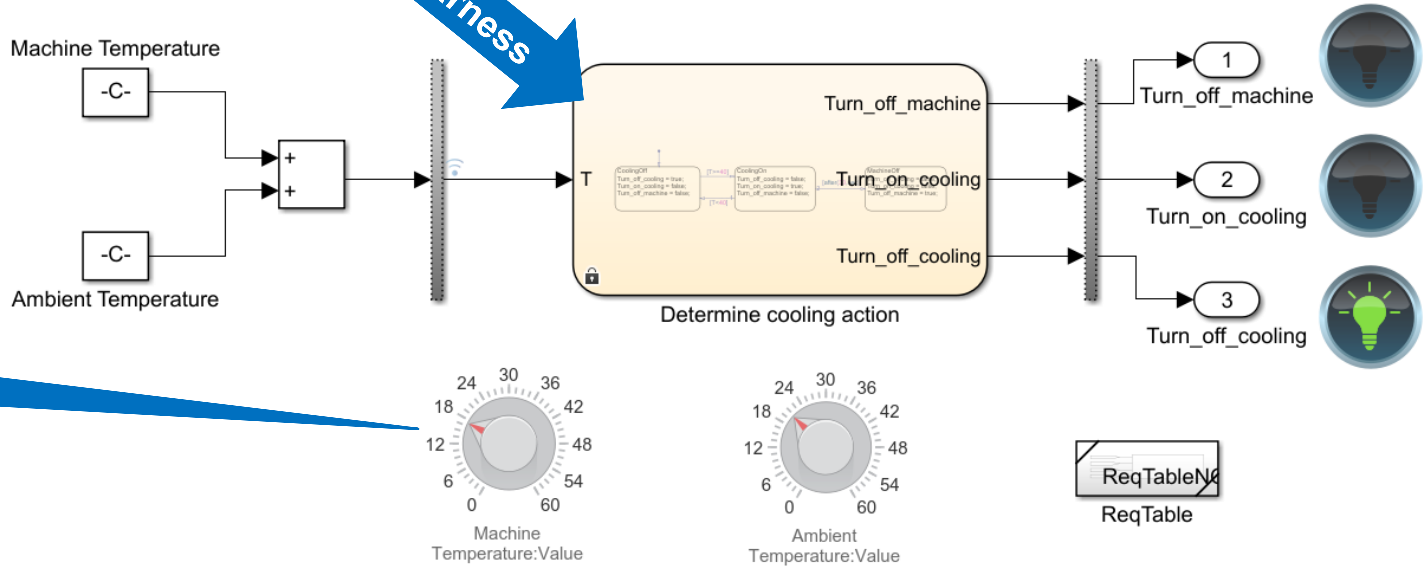


Integrated test harness



Understand requirement through simulation

Test harness



Explore behavior with different parameter inputs

MathWorks Value for Model-Based Systems Engineering

Maintain **requirements** as an **authoritative source of truth** throughout the **product development process**, by using (simulation) models to:

1. **Transform stakeholder requirements/needs**
   into design requirements using models, simulation and code generation
2. **Establish traceability**
   between requirements, architectures, designs and testcases
3. **Explore the design space**
   through (reusable) trade-off studies
4. **Manage system complexity**
   through views and traceable architecture models
5. **Connect system architecture**
   with software architecture and component implementations

Demo Overview

- Demonstrate a process how to design an architecture for a production machine and its cooling functionality using Model-Based Systems Engineering (MBSE)

Case Study: Machine Cooling System, stakeholder needs …..

Provide a system which maintains the operating temperature of a machine, avoiding damage to the machine because of overheating.

- **[constraint]** Cooling system needs to maintain operating temperature below 40 degrees.
- **[constraint]** Cooling needs to be effective within a predetermined time.
- **[assumption]** Environmental temperature greater than -10 degrees and smaller than 80 degrees.