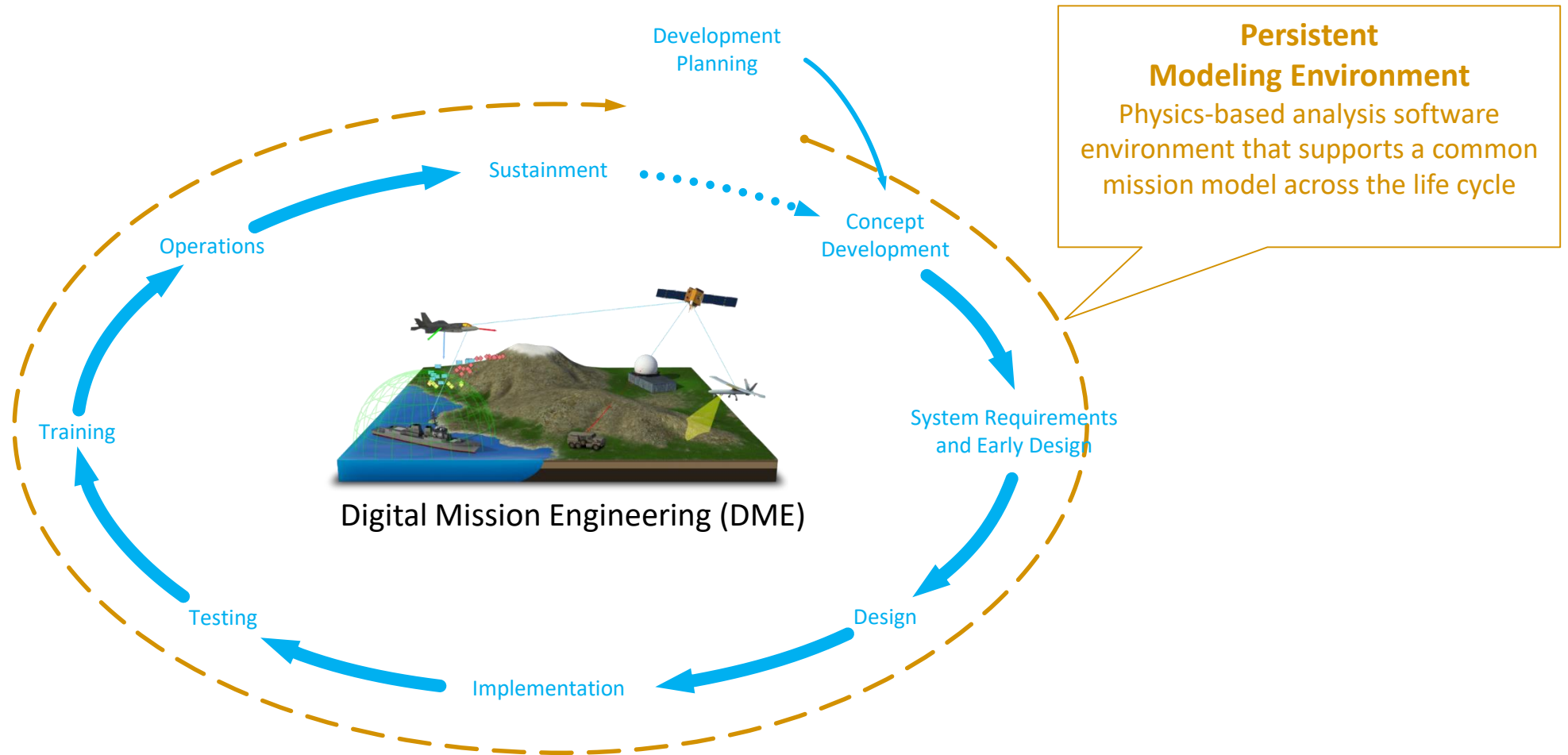# Integrating MBSE with Digital Mission Engineering (DME)
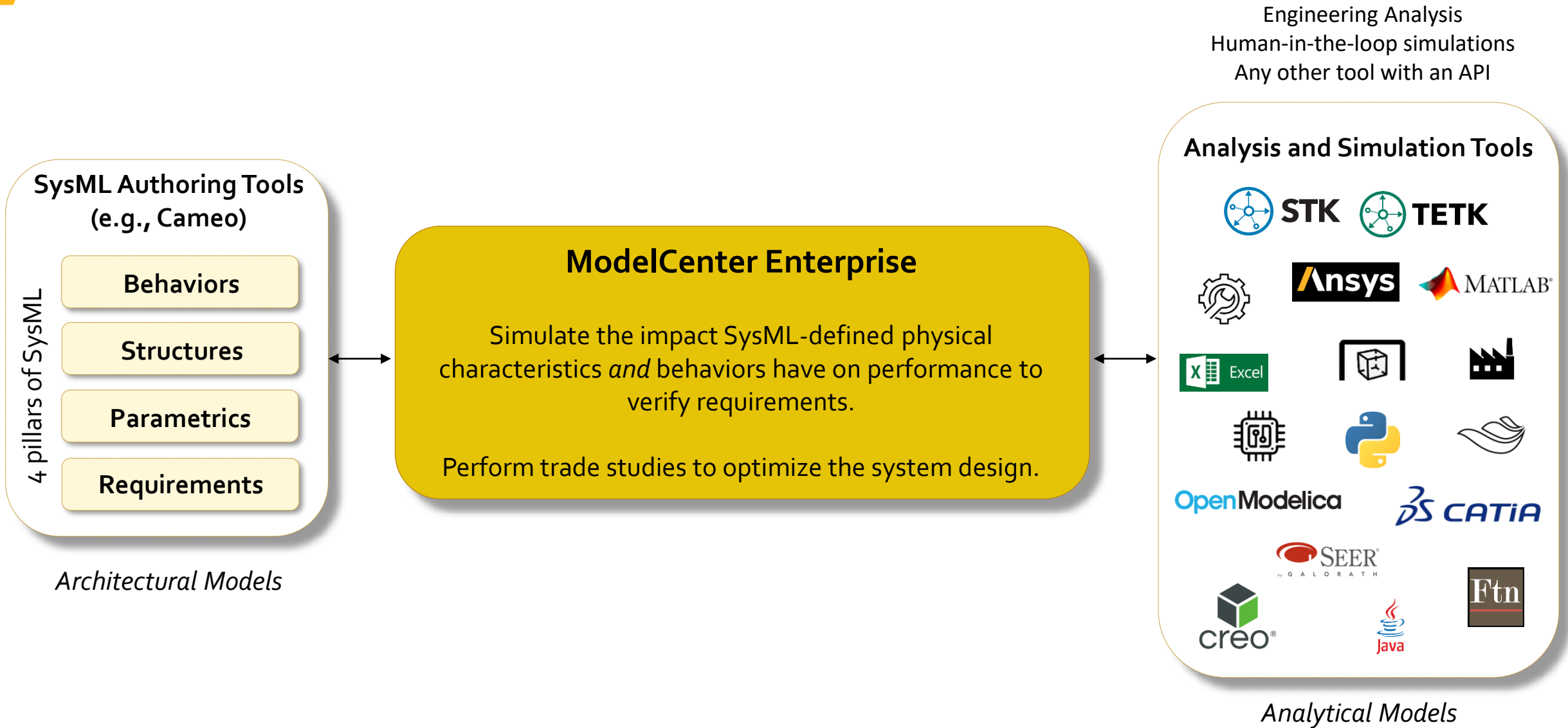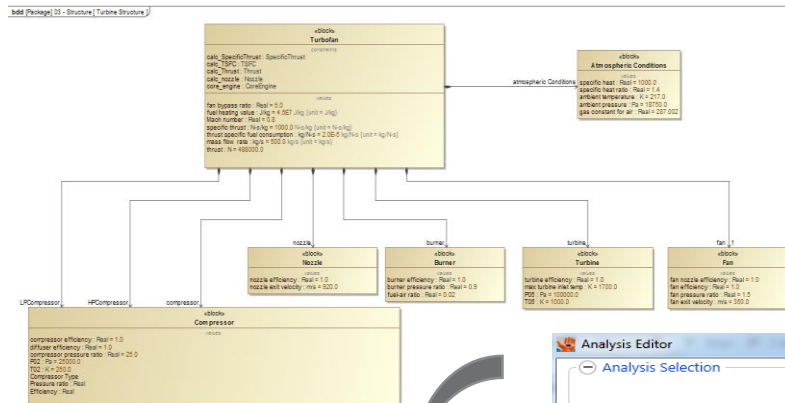
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Focus on the Mission

Assessing all representations of your system across the lifecycle relative to common mission-level requirements accelerates capability delivery

Digital Mission Engineering (DME)

Persistent Modeling Environment
Physics-based analysis software environment that supports a common mission model across the life cycle

Development Planning

Sustainment

Operations

Training

Testing

Implementation

Design

System Requirements and Early Design

Concept Development

Connect SysML to Digital Mission Engineering

Engineering Analysis
Human-in-the-loop simulations
Any other tool with an API

SysML Authoring Tools (e.g., Cameo)

4 pillars of SysML

- **Behaviors**
- **Structures**
- **Parametrics**
- **Requirements**

Architectural Models

ModelCenter Enterprise

Simulate the impact SysML-defined physical characteristics *and* behaviors have on performance to verify requirements.

Perform trade studies to optimize the system design.

Analysis and Simulation Tools

STK   TETK

Ansys   MATLAB

Excel

OpenModelica   CATIA

SEER by GALORATH

Ftn

creo   Java

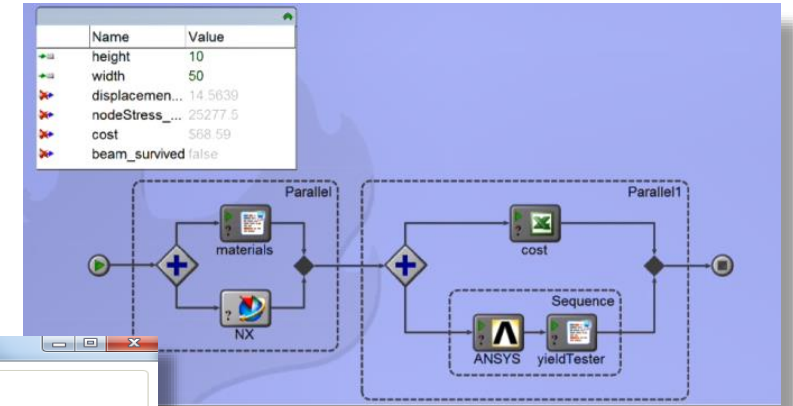*Analytical Models*

Simulate and optimize SysML designs of a system's *physical* characteristics
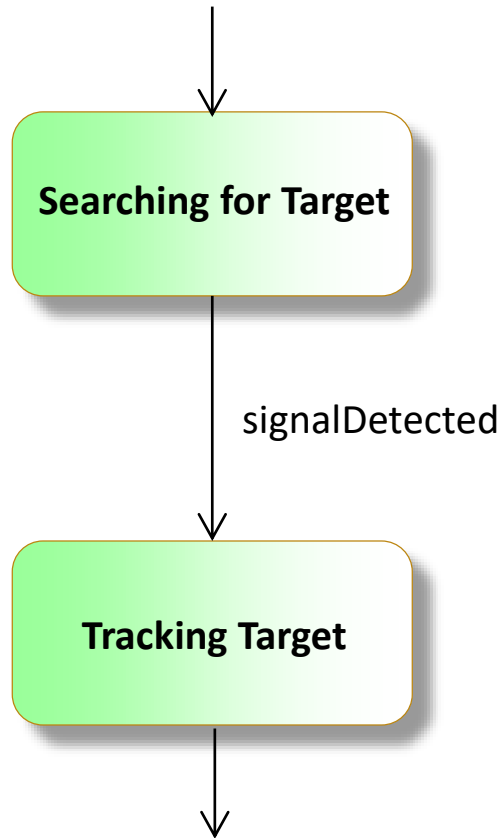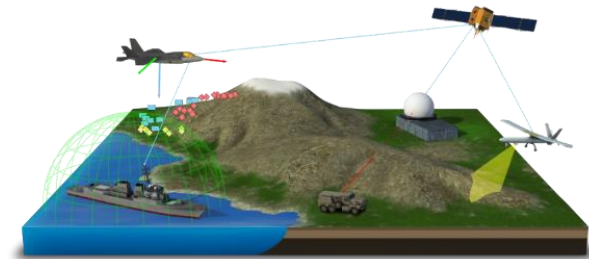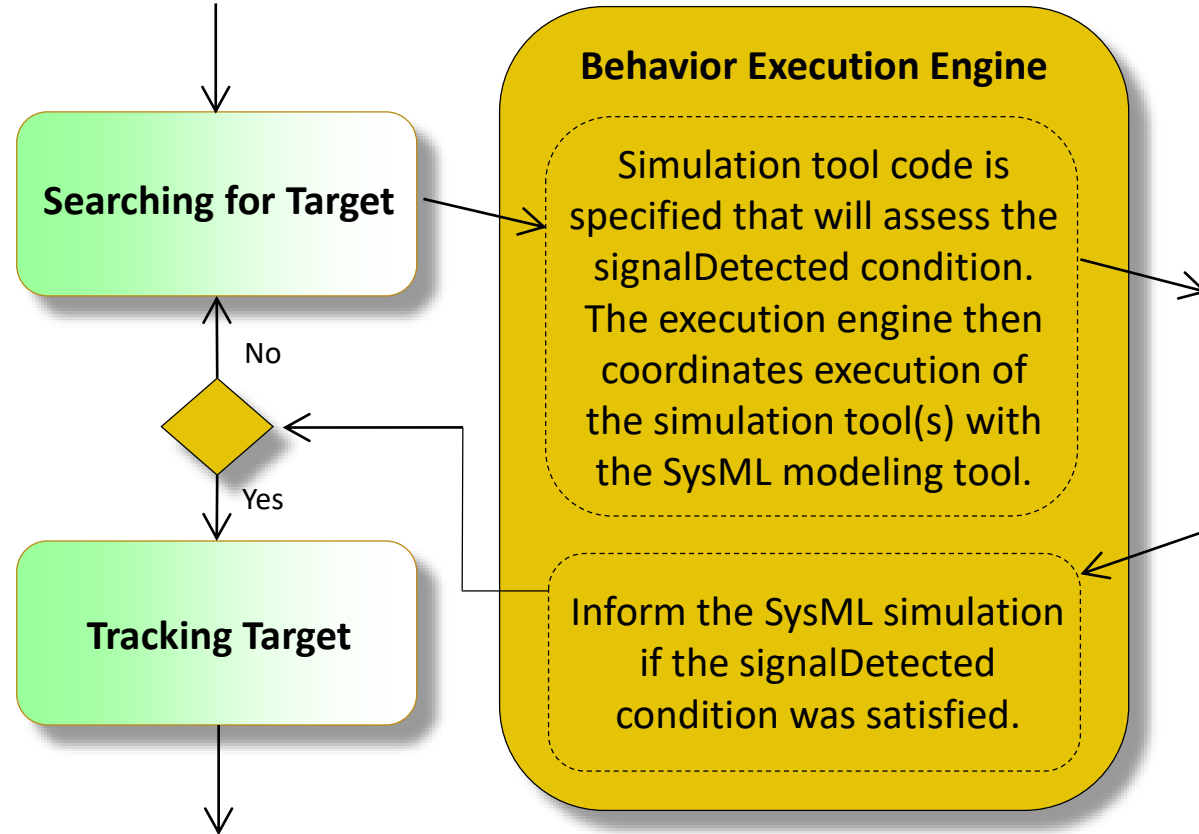

MBSE Value Properties
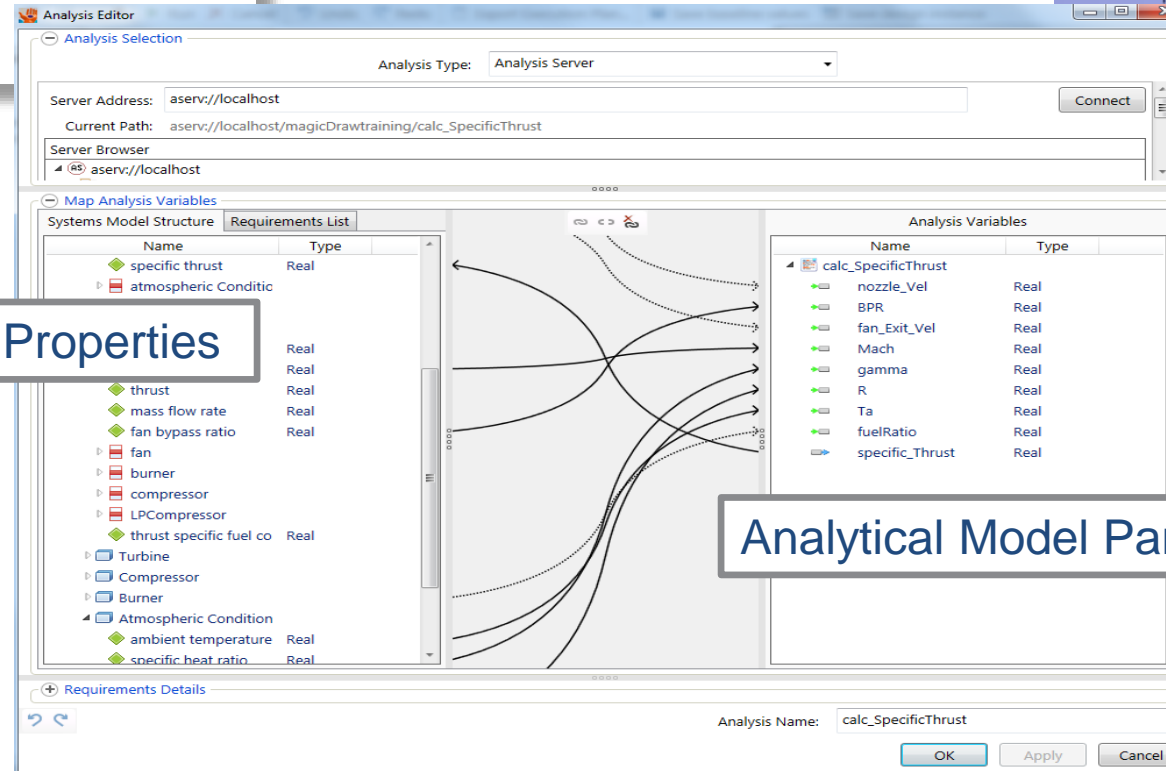
Analytical Model Parameters

Simulate and optimize SysML designs of a system's *behavioral* characteristics

System Engineer view of a state machine in a SysML authoring tool

Behind the scenes view of ModelCenter Enterprise simulating the signalDetected transition

Searching for Target

signalDetected

Tracking Target

Searching for Target

No

Yes

Tracking Target

Behavior Execution Engine

Simulation tool code is specified that will assess the signalDetected condition. The execution engine then coordinates execution of the simulation tool(s) with the SysML modeling tool.

Inform the SysML simulation if the signalDetected condition was satisfied.

Simulation tools such as STK assess if the signalDetected condition is satisfied using precise event-based timing and native algorithms

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Example Use Case: Communications Satellite Design

SysML Authoring Tools (e.g., Cameo)

4 pillars of SysML

- Behaviors
- Structures
- Parametrics
- Requirements

ModelCenter Enterprise

Simulate and optimize SysML-defined *behavioral* characteristics of the satellite system relative to system performance requirements.

For example, are the satellite's data caching behaviors adequate to handle communication degrade scenarios that evolve during the course of particular operational scenarios?
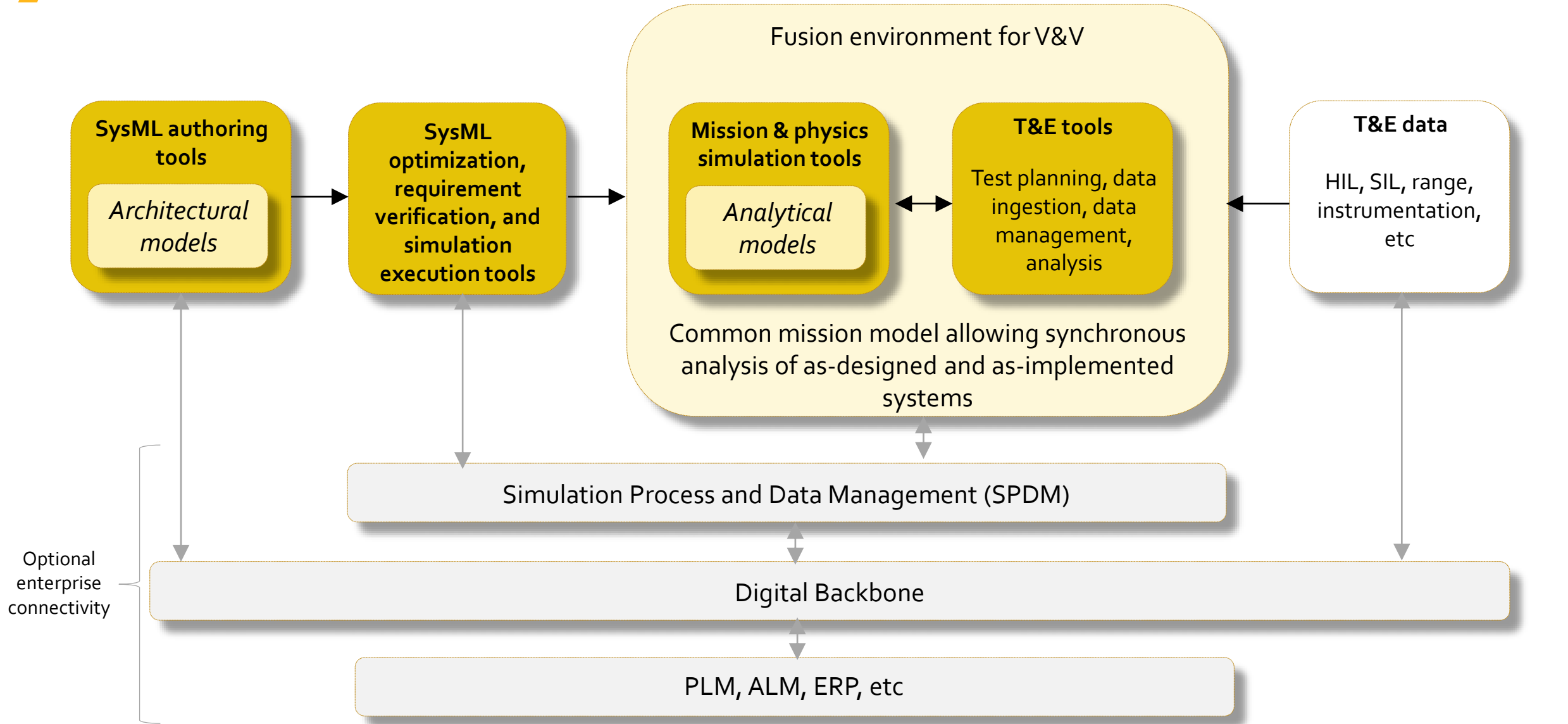
Simulate and optimize SysML-defined *physical* characteristics of the satellite system relative to system performance requirements.

For example, is the gain pattern provided by a particular antenna design adequate to satisfy communication relay requirements in particular operational scenarios? Does the cost model for this antenna meet budget constraints?
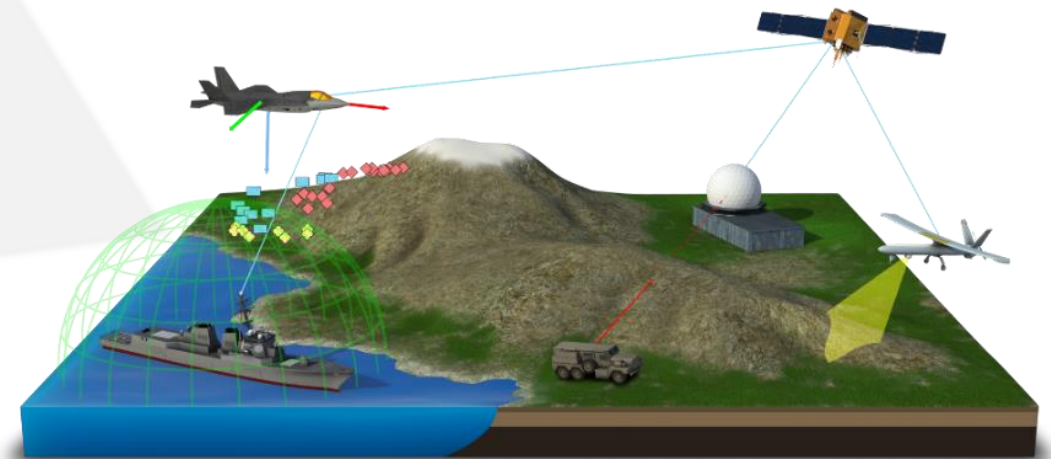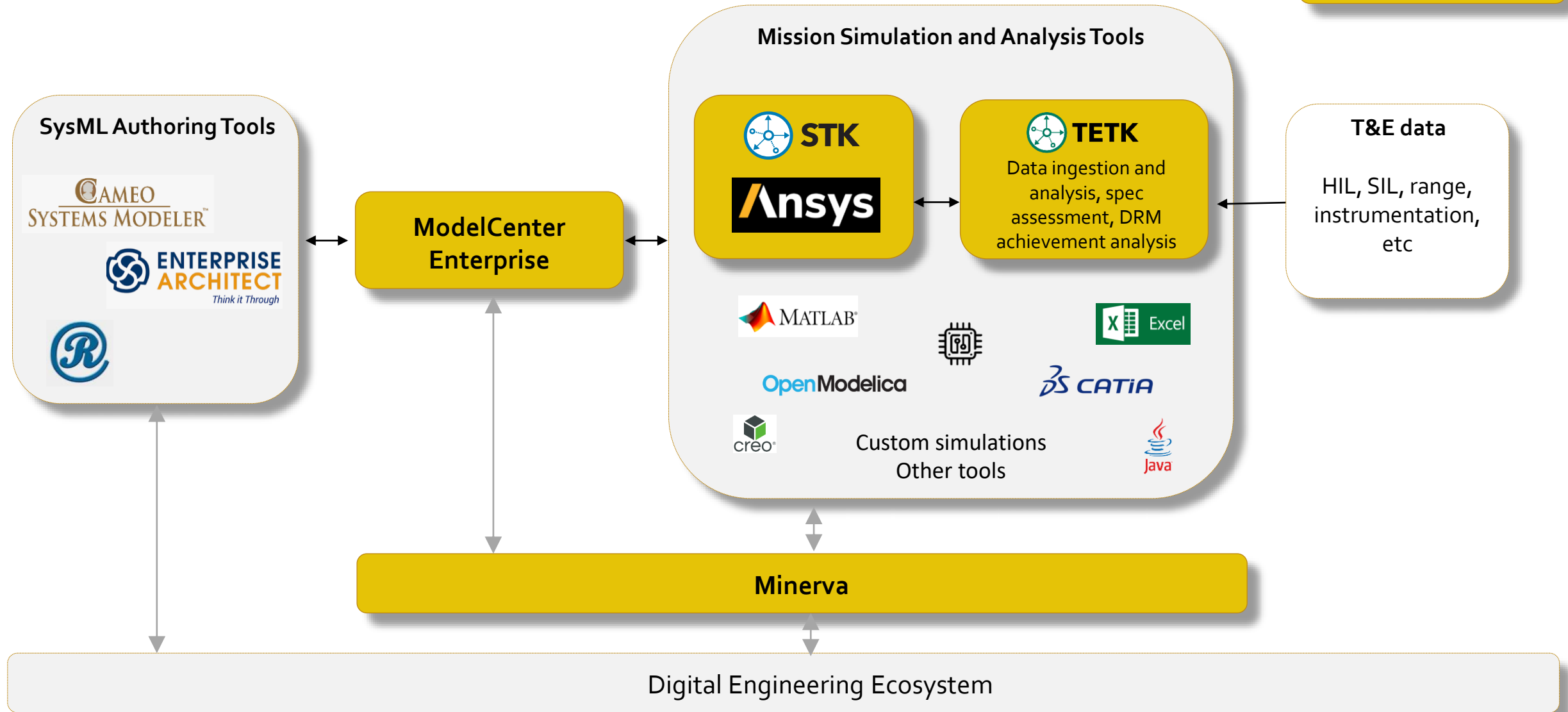
Analytical models and operational scenarios modeled in tools such as STK or MATLAB

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DME Architecture – Tool Agnostic View

Fusion environment for V&V

SysML authoring tools

Architectural models

SysML optimization, requirement verification, and simulation execution tools

Mission & physics simulation tools

Analytical models

T&E tools

Test planning, data ingestion, data management, analysis

T&E data

HIL, SIL, range, instrumentation, etc

Common mission model allowing synchronous analysis of as-designed and as-implemented systems

Simulation Process and Data Management (SPDM)

Digital Backbone

PLM, ALM, ERP, etc

Optional enterprise connectivity

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DME Architecture – Tool Specific View