MathWorks
AUTOMOTIVE CONFERENCE 2023
Korea

System Architecture Development for Vehicle Performance Analysis Using System Composer

SUNGHYUN CHO, HYUNDAI Motor Group

MathWorks

Agenda

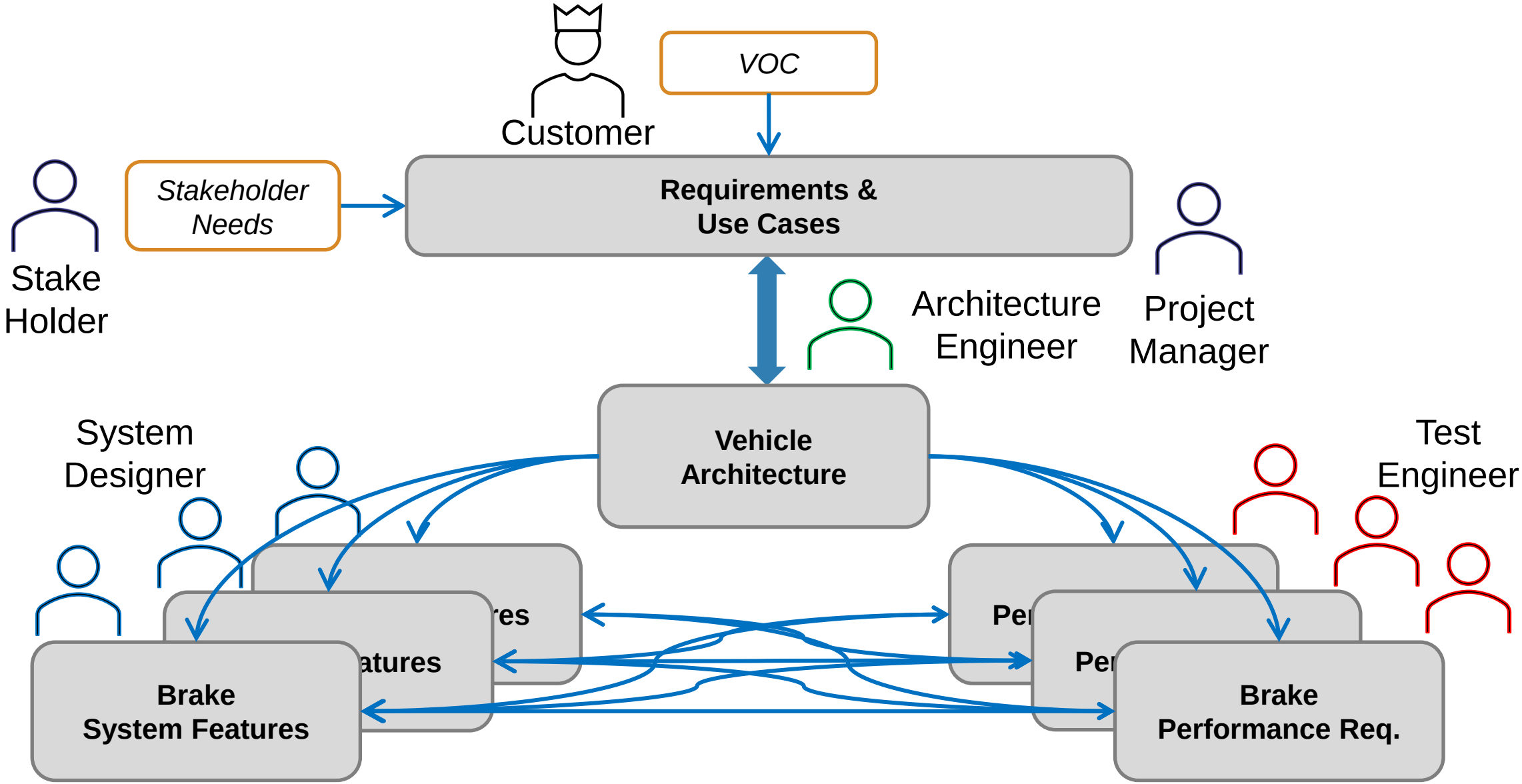
- What has made the search for a new methodology?
- Adopt “System Composer” for Brake System Architecture
- How does new approach help building Vehicle Architecture?
- Summary & Conclusion

Challenges in Vehicle Architecture Development

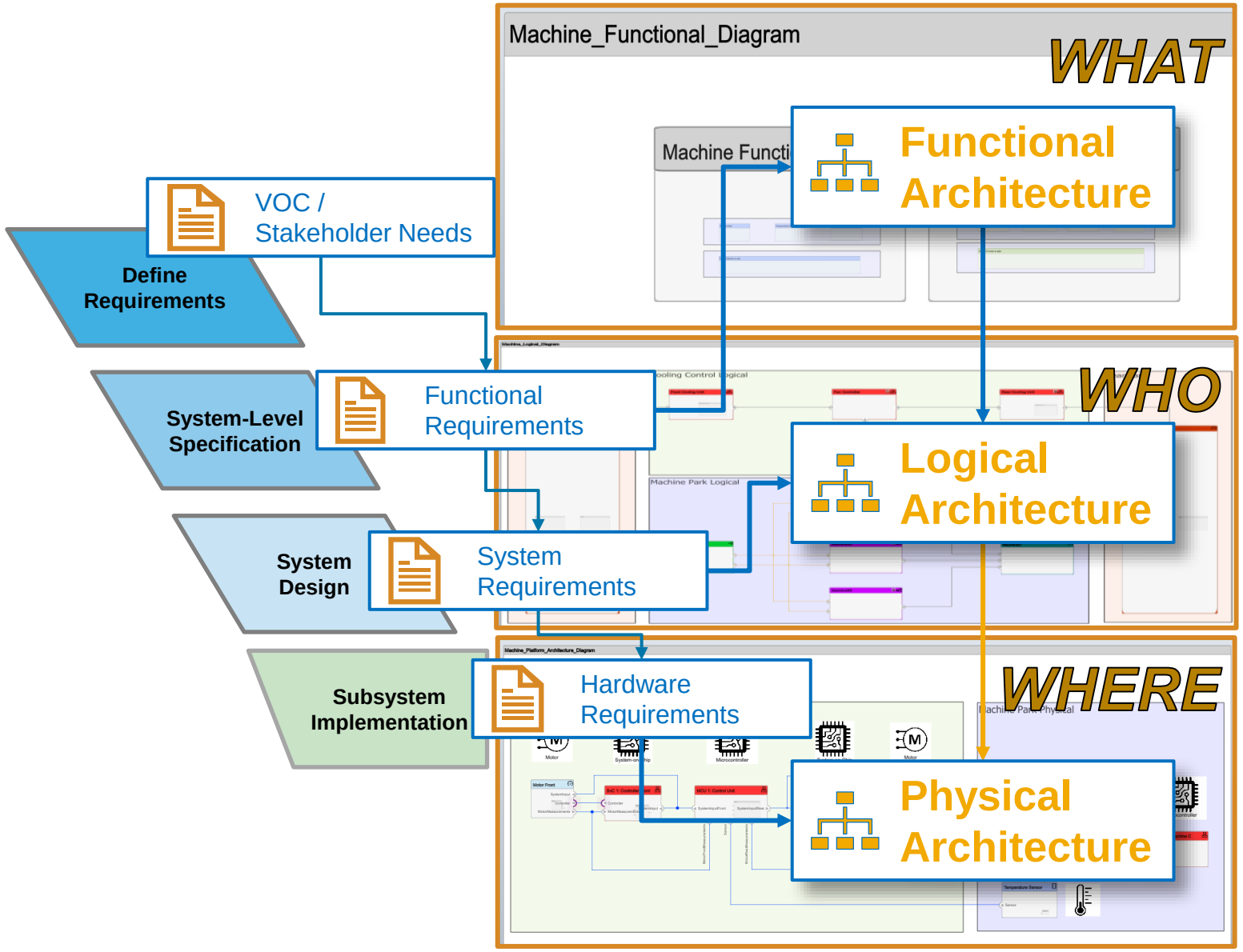
- Improve Customer Experience
- Scalability
- Reduced Development Complexity

- New Configuration
- Improve Performance
- Enhanced Function

VOC and Vehicle Architecture Development



How to Adopt System Composer for Architecture Modeling?



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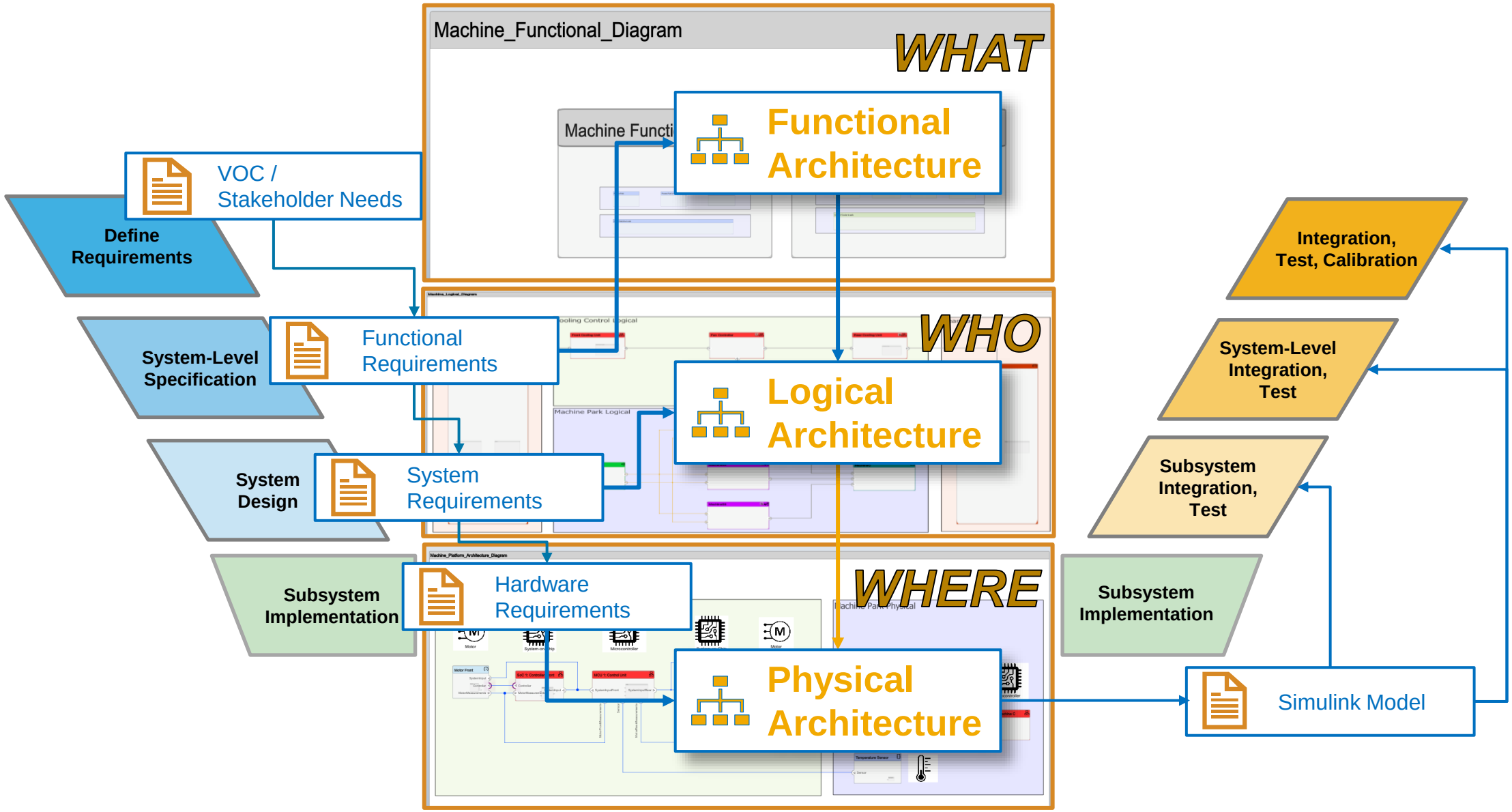
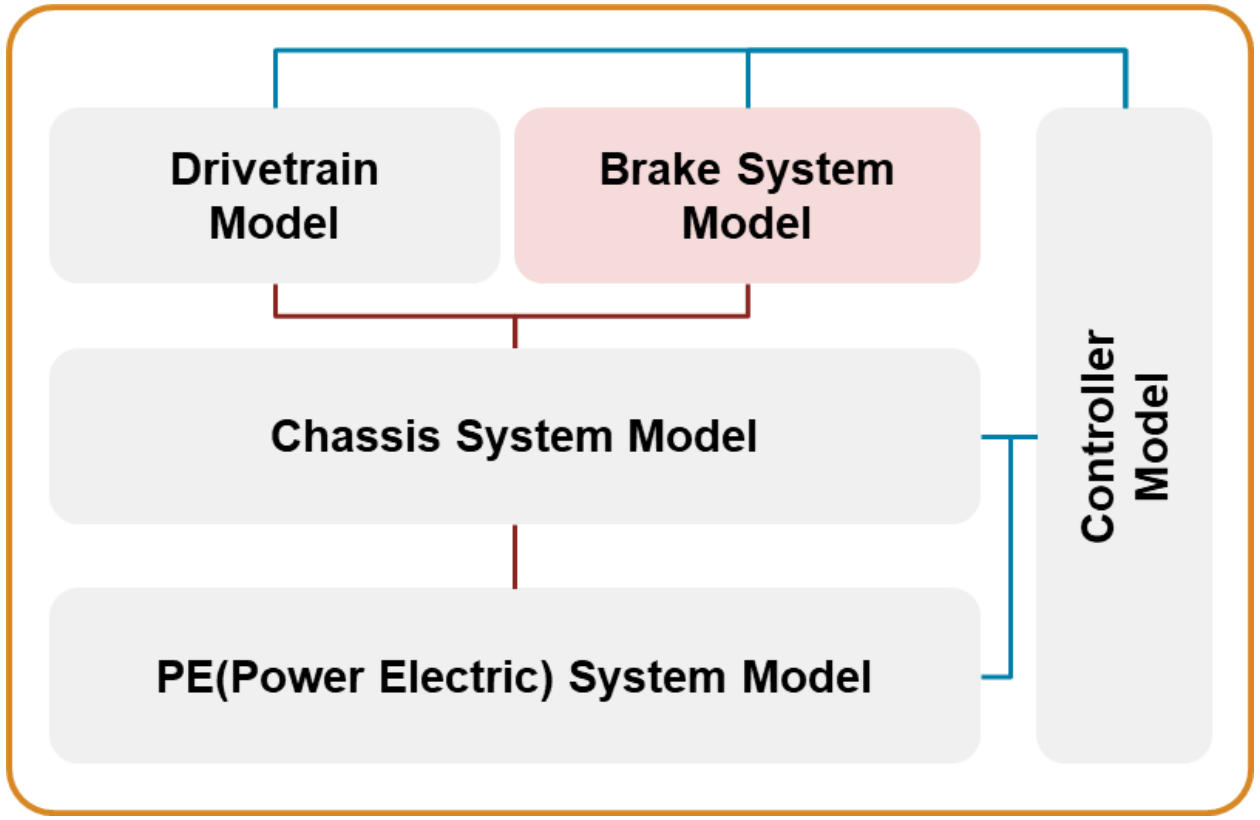


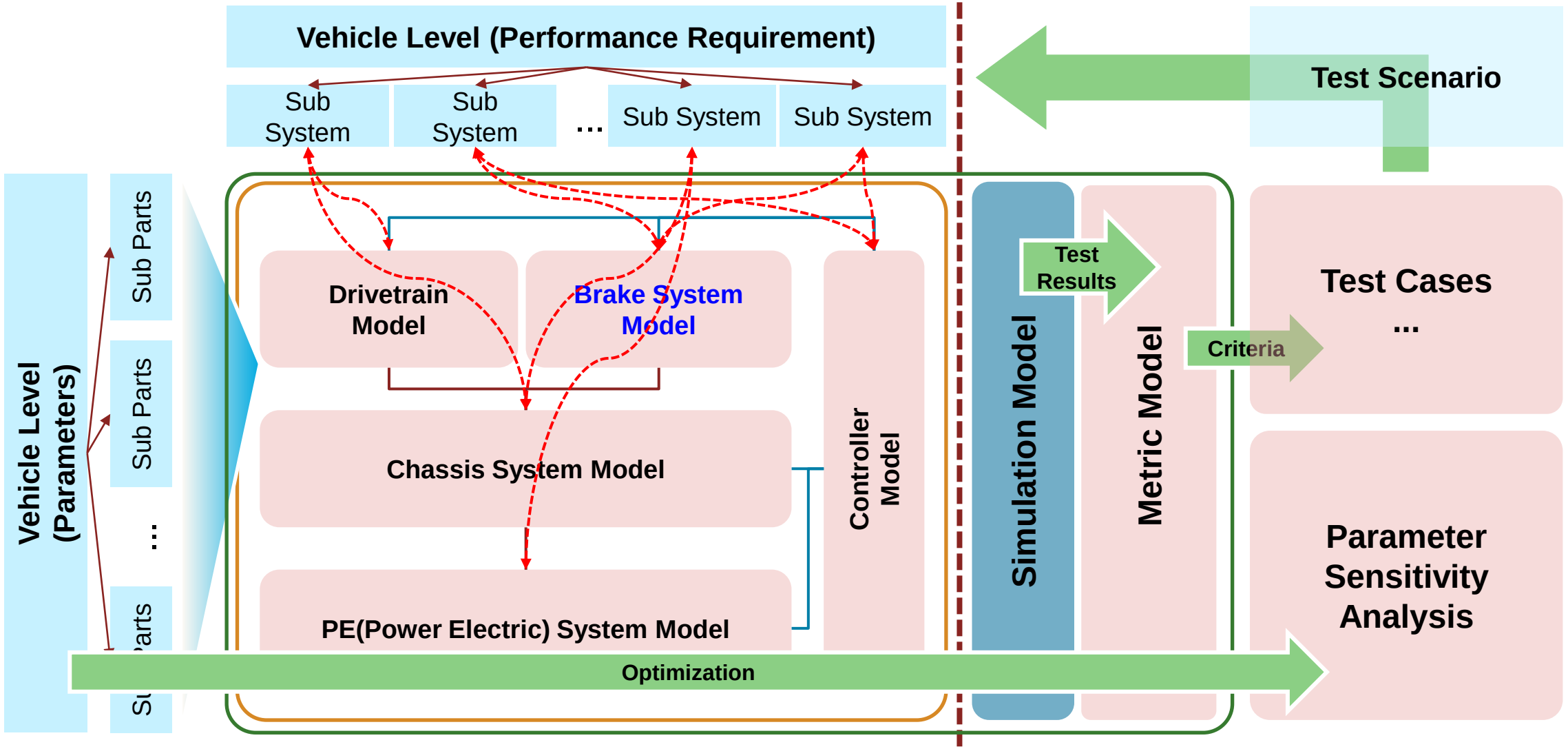
Vehicle Architecture Design with System Composer

- The Development of Brake System Architecture as the First Step



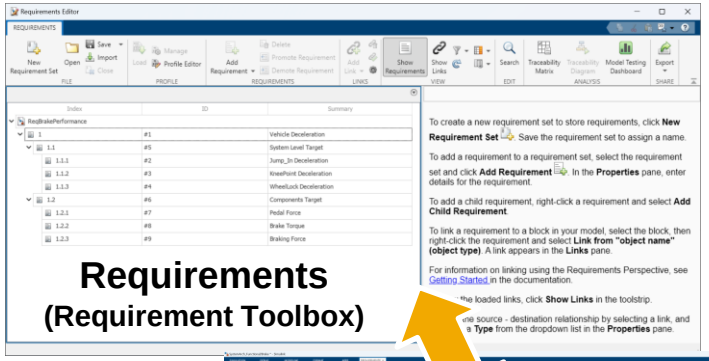
Vehicle Architecture Overview

- **Vehicle Architecture Concept Diagram**

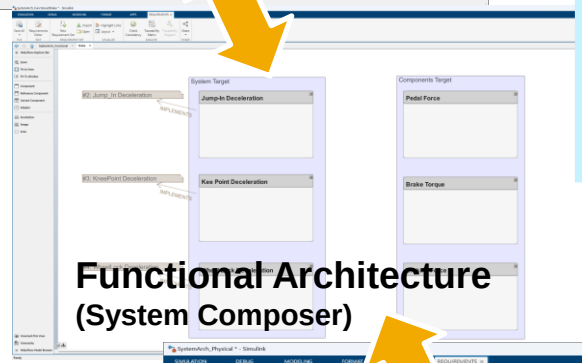


Vehicle Architecture Overview

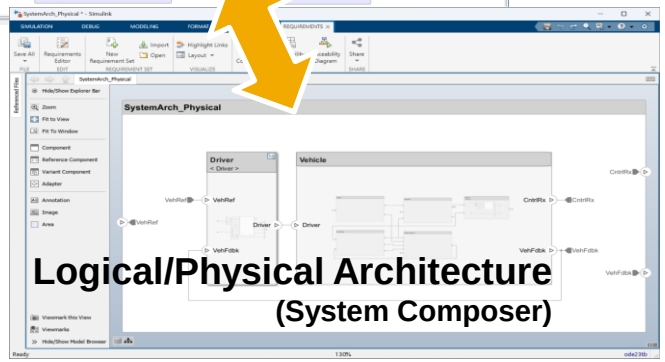
- **Architecture Modeling Concept**



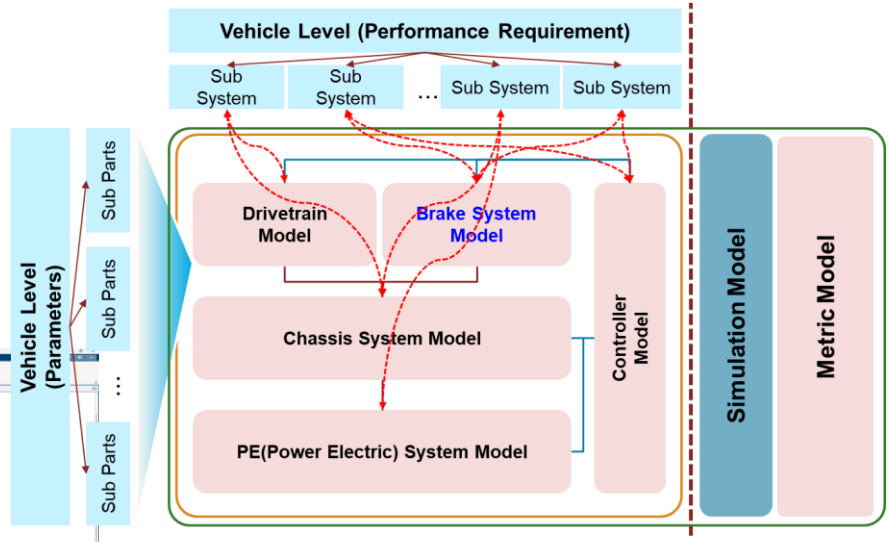
Requirements
(Requirement Toolbox)



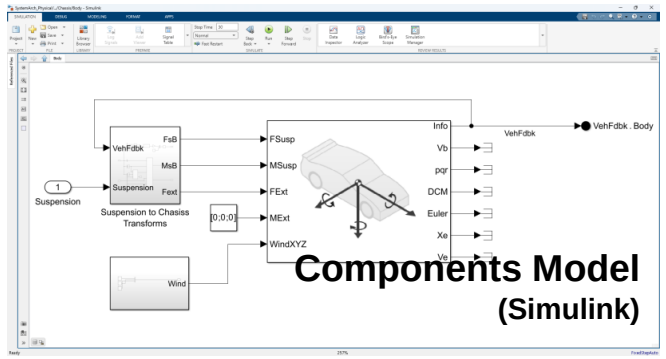
Functional Architecture
(System Composer)



Logical/Physical Architecture
(System Composer)



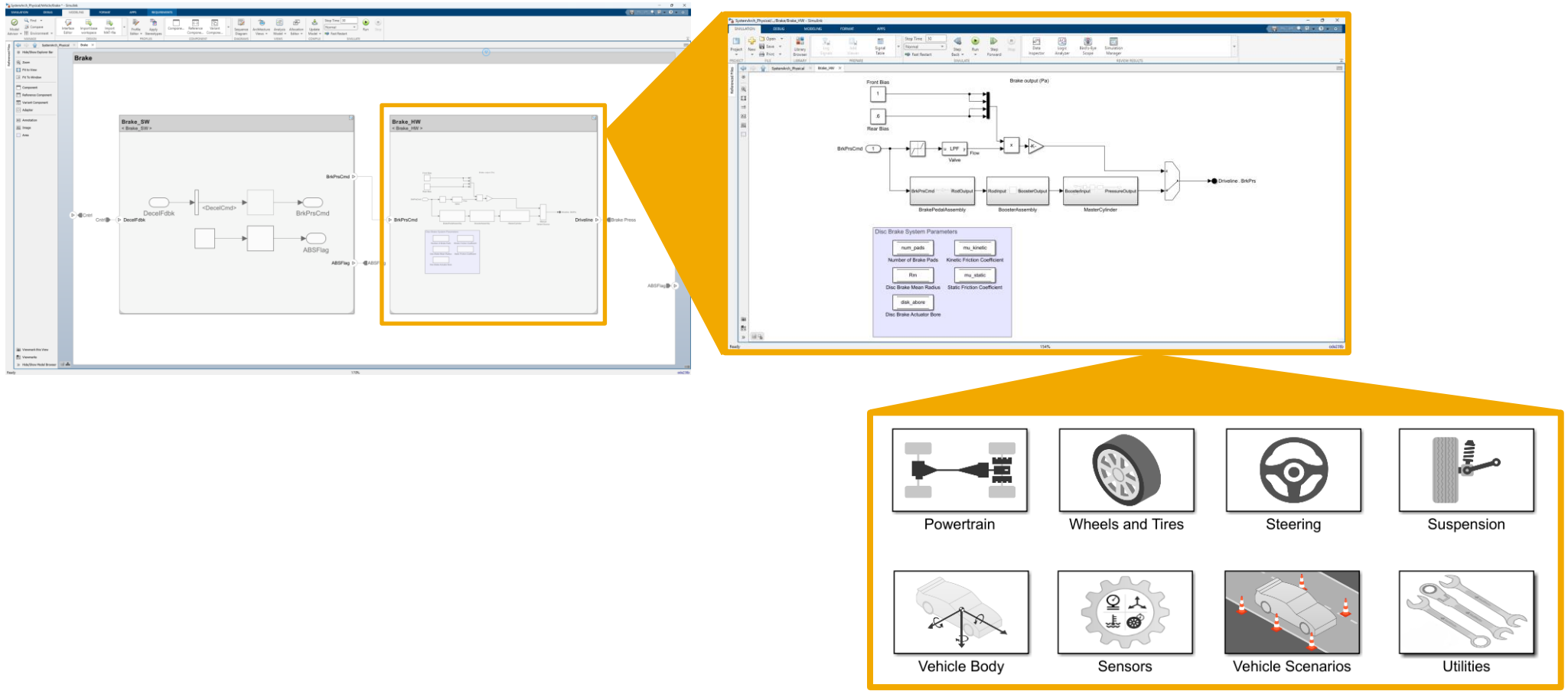
Architecture Concept



Components Model
(Simulink)

Simulink Modeling from defined Physical Architecture

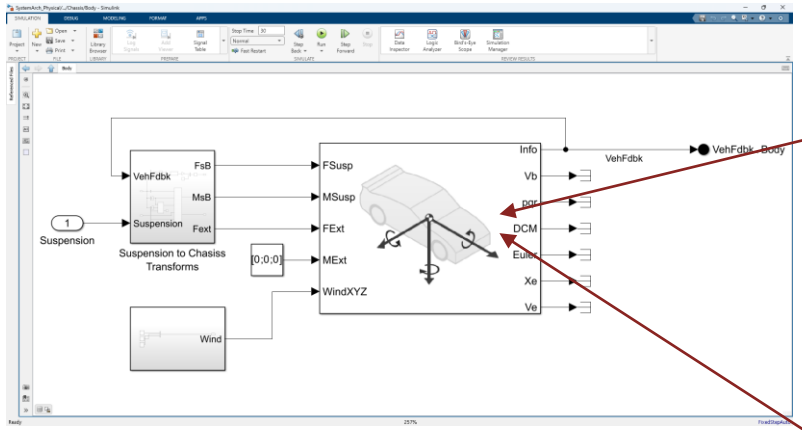
- Integrated Simulink model can access block or parameters through System Composer

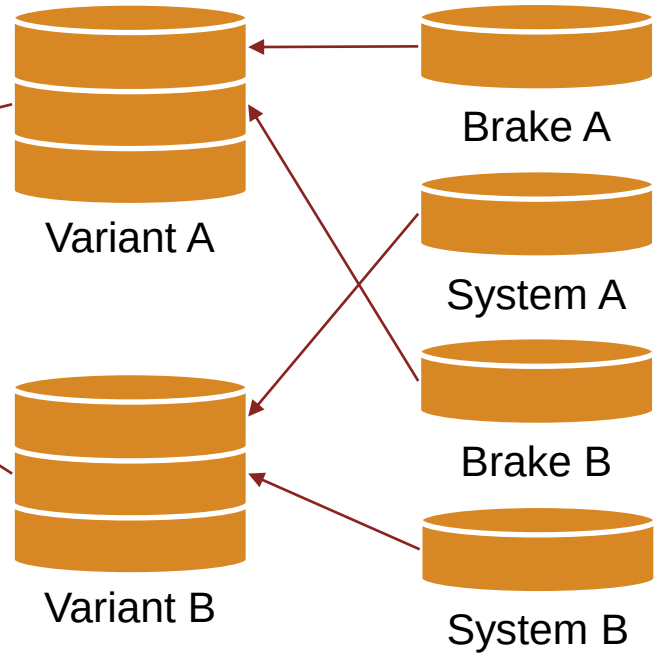


Vehicle Dynamics Blockset

Variant Management using SLDD(Simulink Data Dictionary)

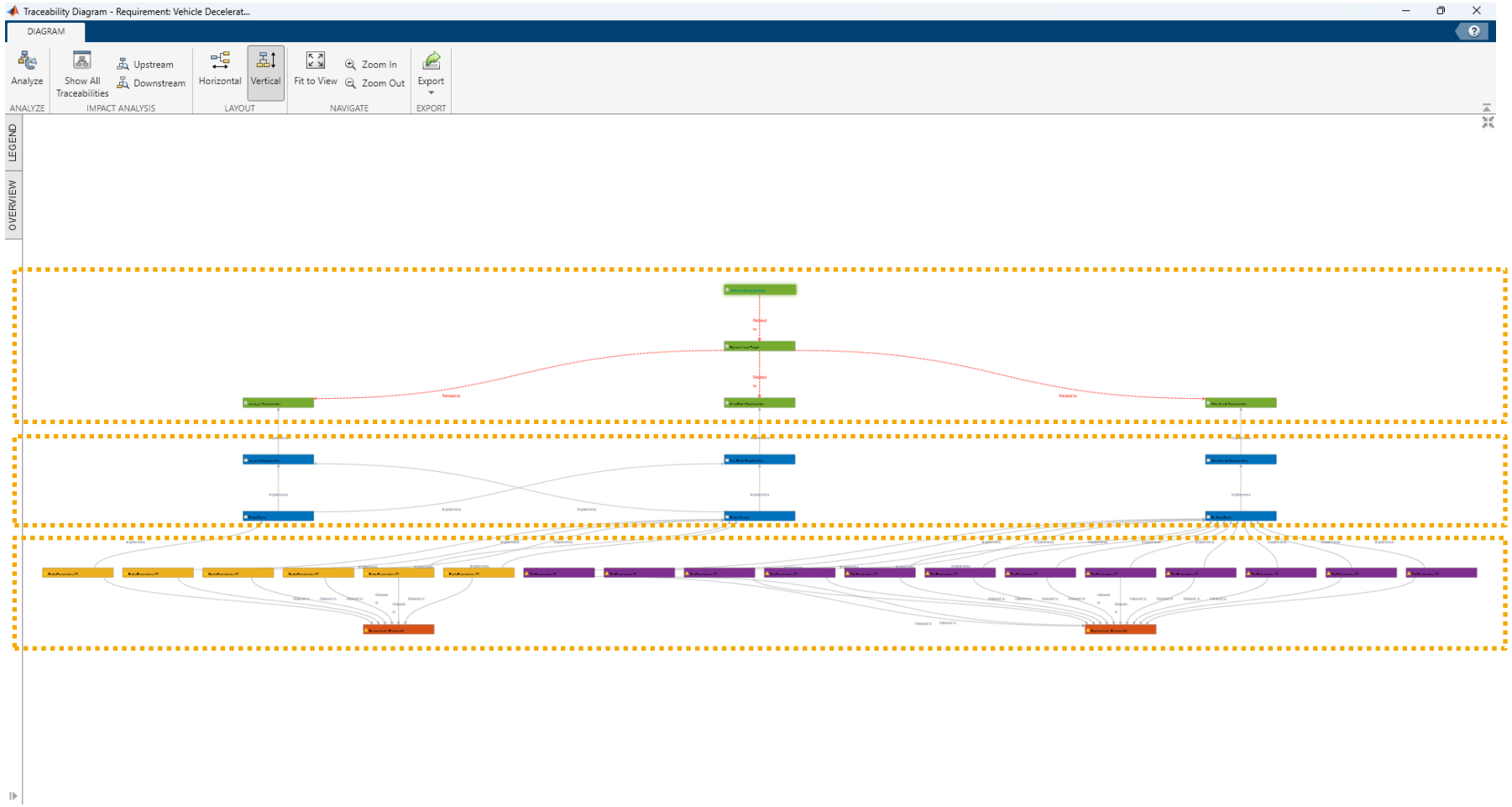
- The Benefits
  - Optimal data management for large model and complex design
  - Concurrent development
  - Clear data ownership





Overview of Traceability Diagram

- Identify Influencing Parameters related to Requirements



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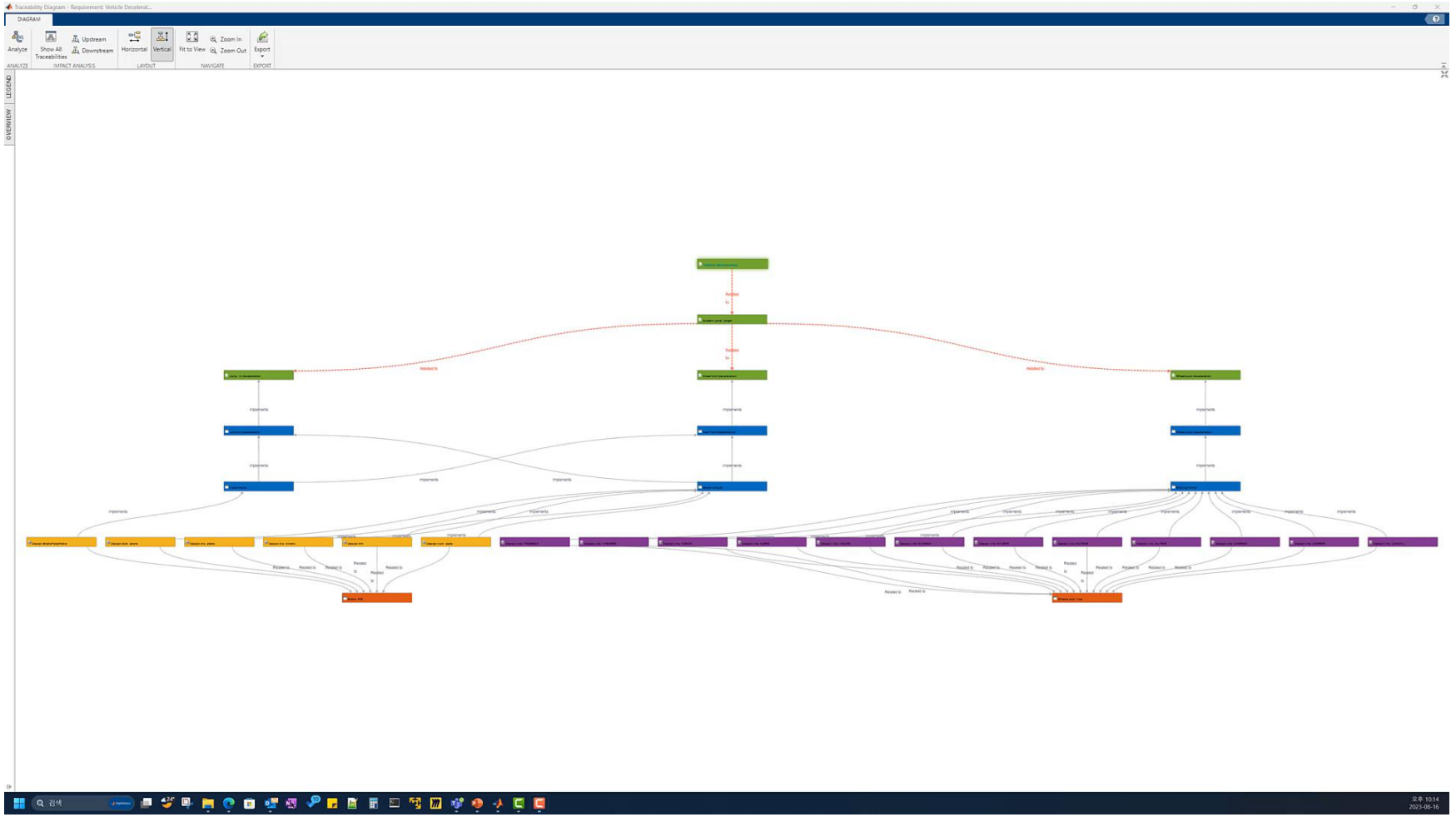

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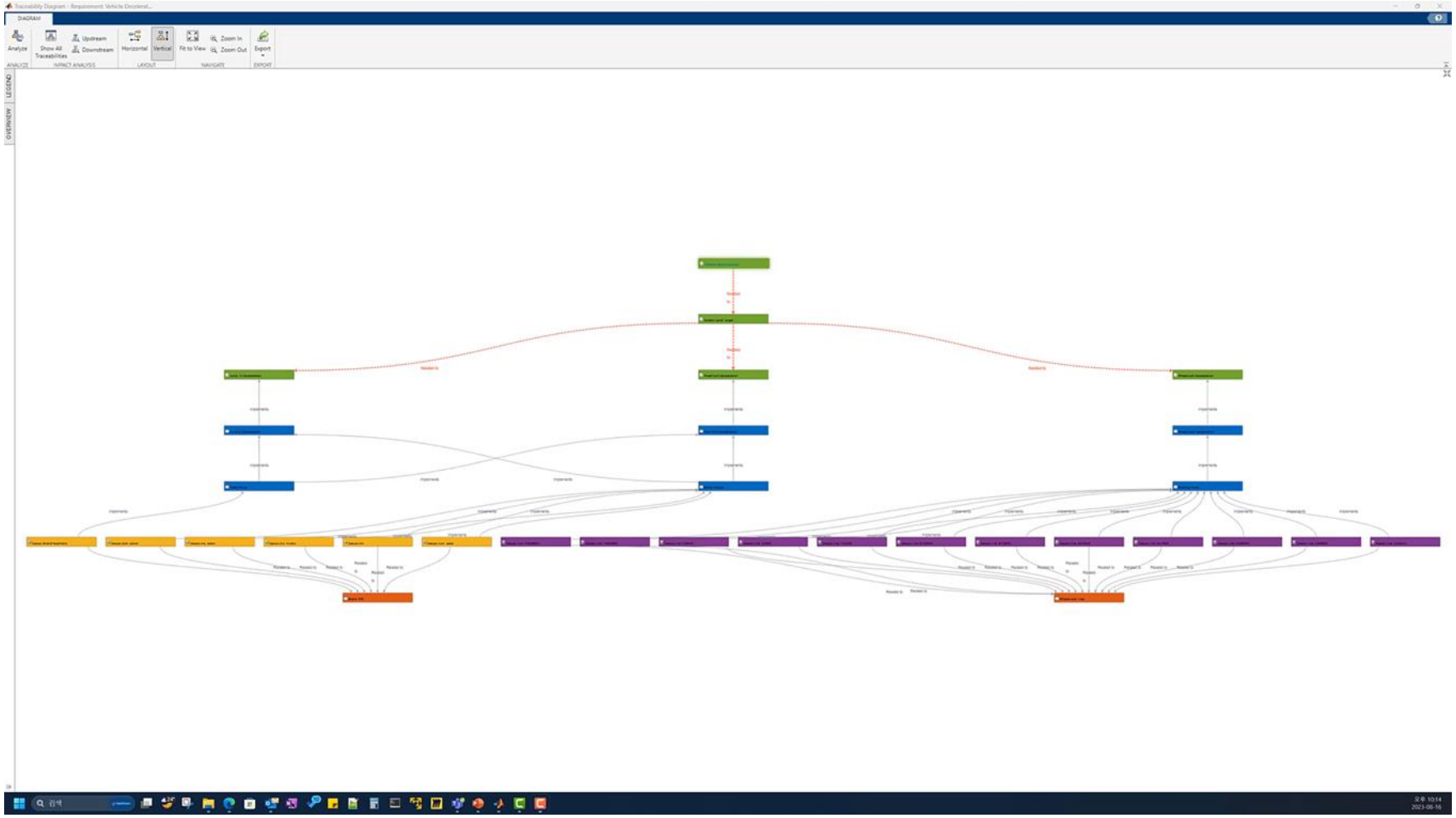
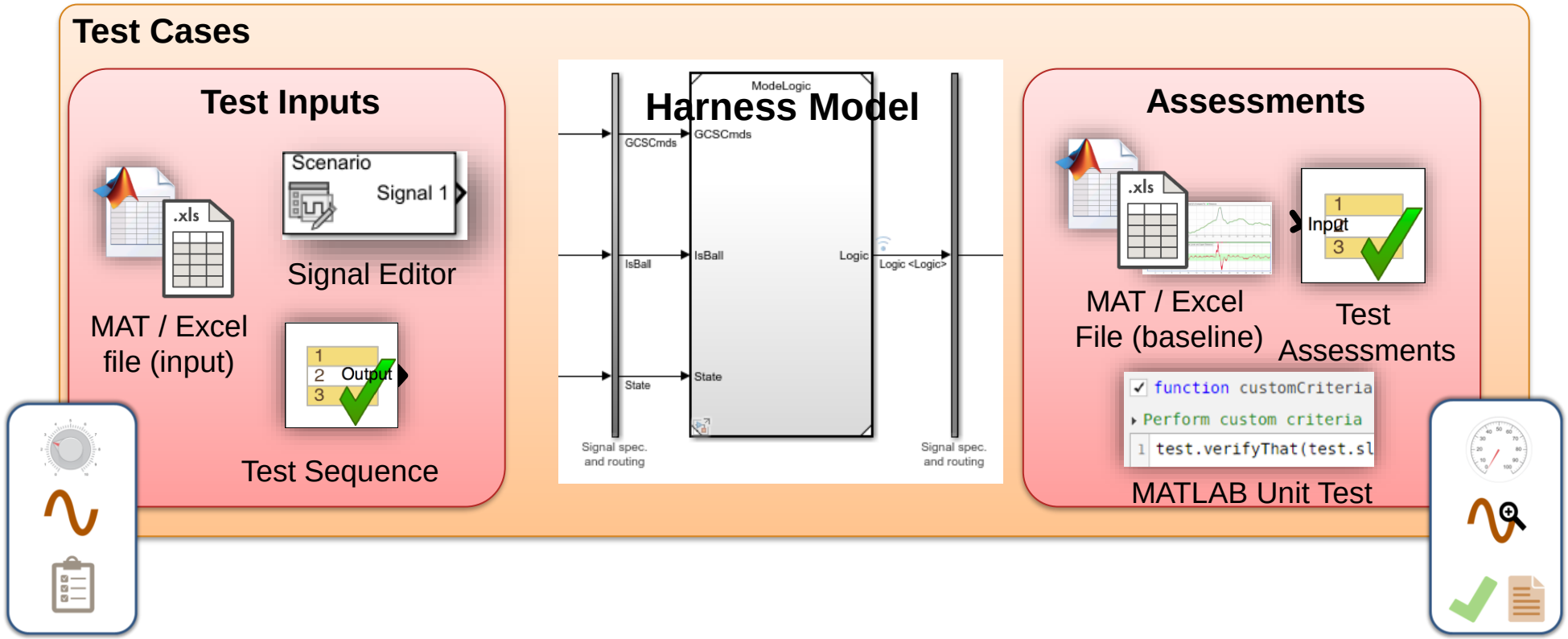


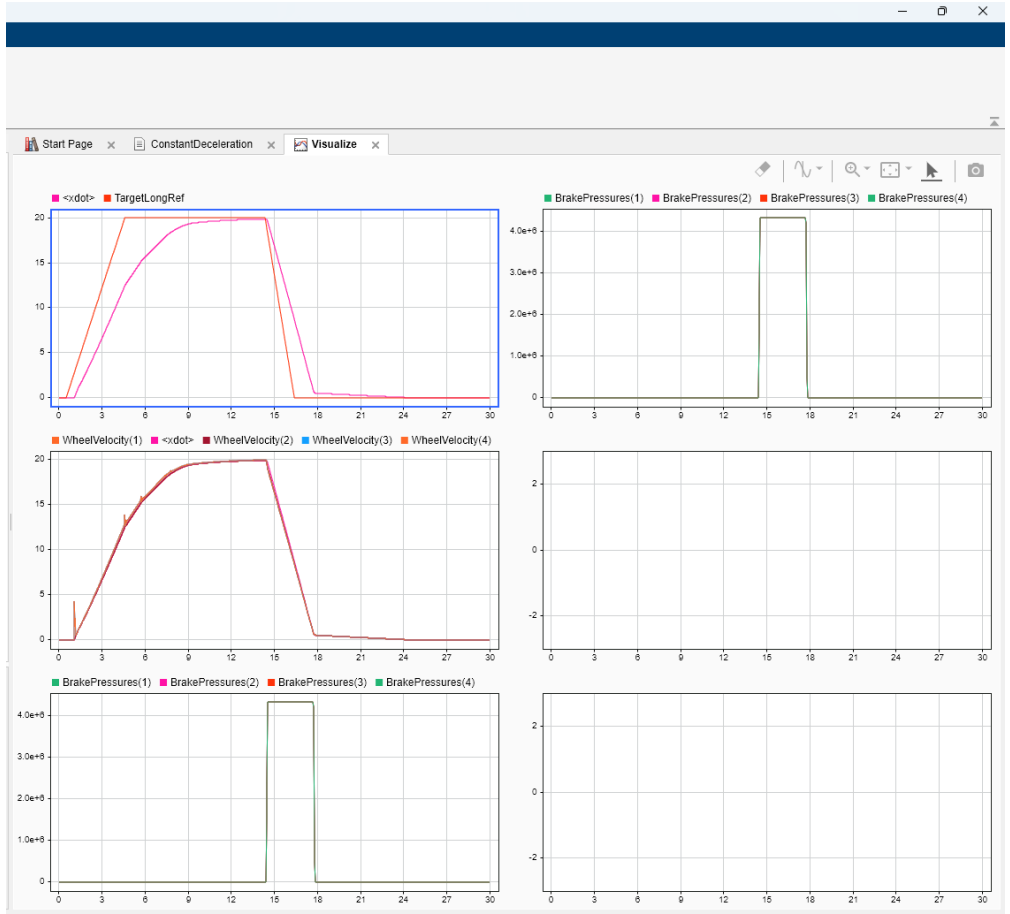
Build Harness Model to Simulate Vehicle Performance

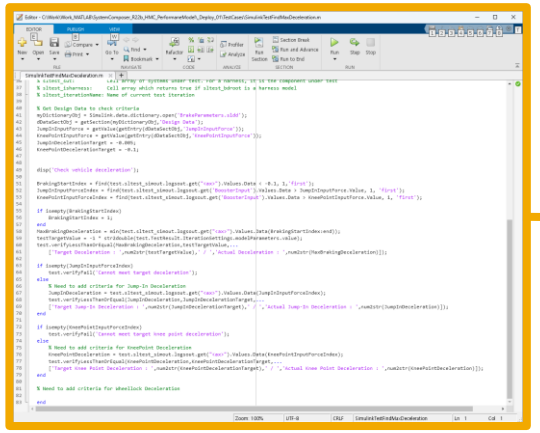
- Create test harness model to simulate model without modification of Simulation model

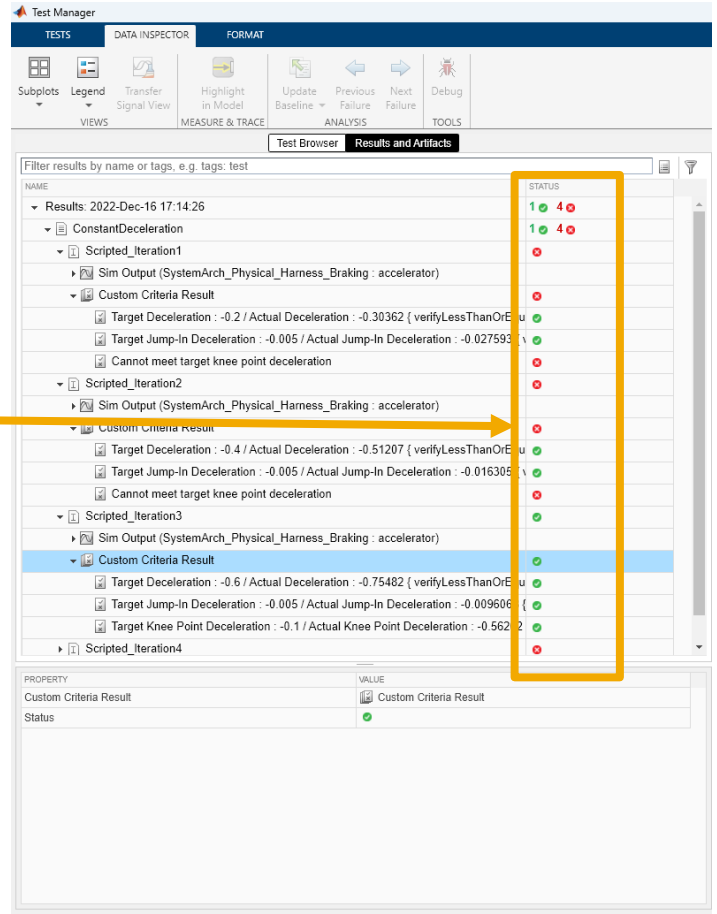


Generate Results and Artifacts with Assessment Criteria

- Custom criteria automatically evaluates based on test scenarios

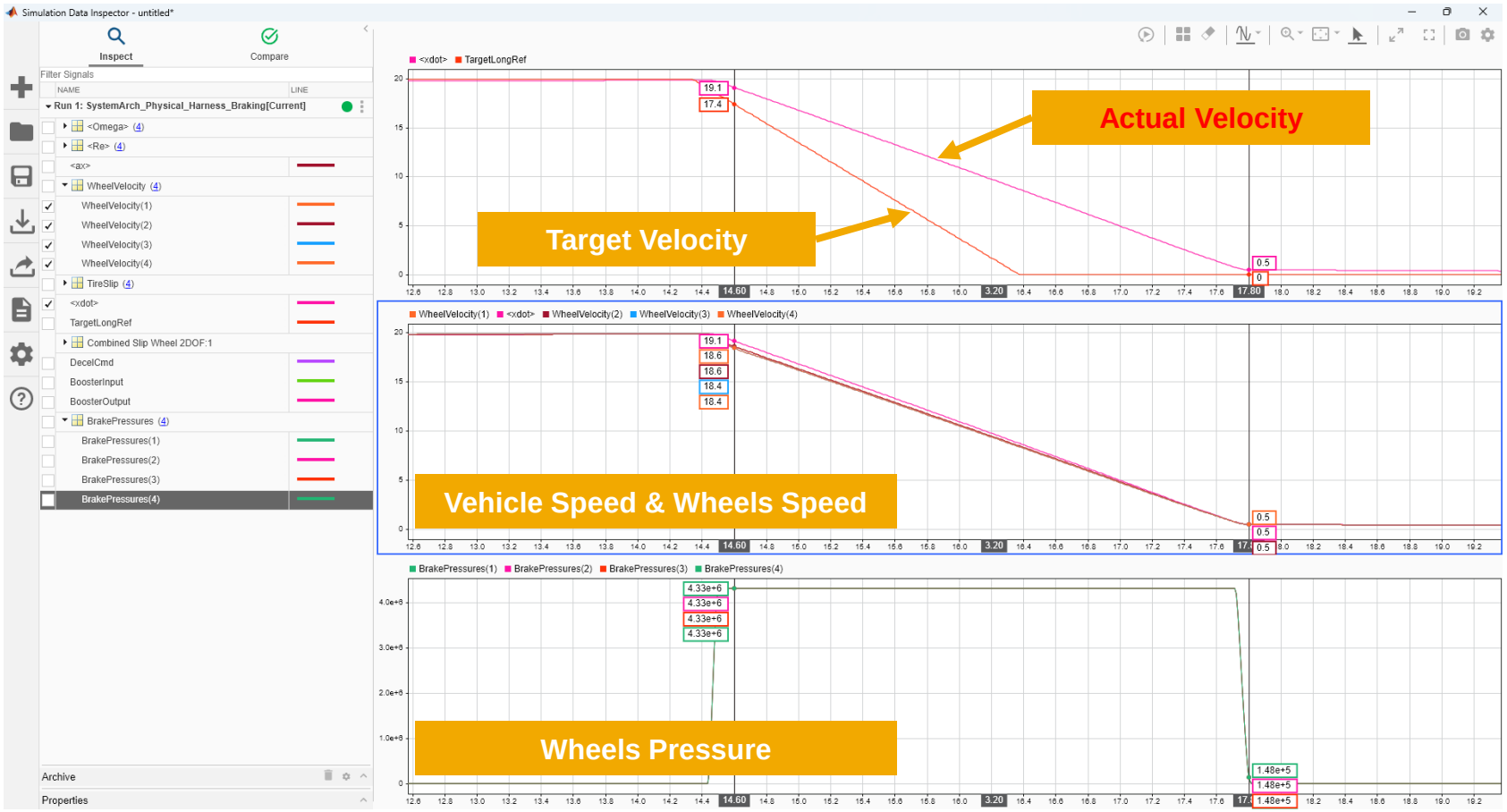






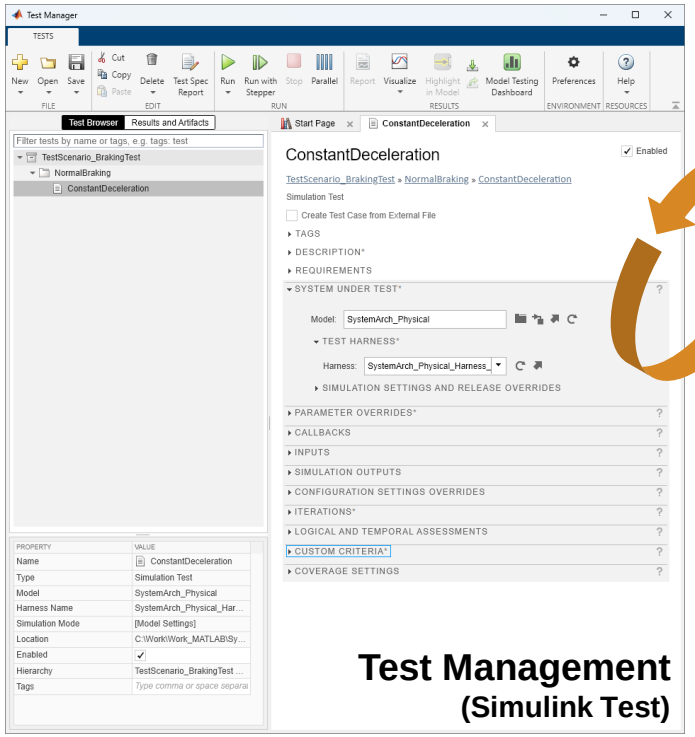
Visualize Simulation Results using SDI(Simulation Data Inspector) in Simulink

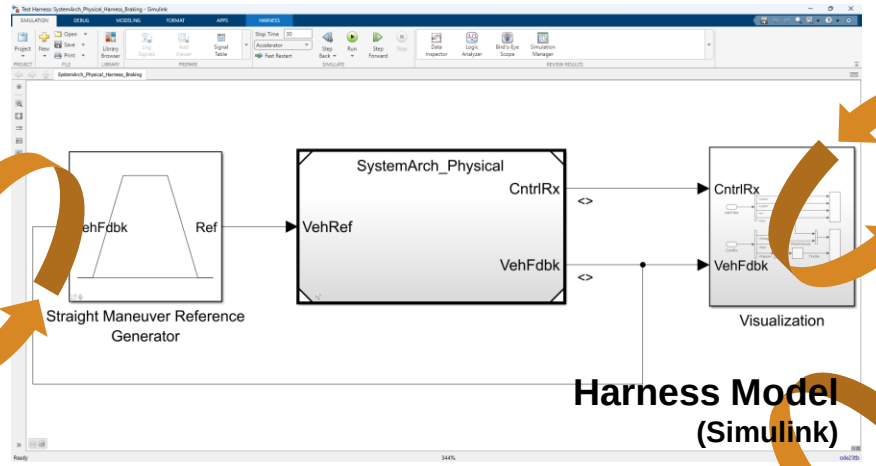
- Analyze simulation results of model using logged data

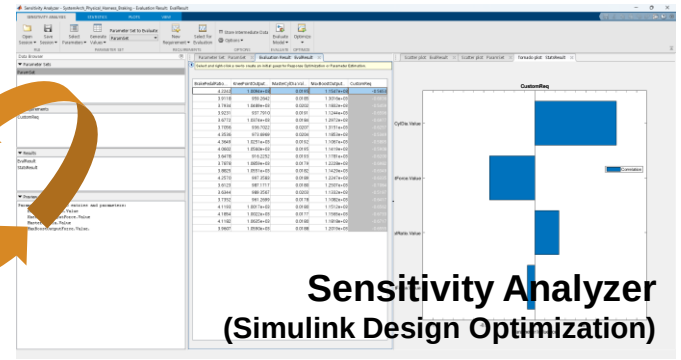


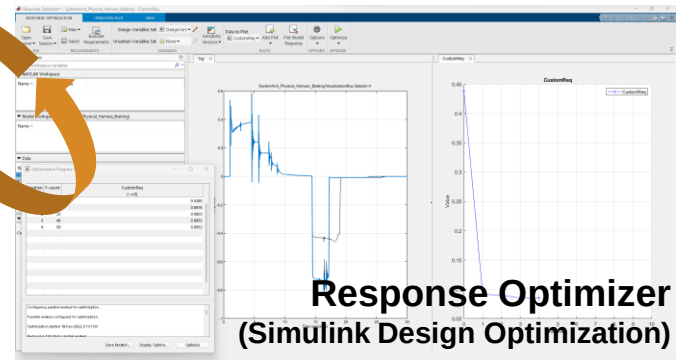
Manage Test Scenario and Parameter Estimation & Optimization

- Simulink Test can manage multiple scenarios and Simulink Design Optimization supports sensitivity analysis and optimization workflow





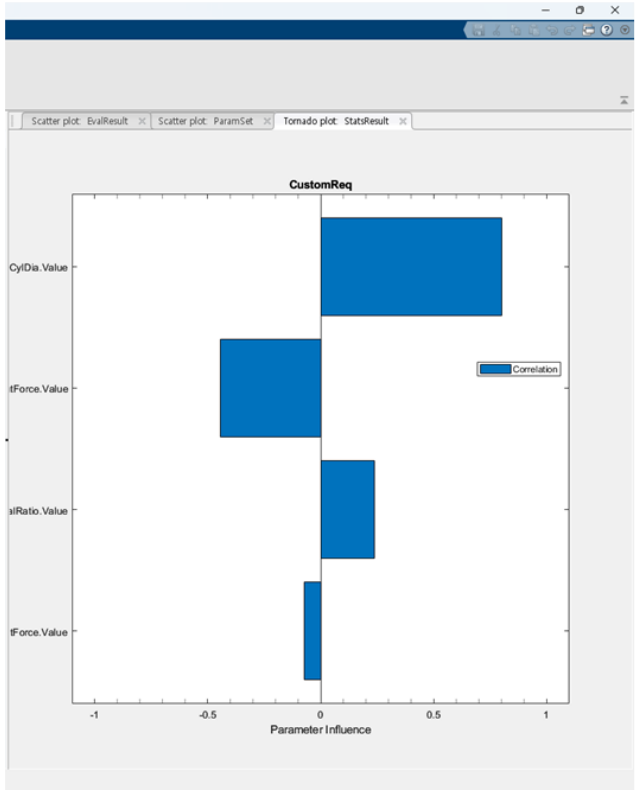




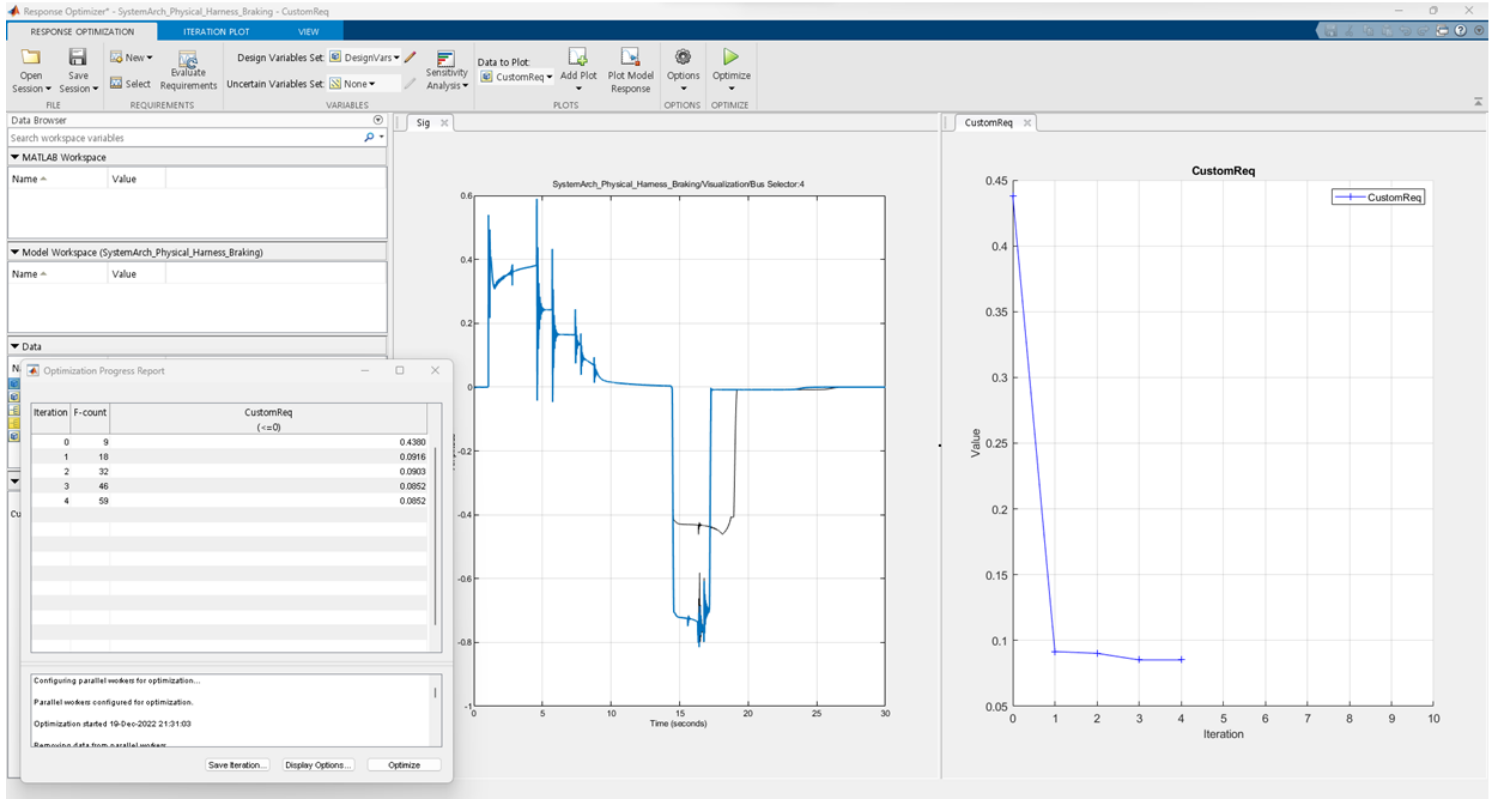
Study Sensitivity Analysis & Optimization using Simulink

- System Composer can use integrated simulation with another tool in Simulink

Sensitivity Analyzer
(Simulink Design Optimization)

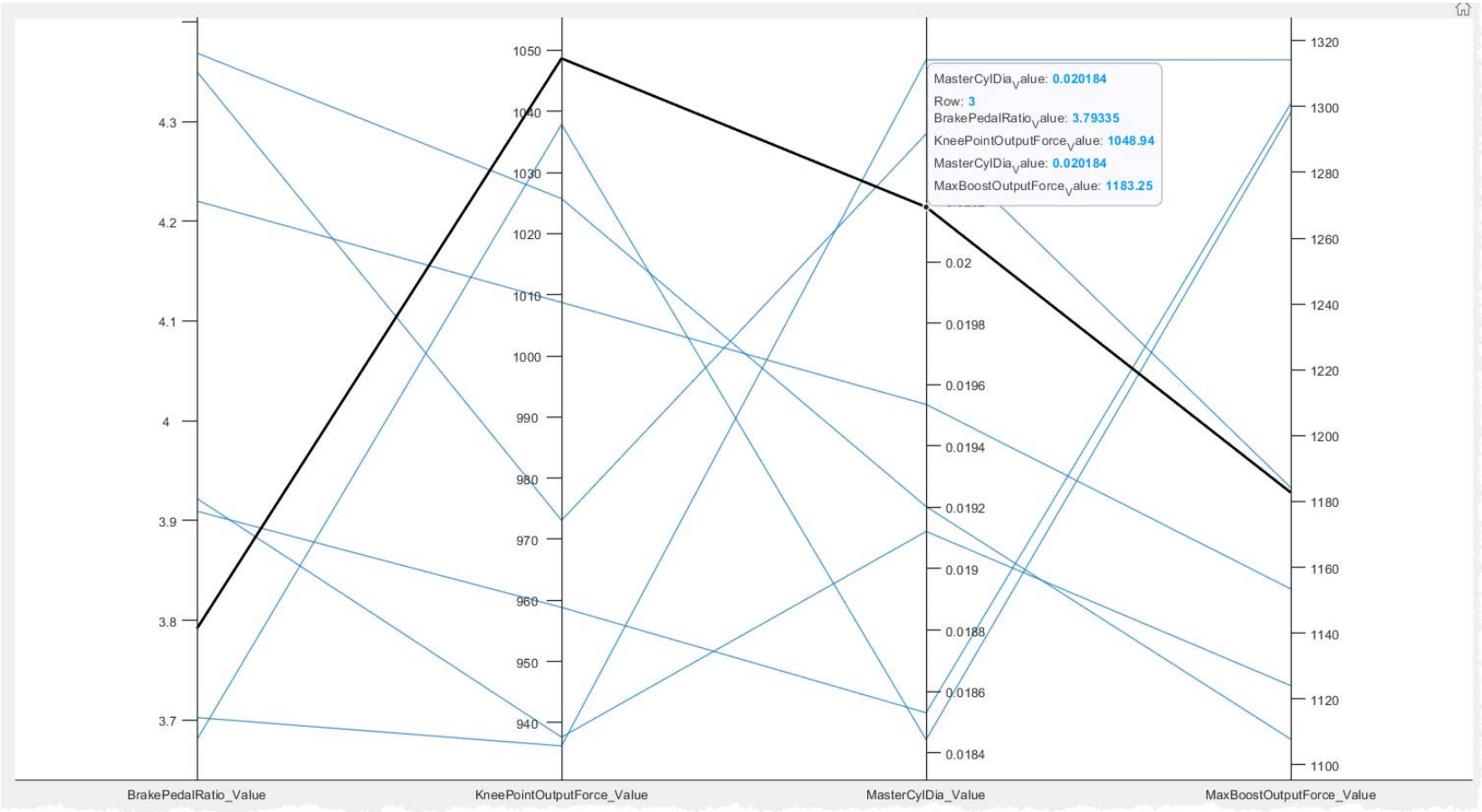


Response Optimizer
(Simulink Design Optimization)

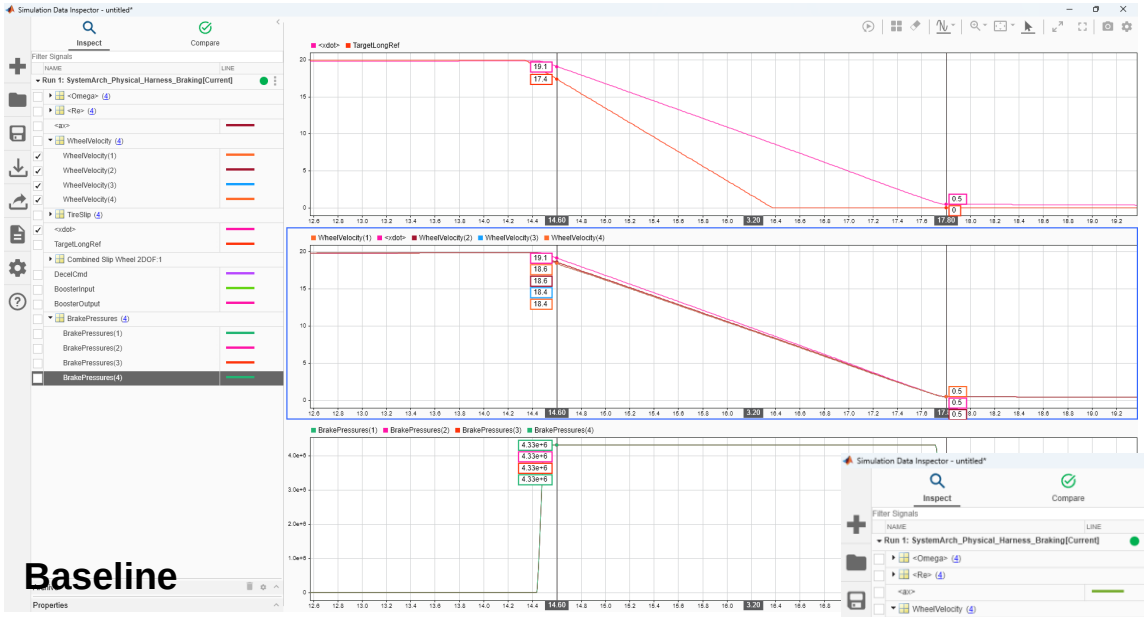


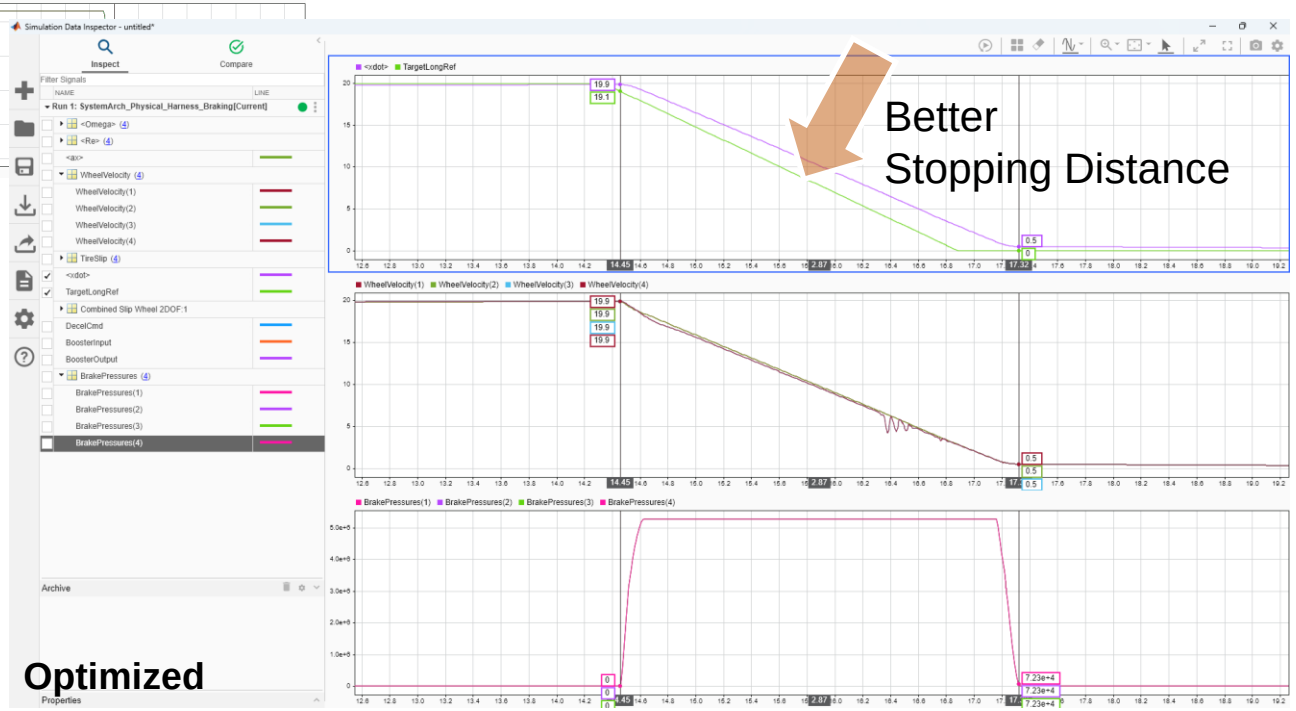
Visualization of Parameter Sensitivity Analysis

- Show parameter variation using Parallel Plot

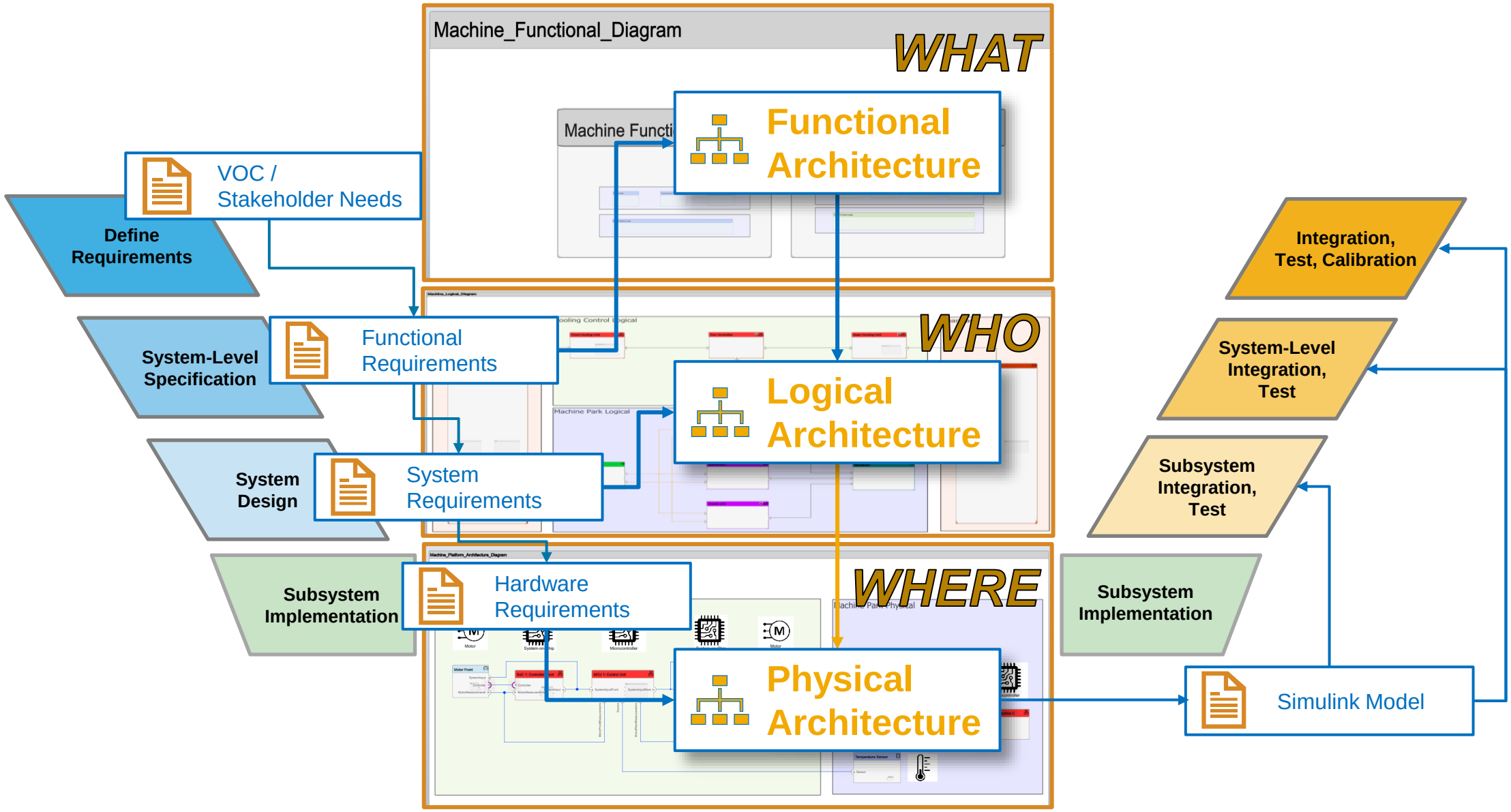


Simulation Results after Optimized Parameters

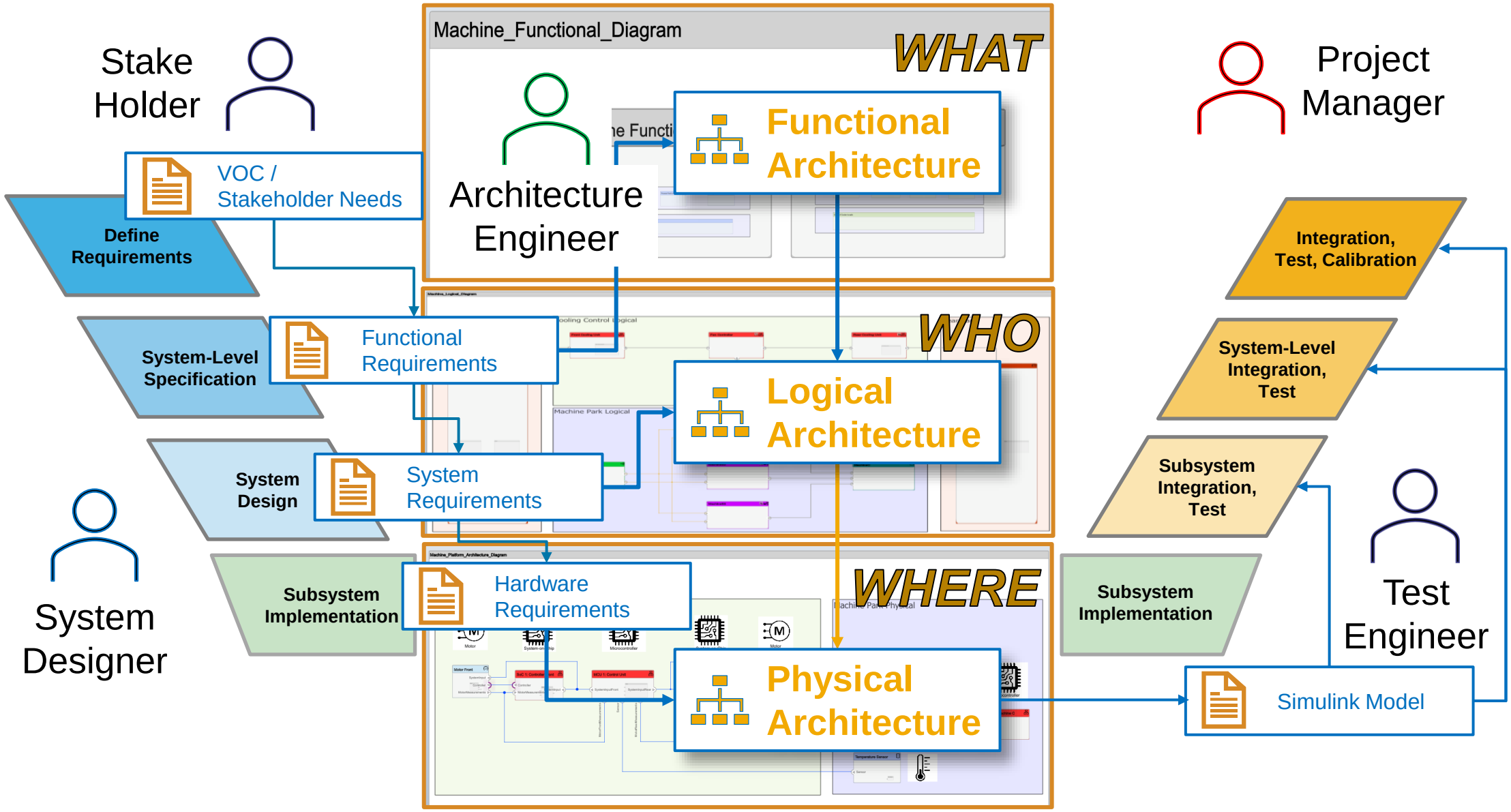




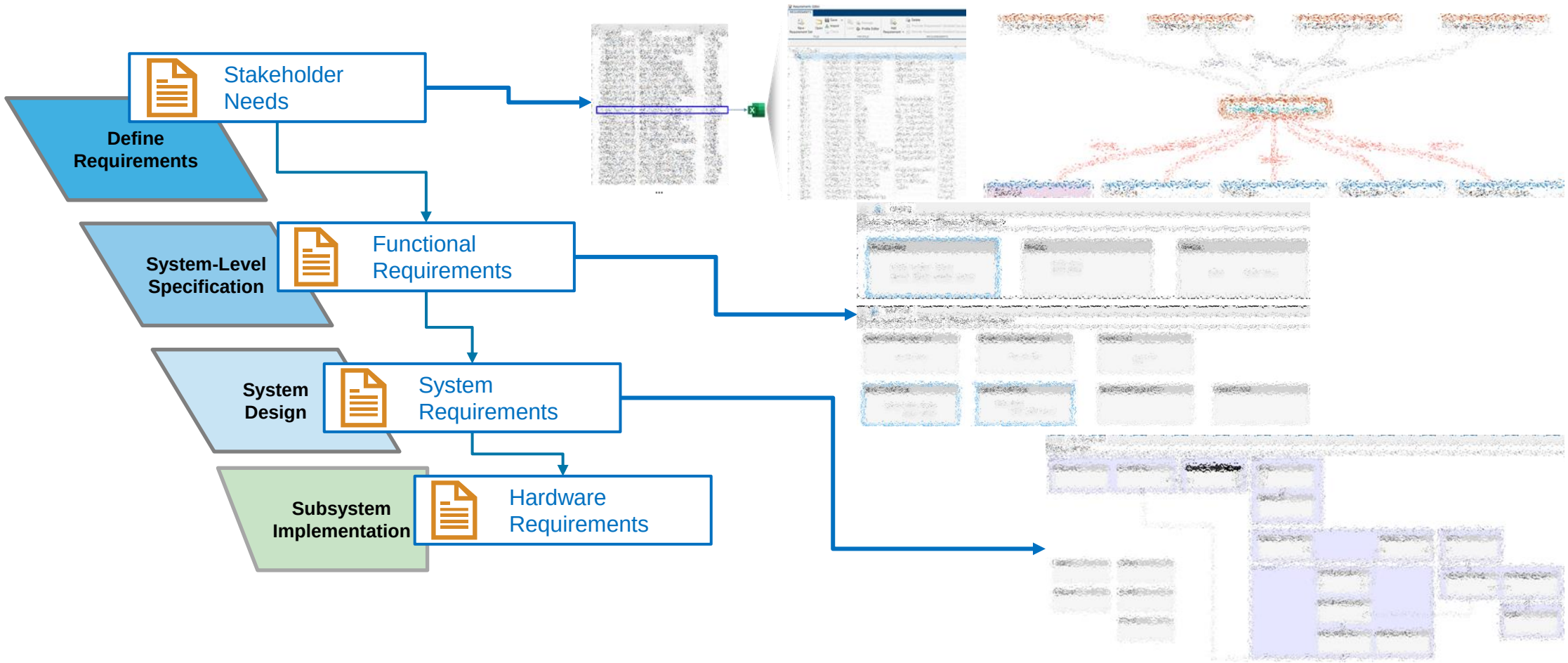
Benefits


Machine_Functional_Diagram
WHAT
Functional Architecture
VOC / Stakeholder Needs
Define Requirements
WHO
Functional Requirements
System-Level Specification
Logical Architecture
System Requirements
System Design
WHERE
Hardware Requirements
Subsystem Implementation
Physical Architecture
Integration, Test, Calibration
System-Level Integration, Test
Subsystem Integration, Test
Subsystem Implementation
Simulink Model

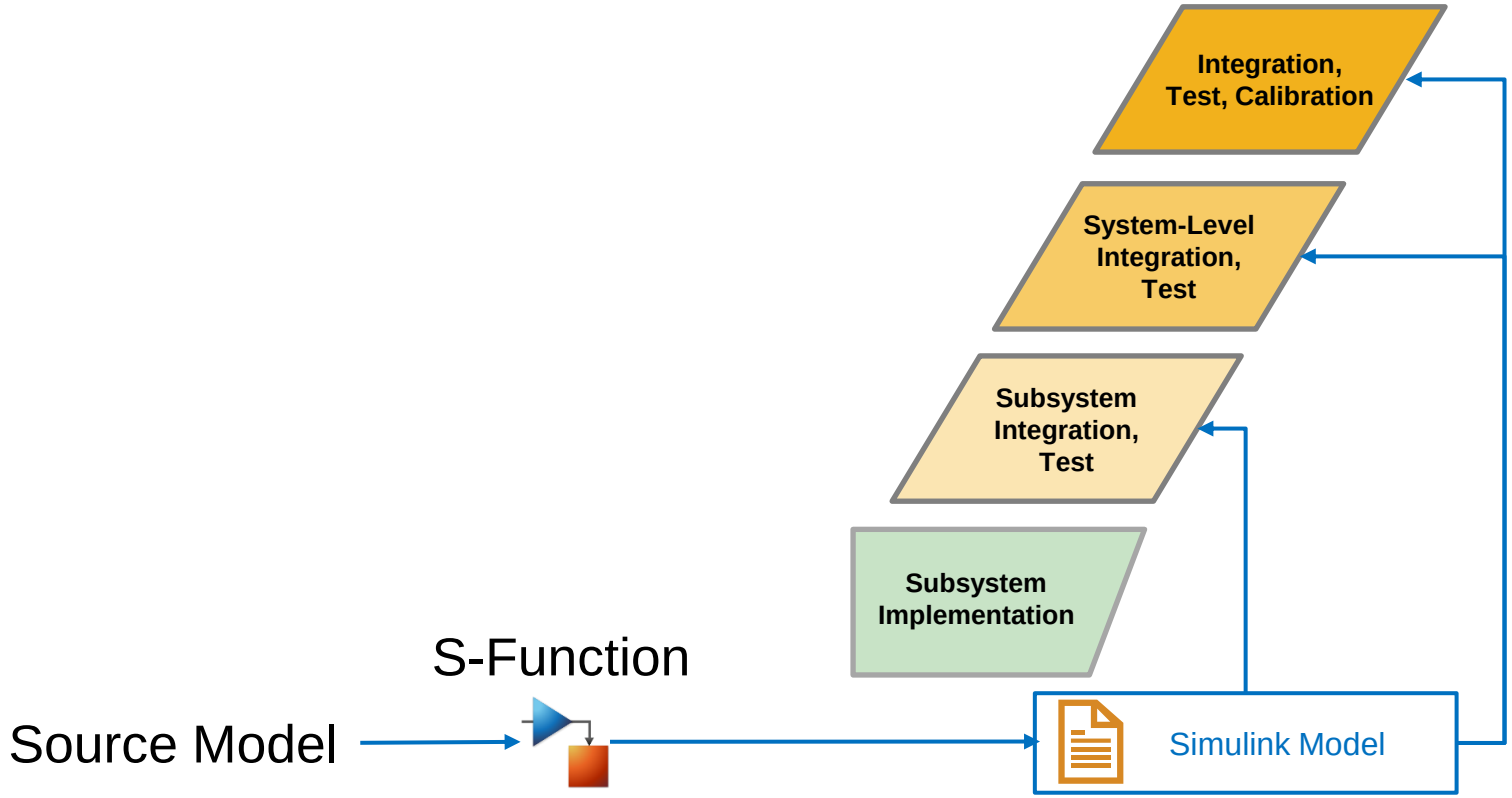
Benefits


Stake Holder
VOC / Stakeholder Needs
Define Requirements
Machine_Functional_Diagram
WHAT
Architecture Engineer
Functional Architecture
Project Manager
Integration, Test, Calibration
System-Level Specification
Functional Requirements
WHO
Logical Architecture
System-Level Integration, Test
System Design
System Requirements
Subsystem Integration, Test
System Designer
Subsystem Implementation
Hardware Requirements
WHERE
Physical Architecture
Subsystem Implementation
Test Engineer
Simulink Model

Implementation

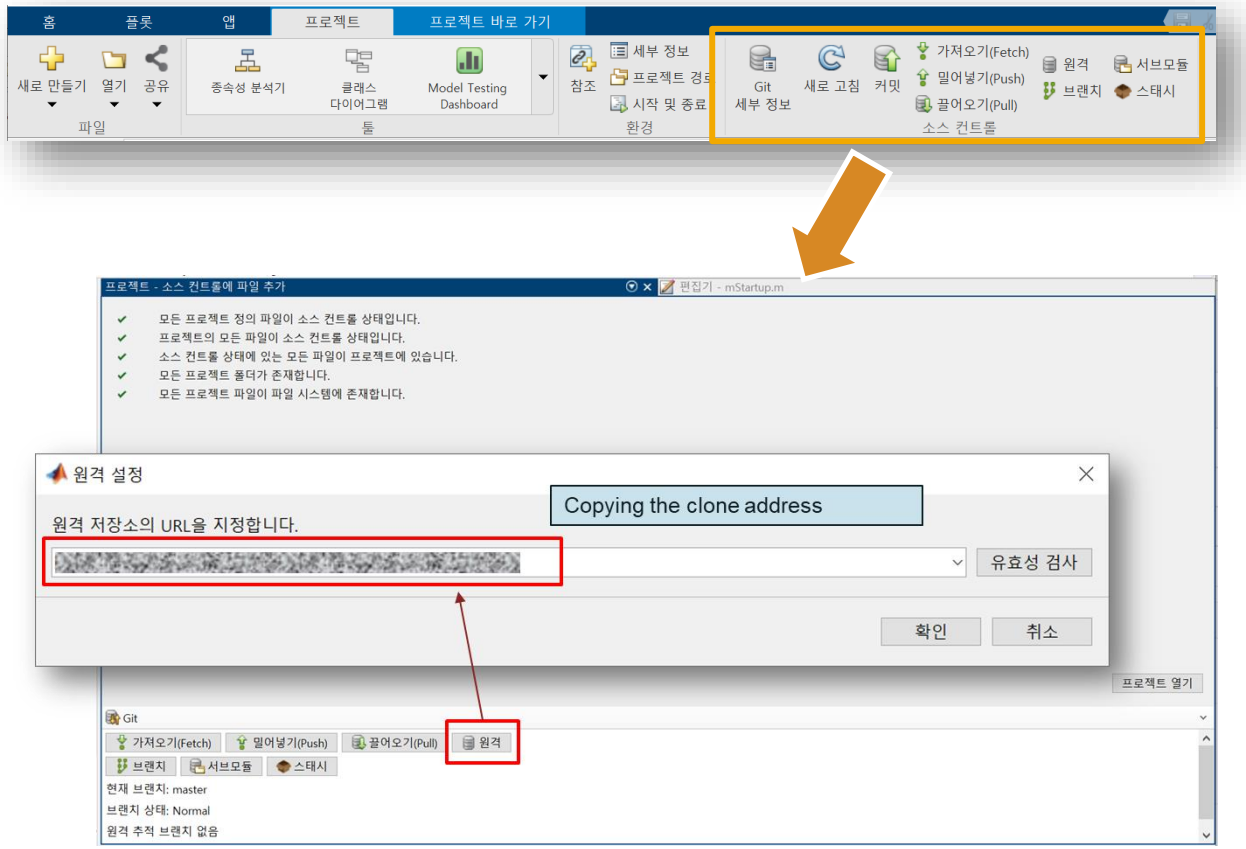


Implementation



Collaboration using Source Control : Gitlab

- The Benefits of Source Control :
  - Maintain backups, history, and ability to restore
  - Track changes and responsibility
  - Simplify reconciling conflicting changes
  - Generate discussion
  - Save you from yourself



Summary & Conclusion

- System Composer & MathWorks Framework are able to …
  - Organize Requirements hierarchically
  - Build Functional, Logical, Physical Architecture model
  - Validate and Verify performance fulfill requirements
  - Analyze Sensitivity and Optimize Parameters
  - Provide an Environment where we can concentrate to Building Architecture

- Future Plan
  - Building Brake System Architecture
  - Expanding target System
  - Learning from legacy system and Applying to Future Mobility

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Thank you