MATLAB EXPO 2017

Simulink as Your Enterprise Simulation Platform

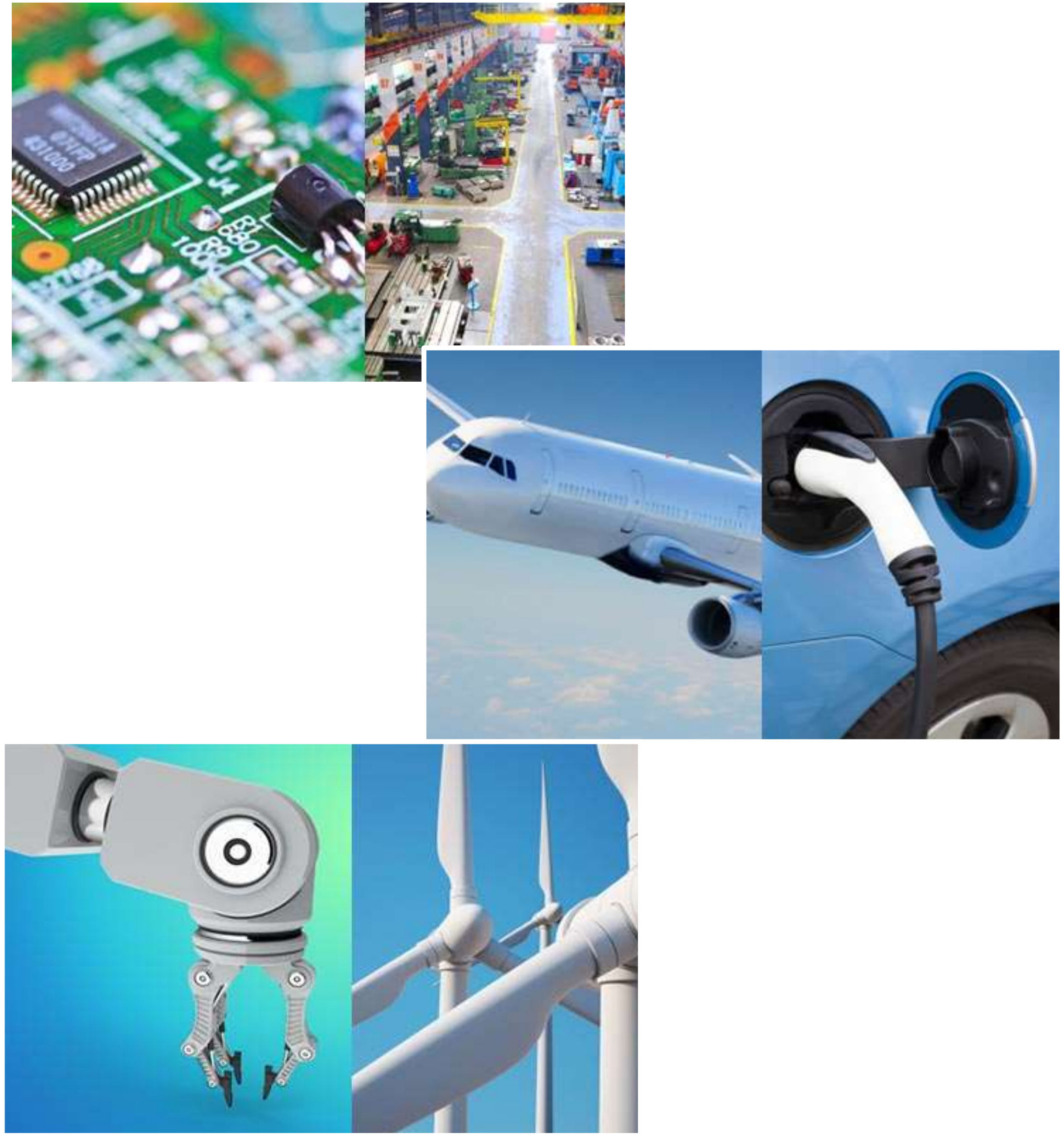
Prasanna Deshpande & Naga Pemmaraju

Enterprise Simulation Platform

- Enterprise - Any size business or project

- Simulation – Evaluating system behavior through computation

- Platform – Scalable environment for multi-disciplinary collaboration



Challenges faced by teams working at enterprise level

- Products / projects involve multiple engineering and non-engineering domains

- Systems are complex; require many teams to work together on different components and share available resources

- Many different tools may require to work together to achieve the bigger goal

Simulink as an Enterprise Simulation Platform

Simulating Spacecraft Communications for Deep-Space Missions

Dr. Deepak Mishra, Scientist/Engineer (SF)

Indian Space Research Organization

Challenge

- Integrating large multi-faceted project
- Simulation at multiple stages and in multiple domains to explore the problem

Solution

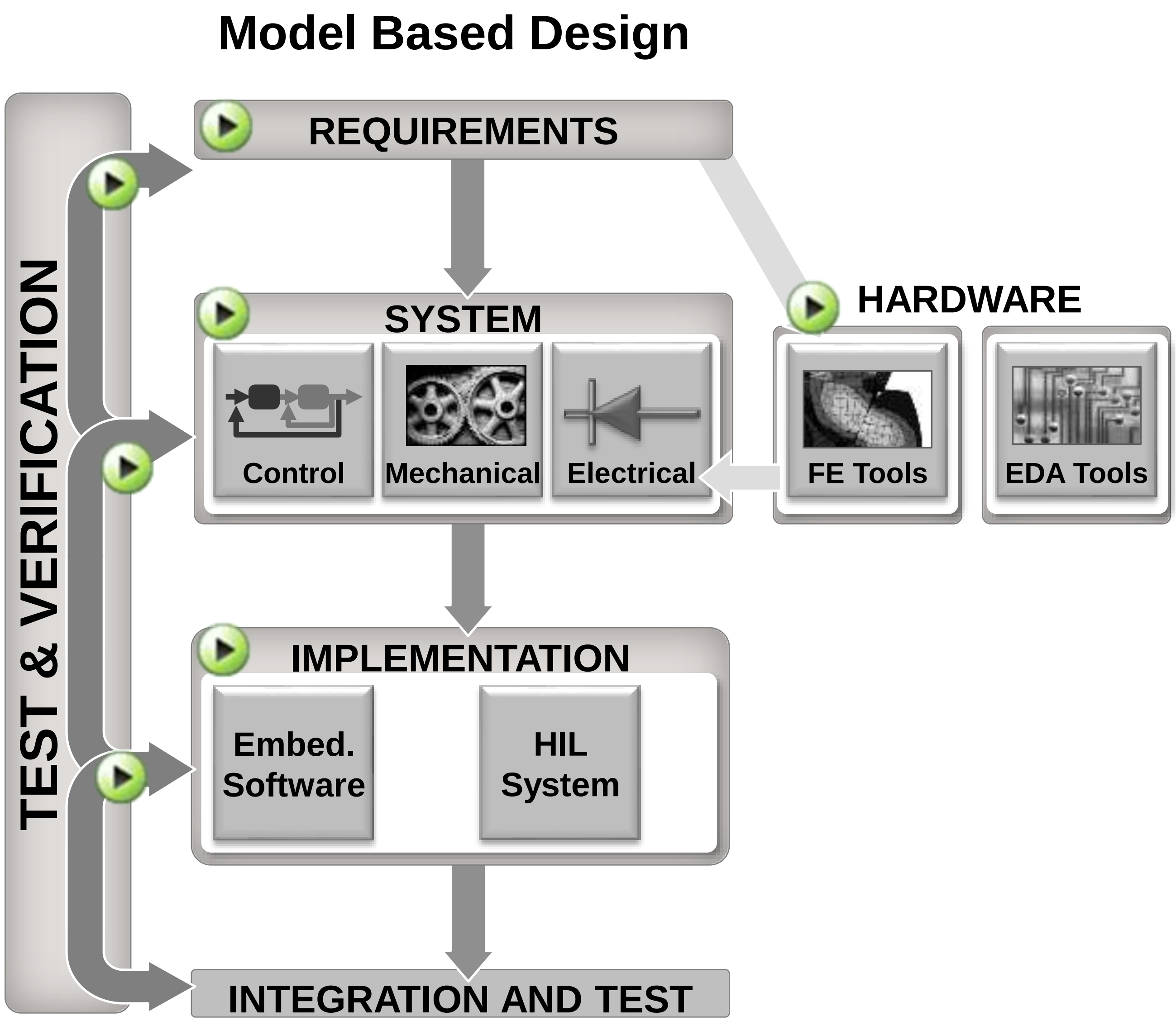
- Leverage Simulink as a platform

Simulink as an Enterprise Simulation Platform

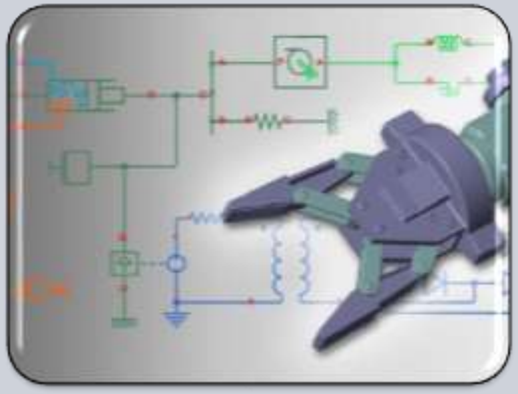
Simulink as Enterprise Simulation Platform

- Enterprise - Any size business or project
- Simulation – Evaluating system behavior through computation
- Platform – Scalable environment for multi-disciplinary collaboration

Simulation

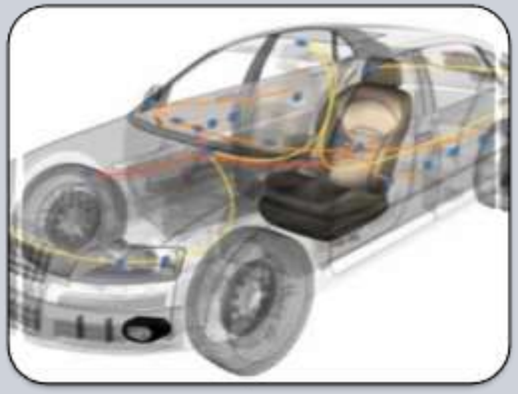


Enterprise Simulation Platform Enablers



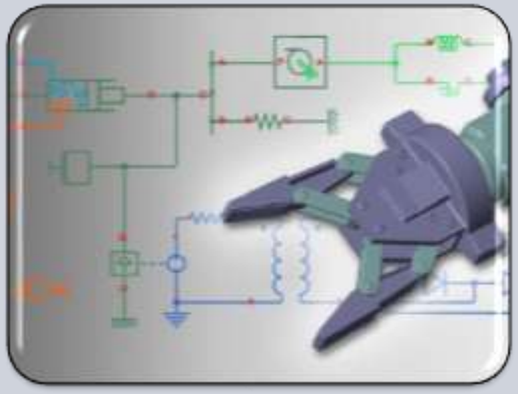
Multi-Domain Modeling

Scalability



Integration

Enterprise Simulation Platform Enablers



Multi-Domain Modeling

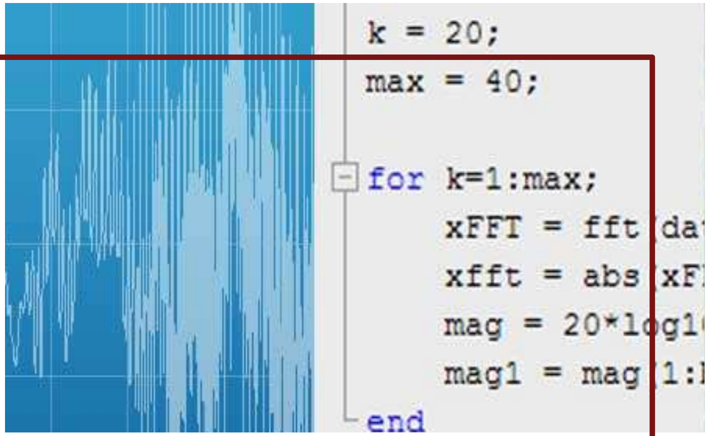
Multi-Domain Modeling in Simulink

Dynamic Systems

State Machines

Discrete-Event Systems

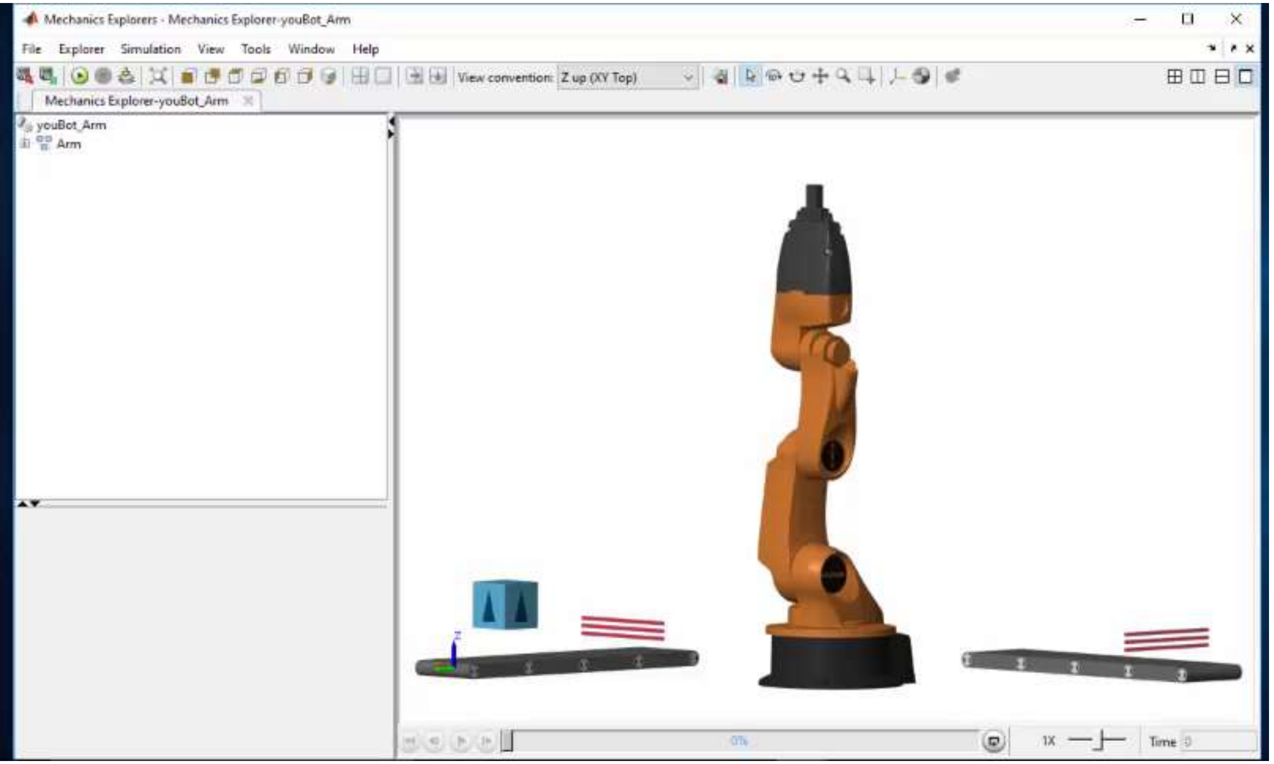
Physical Modeling



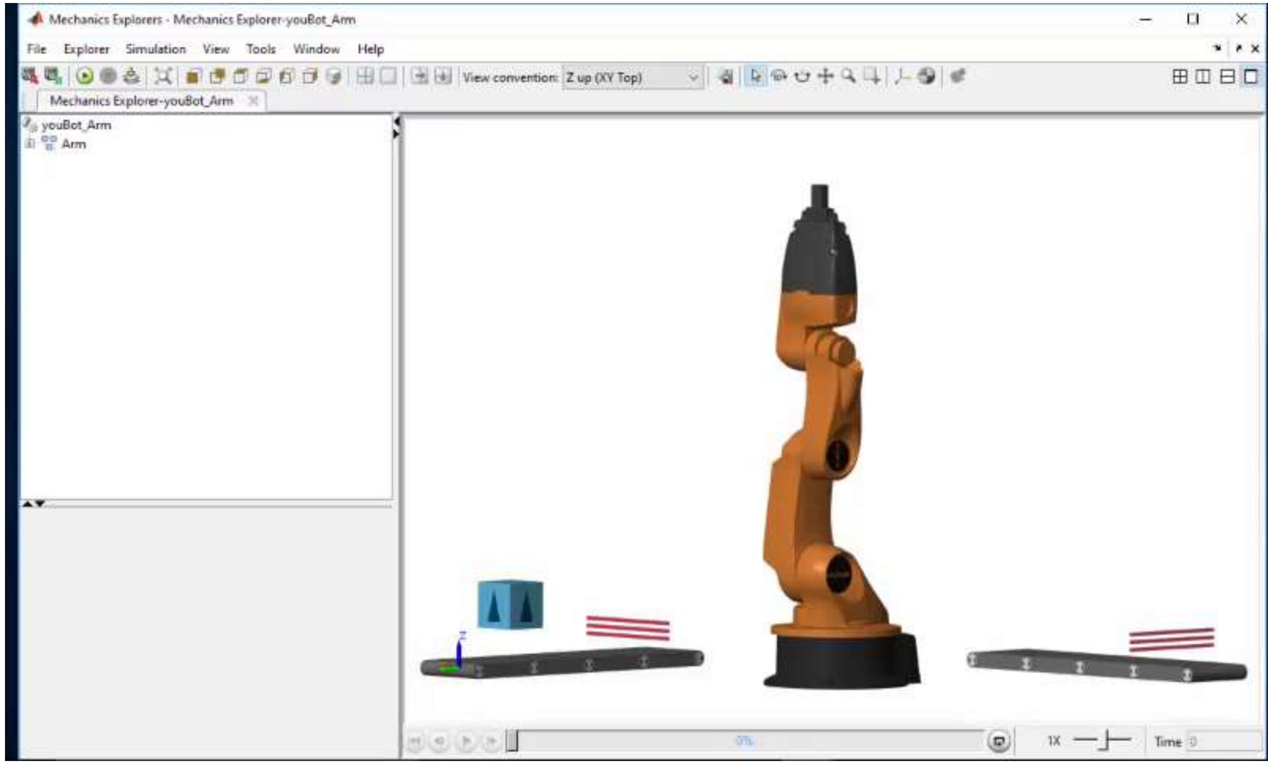
Object-Oriented

Robot Arm Multi-Domain Simulation

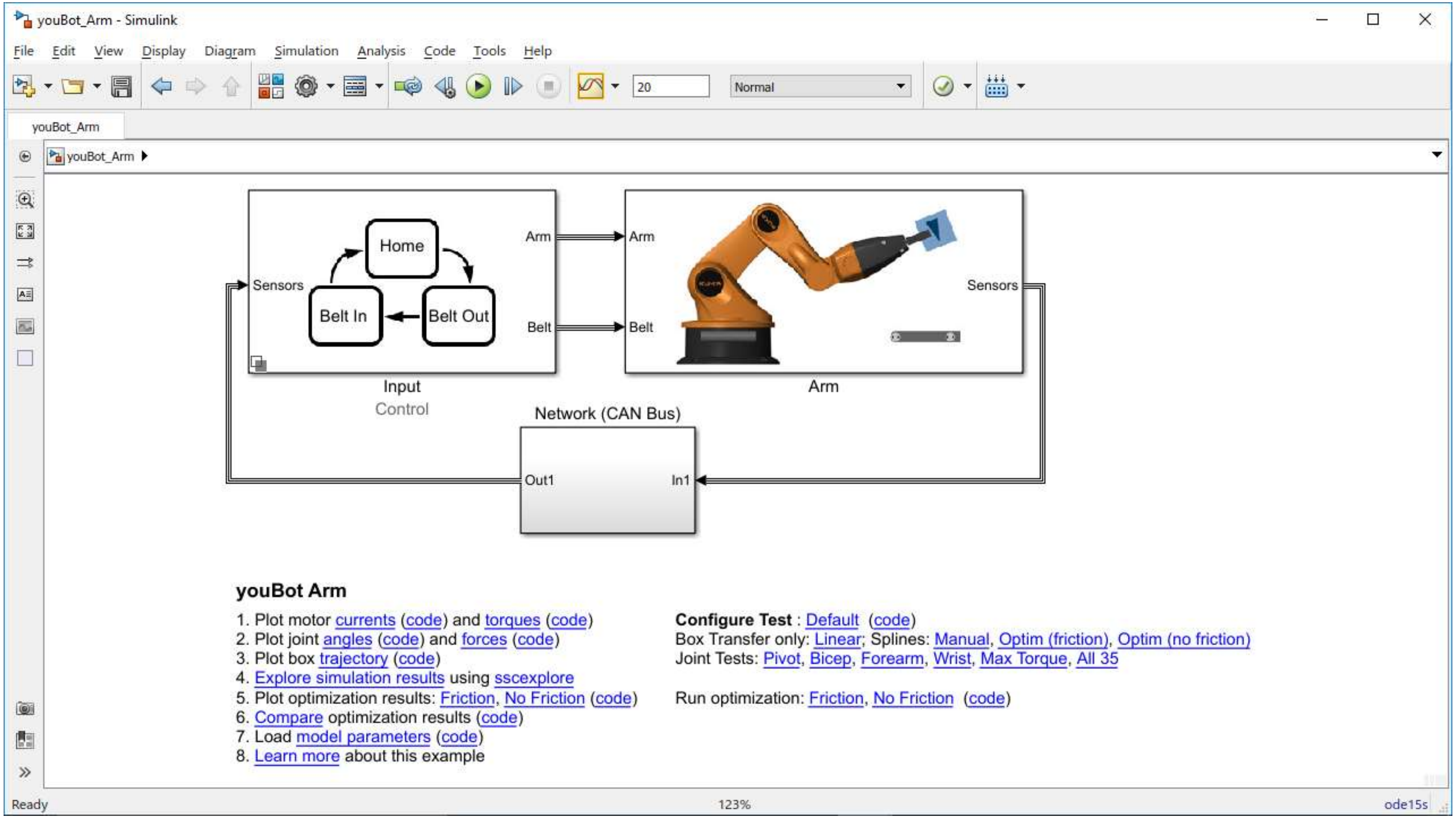
Mechatronic System Model



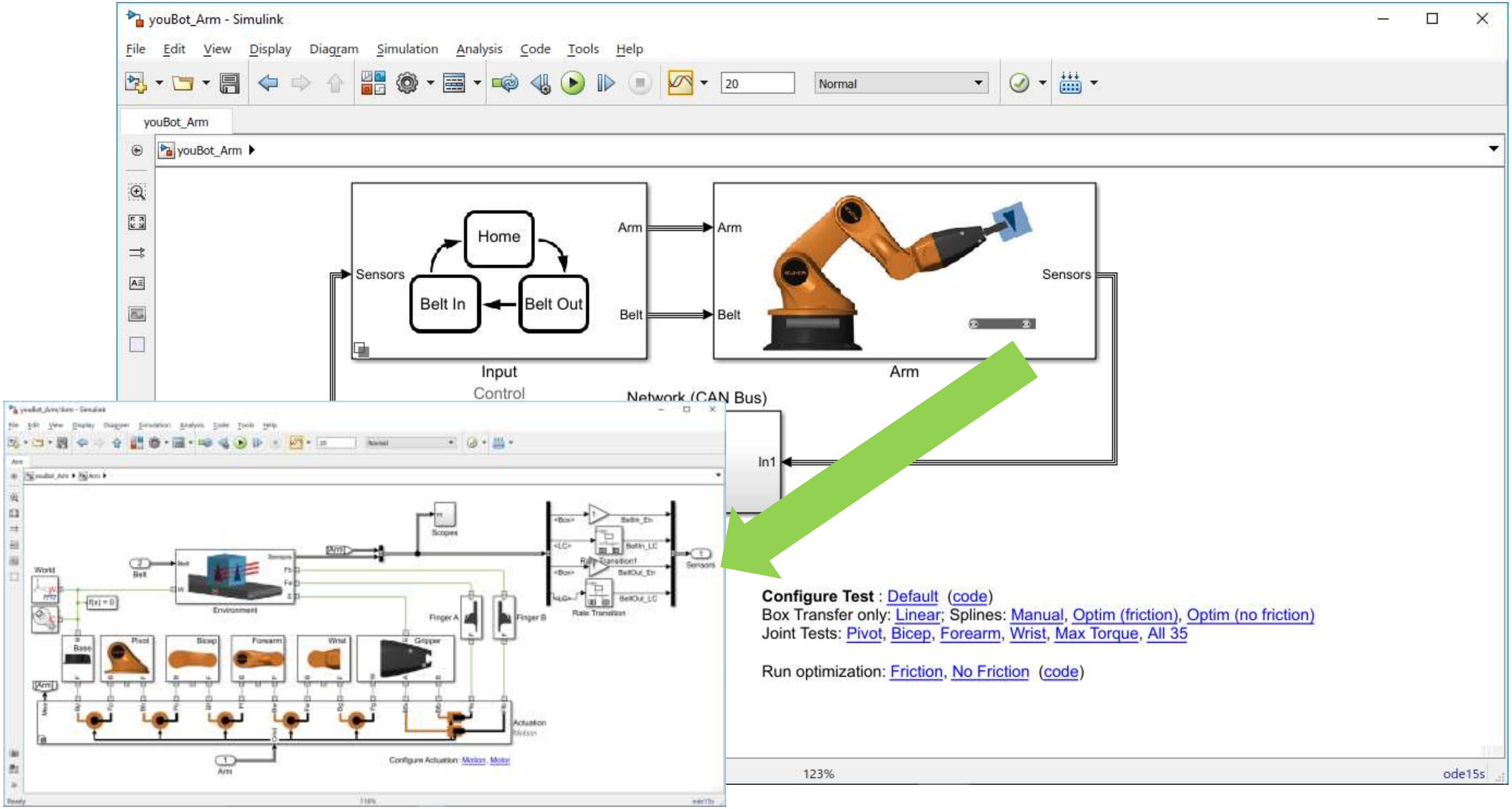
Mechatronic system model with communication latencies



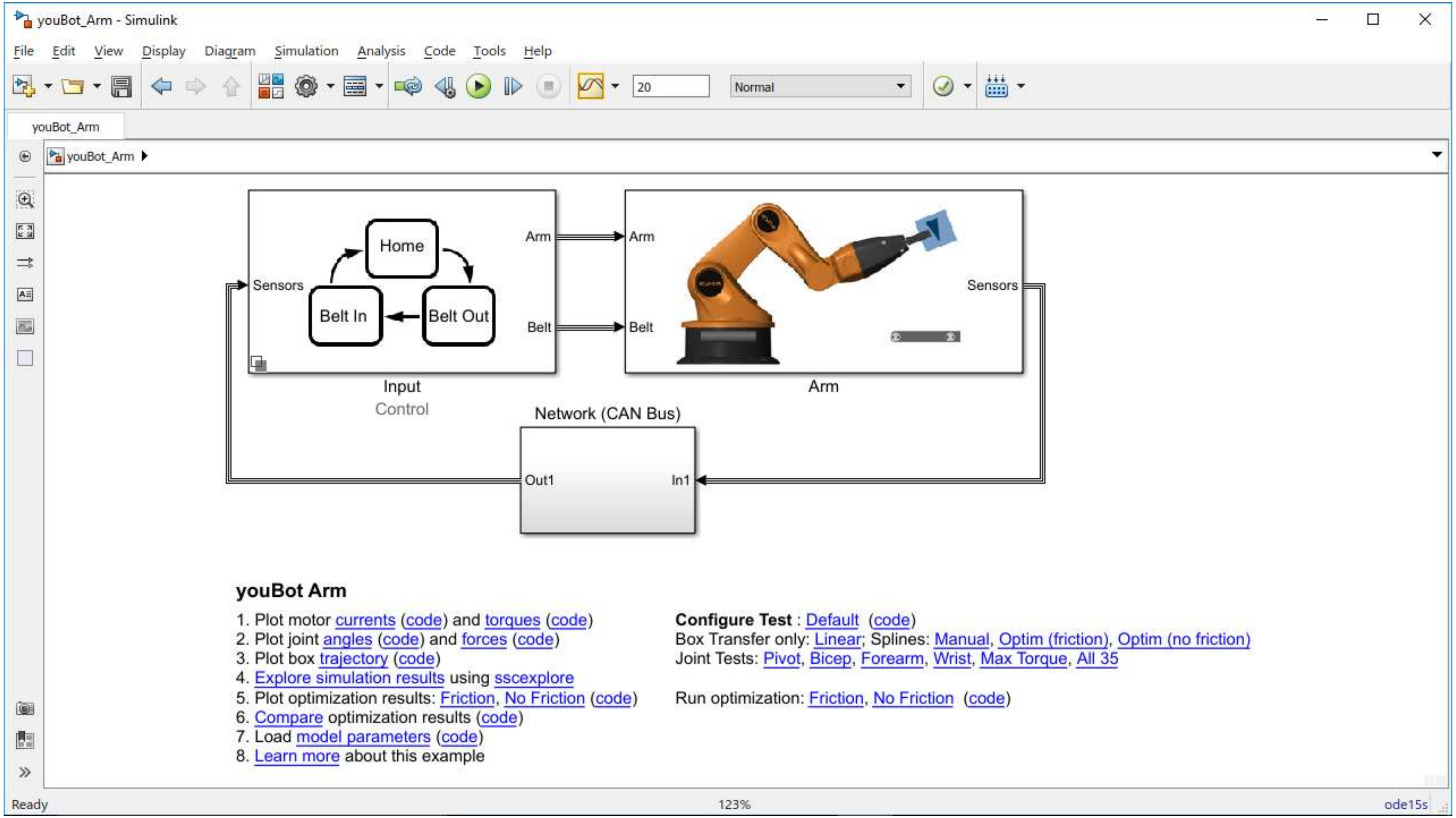
Multi-Domain Model



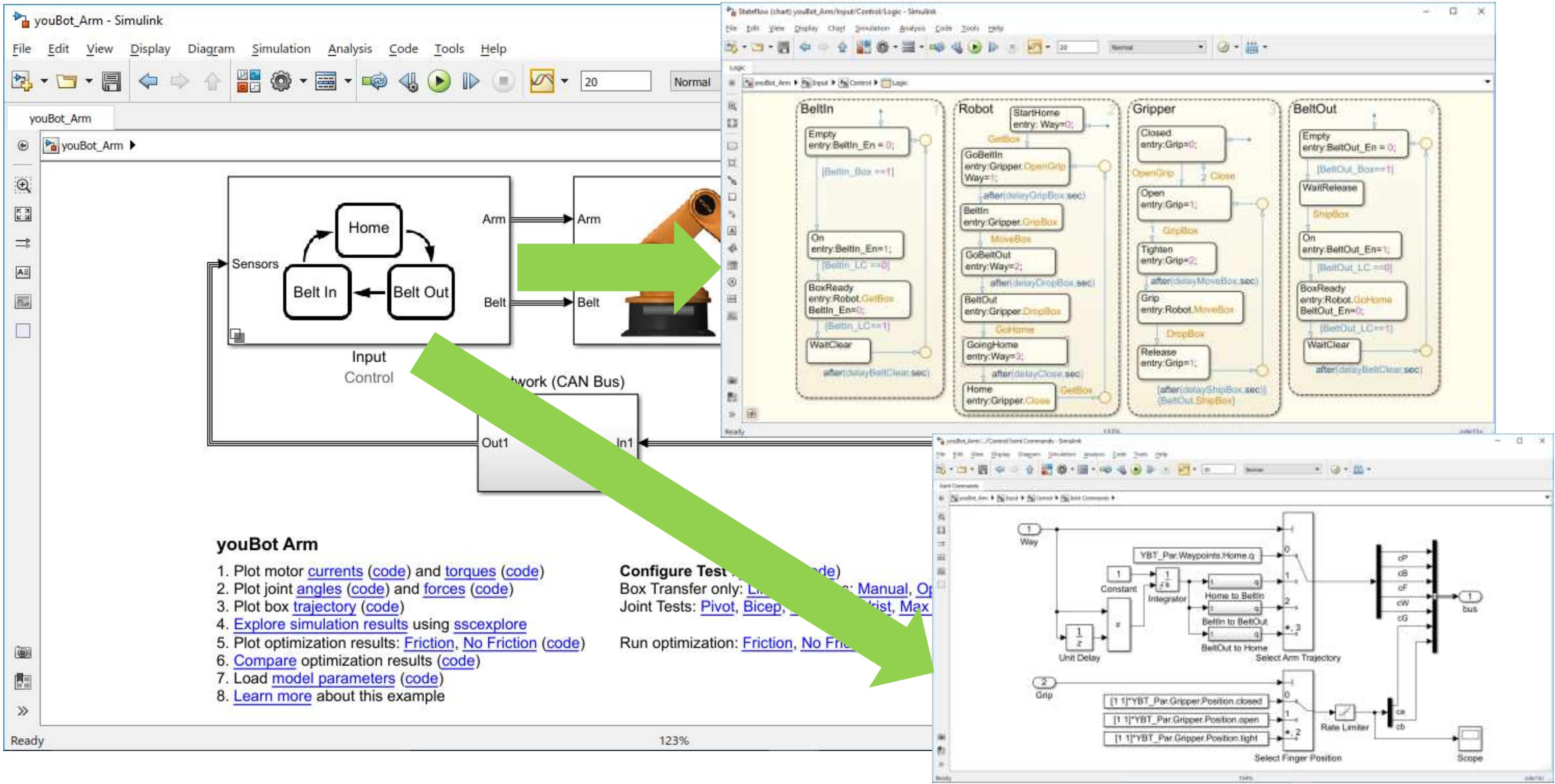
Physical Modeling



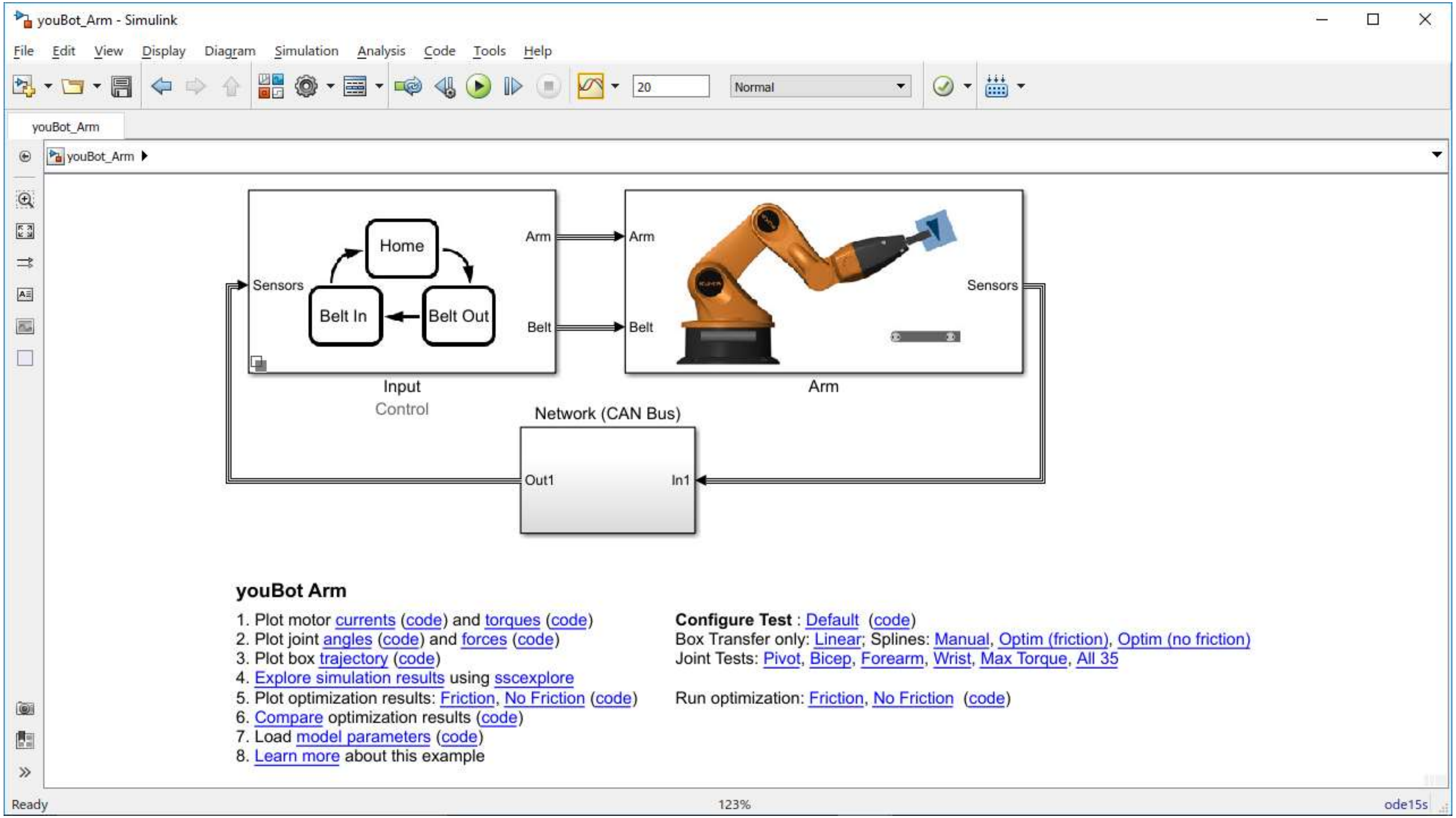
Multi-Domain Model



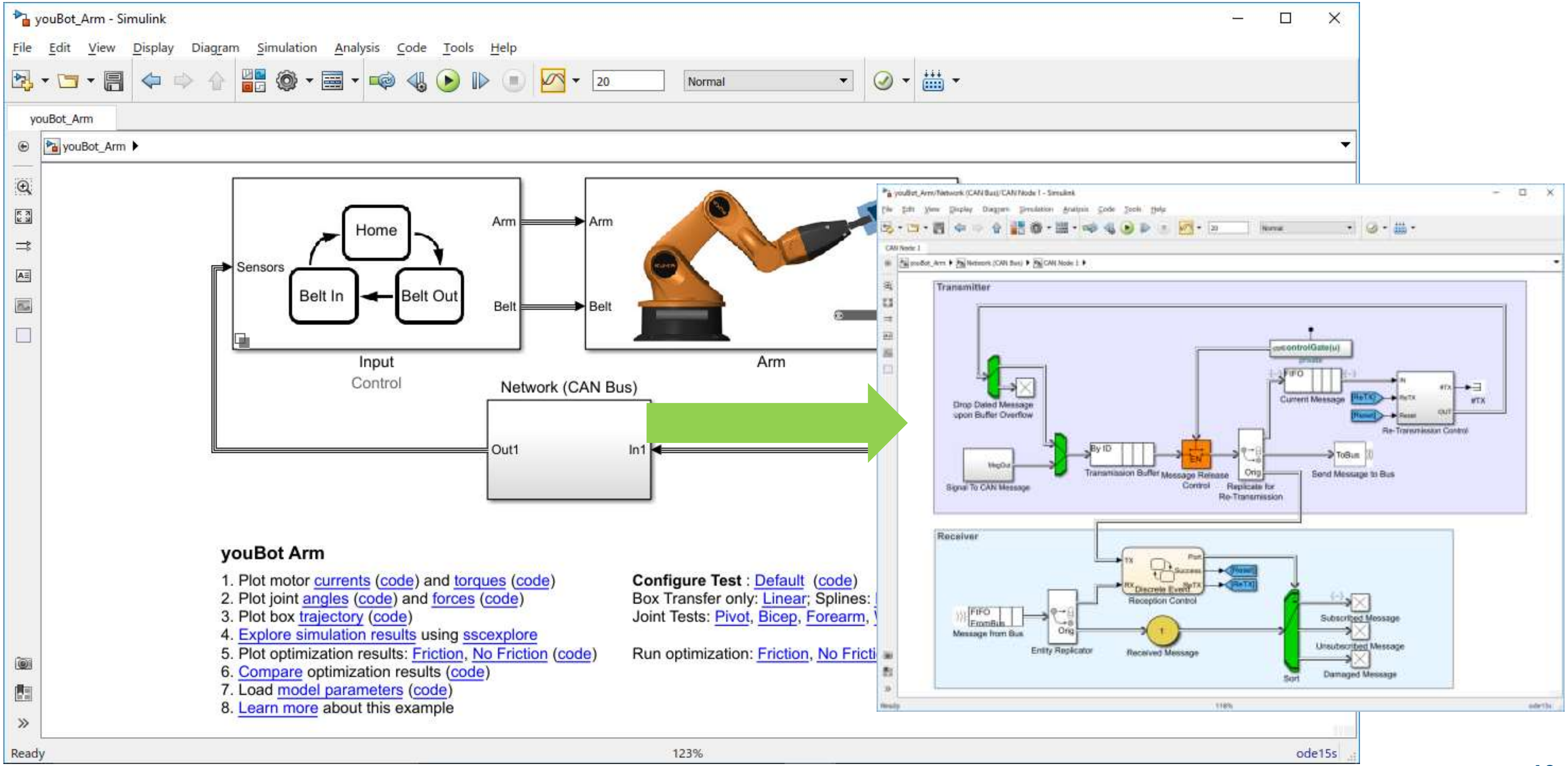
State Charts and System Dynamics



Multi-Domain Model

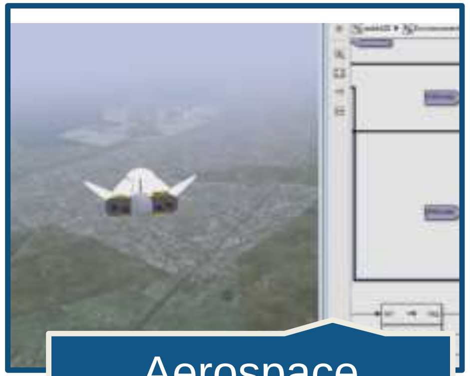


Discrete-Event Modeling



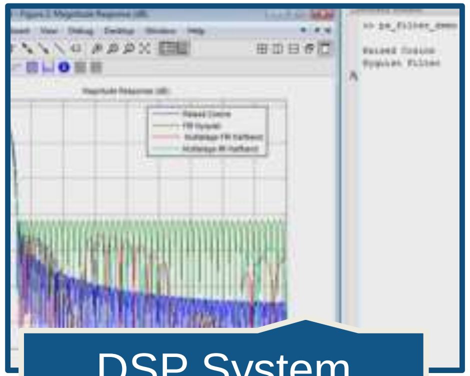
Domain-Specific Blocksets and Toolboxes

Simulink has numerous domain-specific tools, for example:

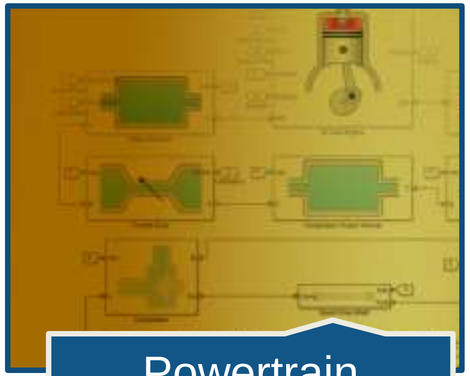


Aerospace Blockset

Computer Vision System Toolbox



DSP System Toolbox



Powertrain Blockset

Robotics System Toolbox

Customer Success in Multidomain Modeling

ABB, Deltamarin, and VTT Simulate and Optimize Ship Energy Flows

Challenge

- Increase the energy efficiency of large vessels

Solution

- Use Simulink and Simscape to model, simulate, and optimize ship energy flow

Results

- Cost- and fuel-saving design improvements
- Testing costs reduced by tens of thousands of euros

Customer Success in Multidomain Modeling

"Simulink and Simscape enabled us to create a dynamic model of a complex energy system that spans several physical domains. By simulating this model, we can see how a new energy subsystem will perform before it is built, and provide customers with an accurate estimate of their return on investment."

Juha Orivuori, ABB

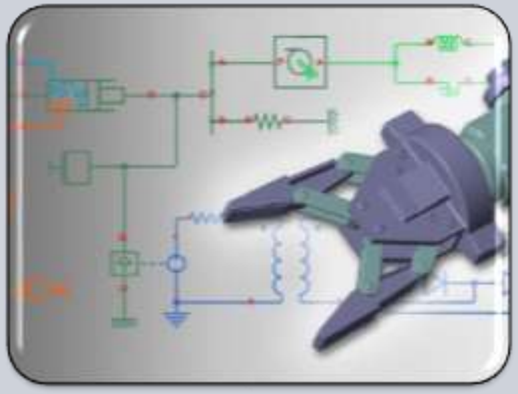
Solution

- Use Simulink and Simscape to model, simulate, and optimize ship energy flow

Results

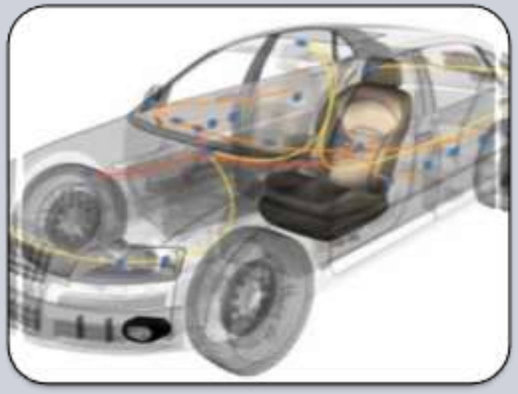
- Cost- and fuel-saving design improvements
- Testing costs reduced by tens of thousands of euros

Enterprise Simulation Platform Enablers



Multi-Domain Modeling

Scalability

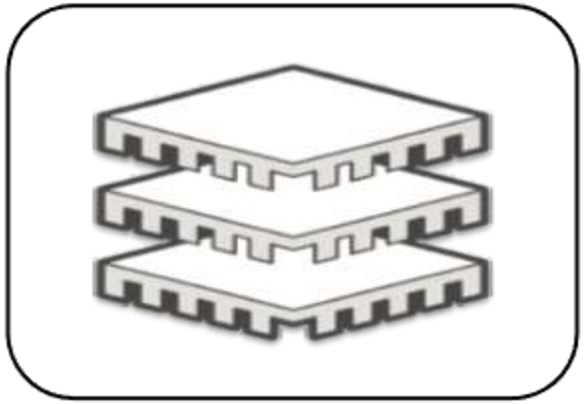


Integration

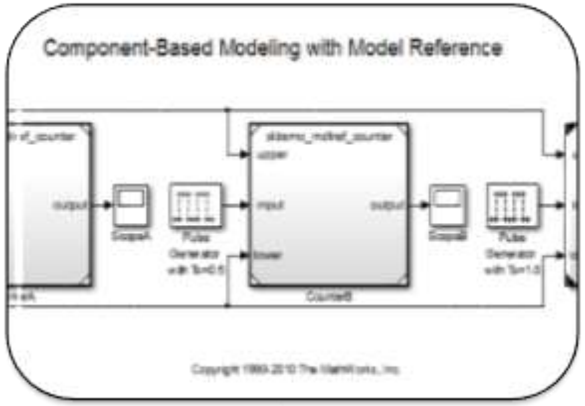
Enterprise Simulation Platform Enablers

Scalability

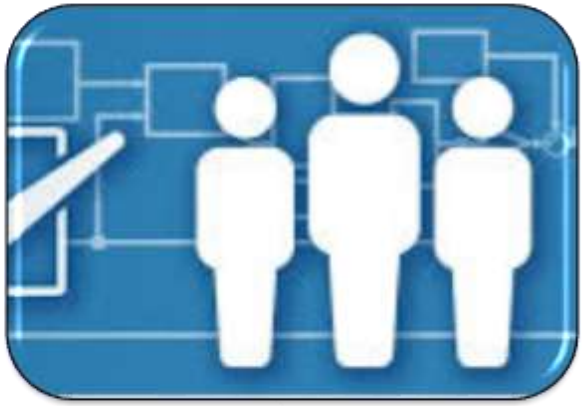
Scalability Challenges



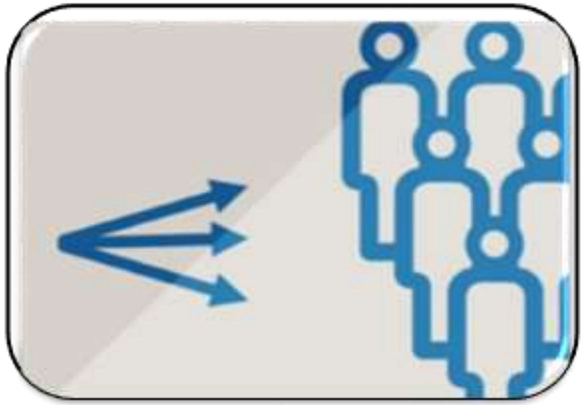
Performance



Componentization

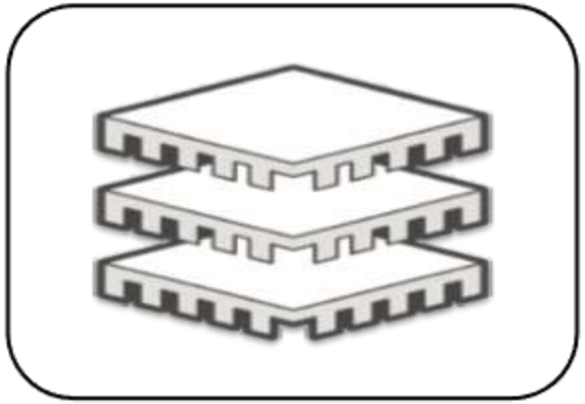


Team Workflows



Sharing

Scalability Challenges



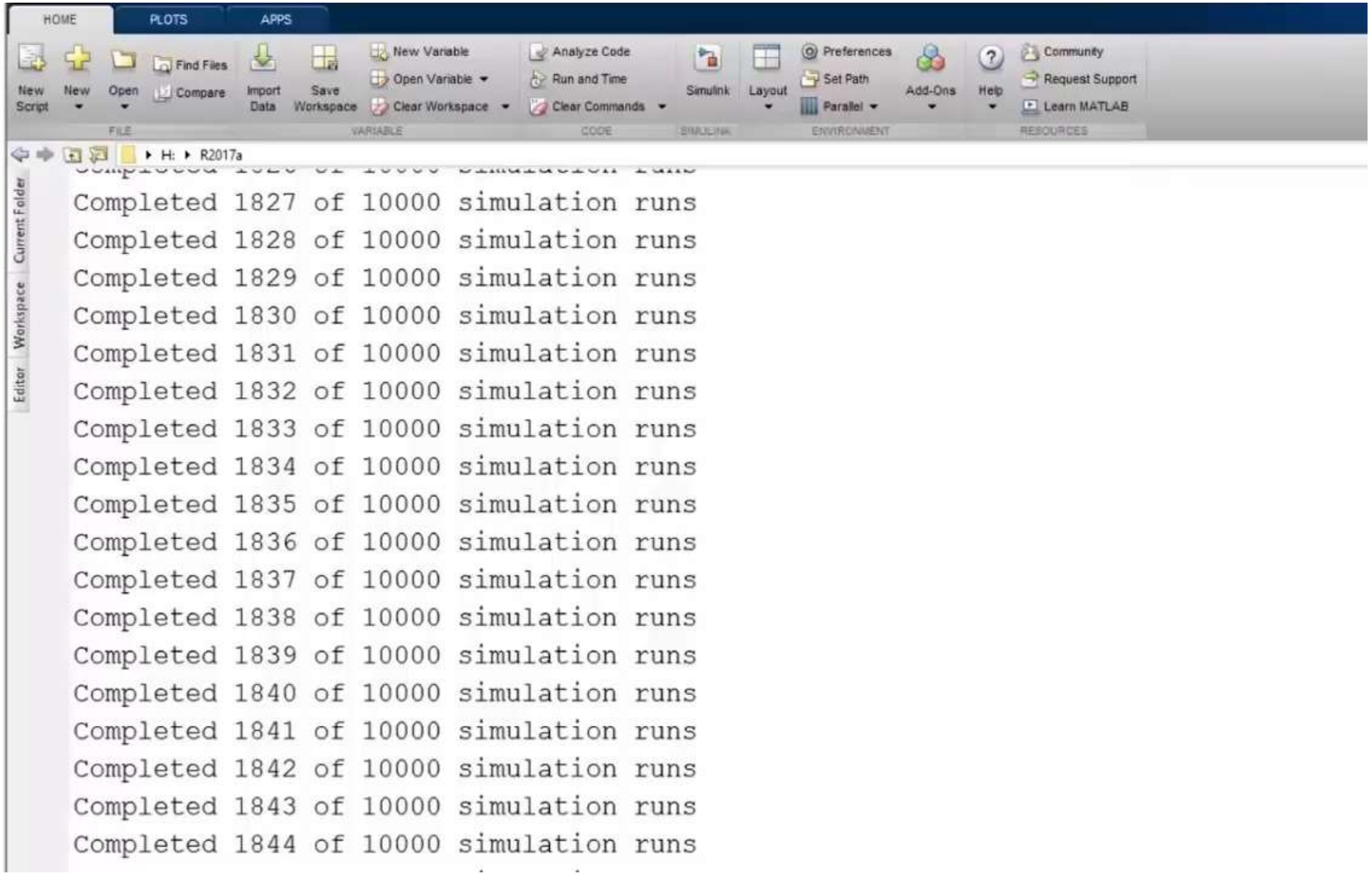
Performance

Tools and Techniques for Speeding Up Simulations

- Choosing the right solver – Automatic Solver Selection
- Examine model dynamics with Solver Profiler
- Using simulation acceleration modes
- Using Performance Advisor

Performance Scalability

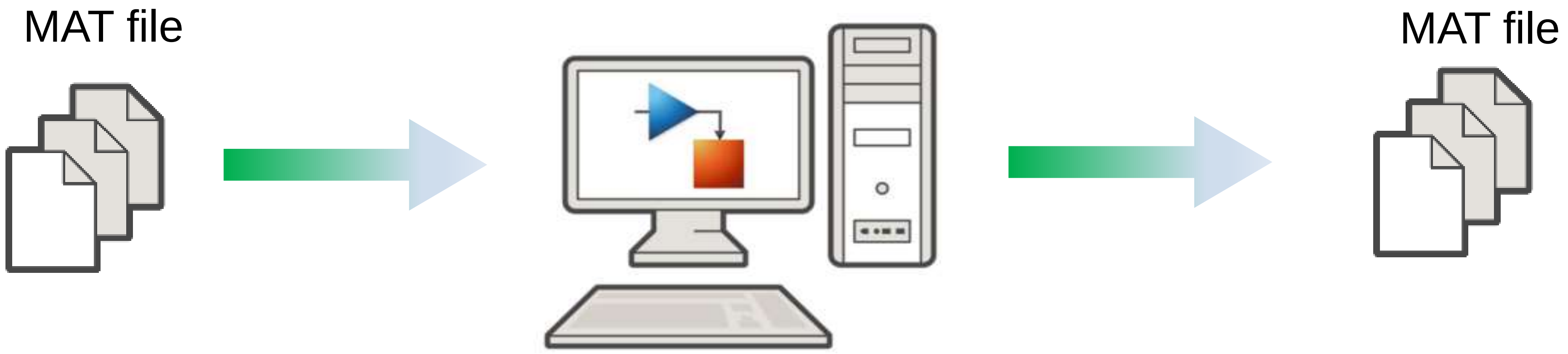
Easy scalability to multicore or cluster/cloud computation environment



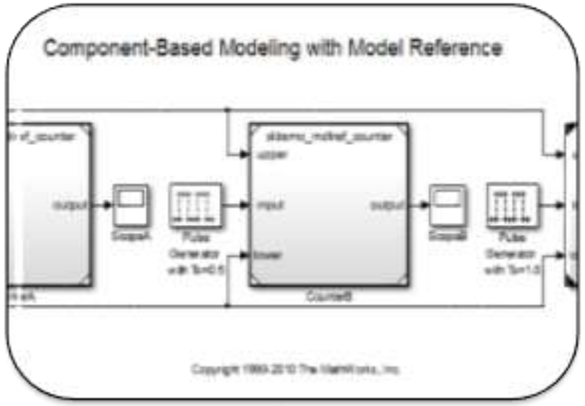
Performance Scalability

Big data workflow

– Processing large amount of simulation inputs / outputs

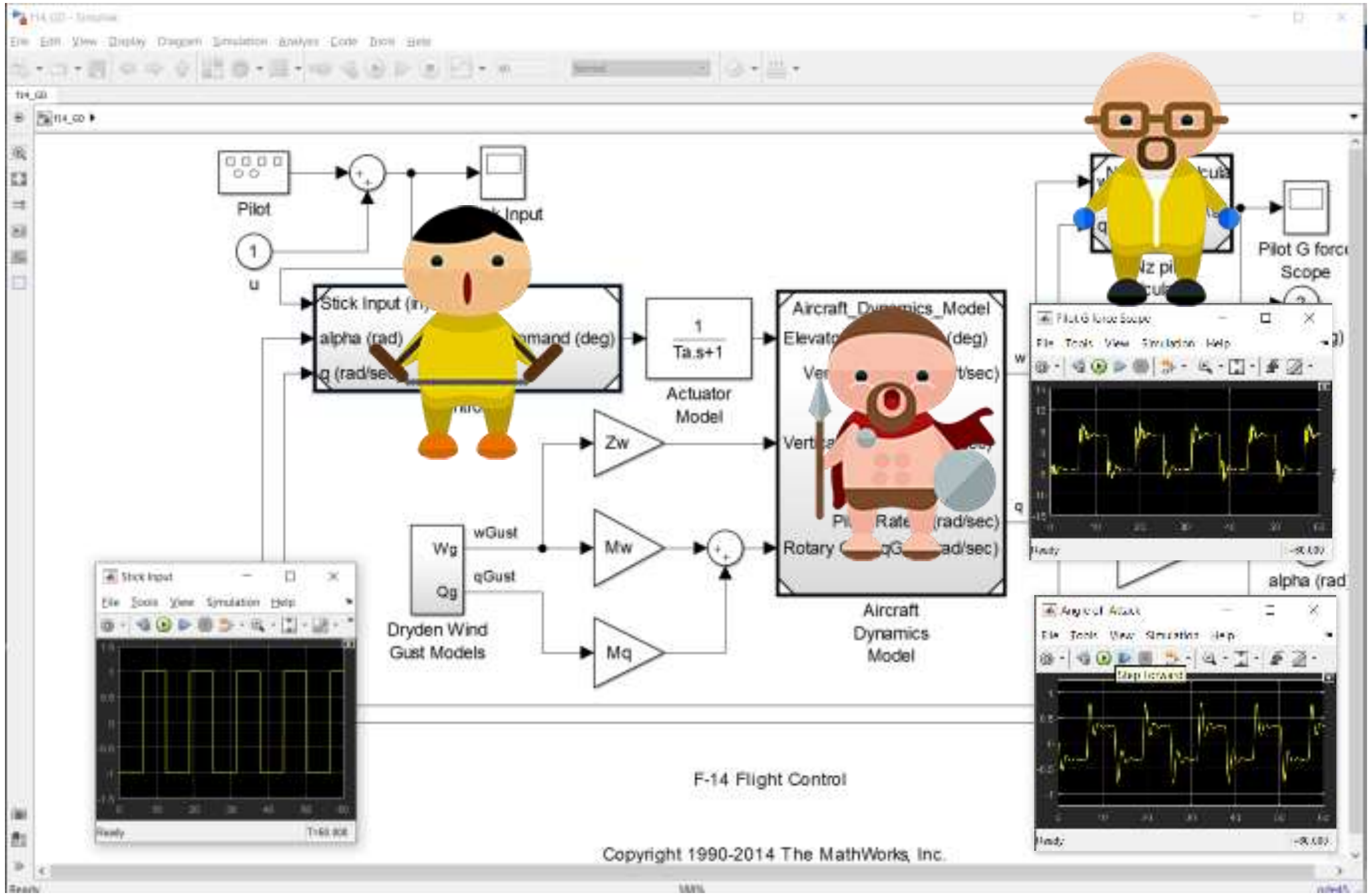


Scalability Challenges

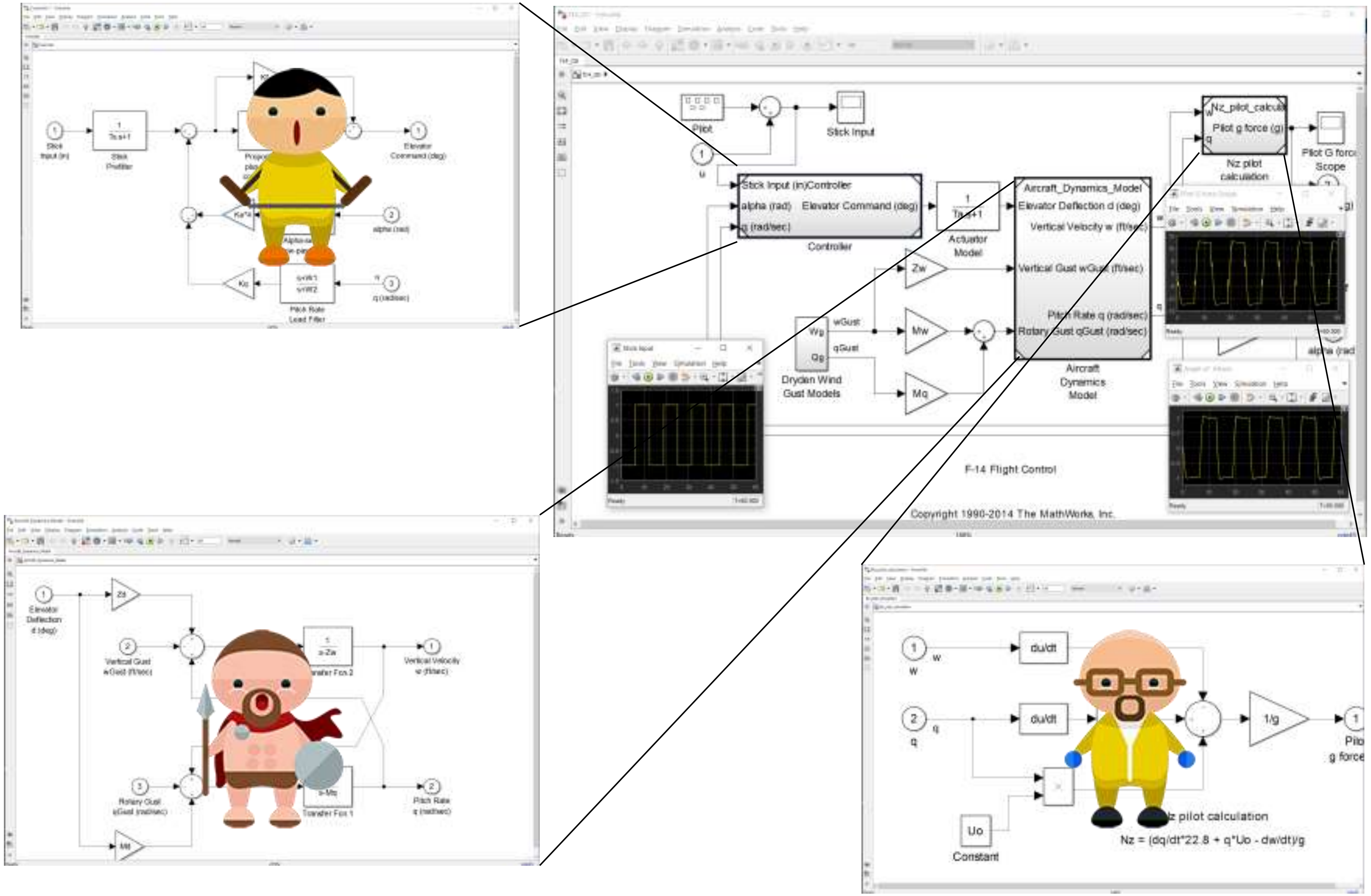


Componentization

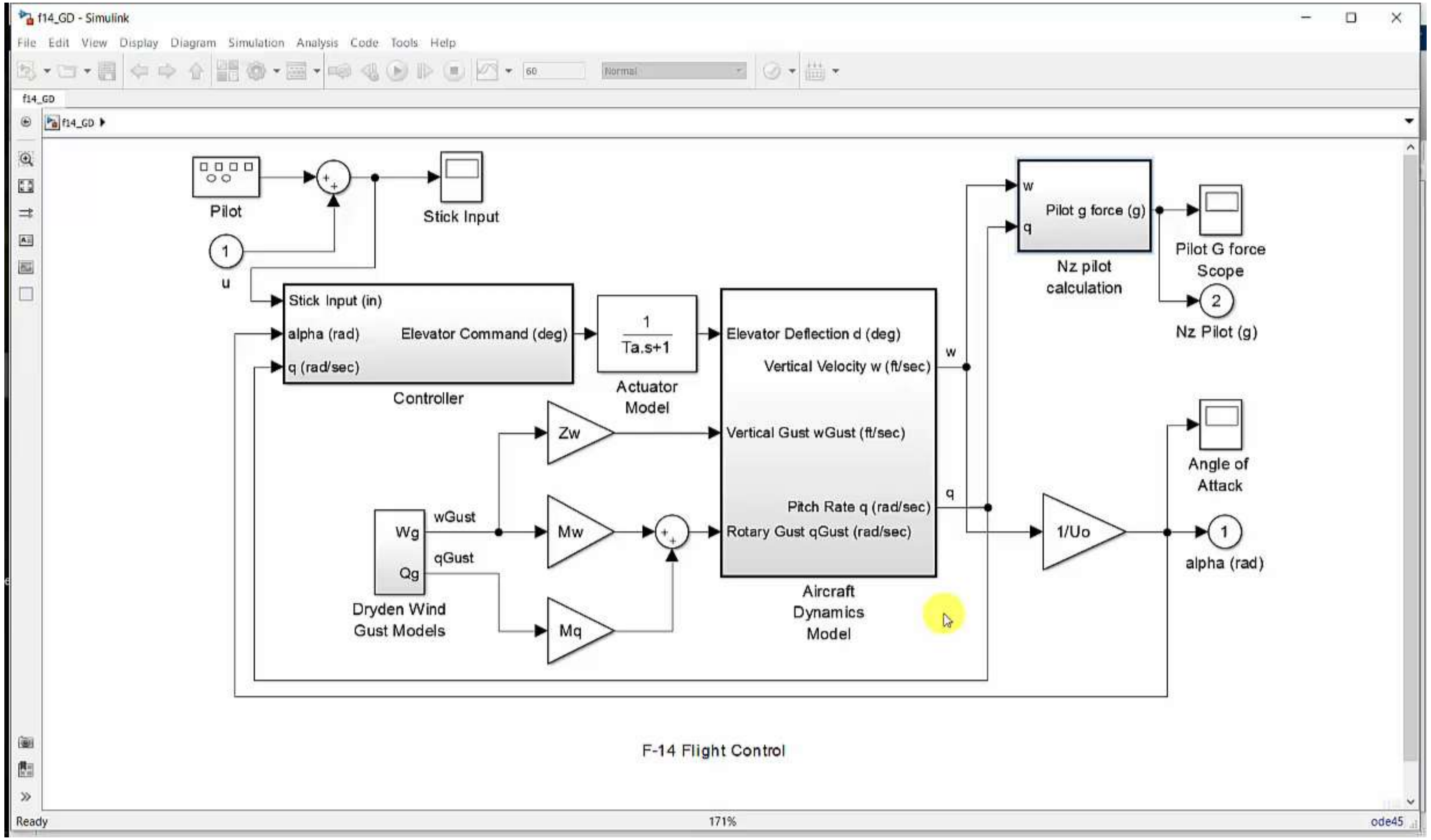
Complex Design Development through Componentization



Partitioning a Model using Model Referencing Technique

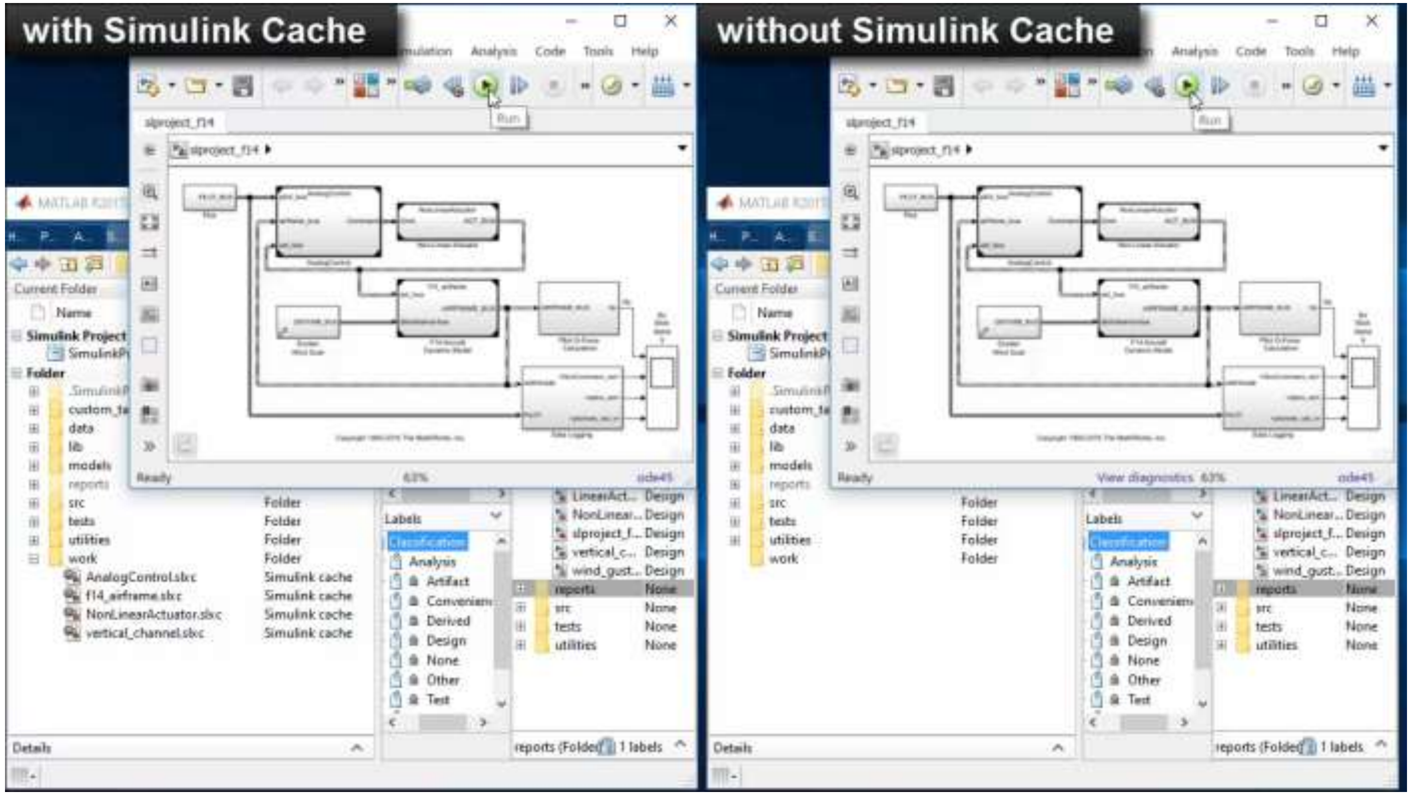


Partitioning a Model using Model Referencing Technique

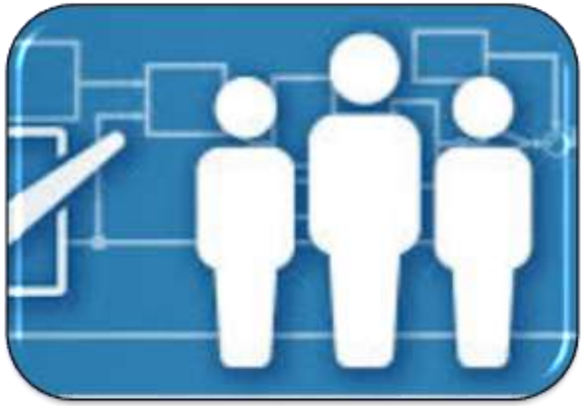


Improve Performance by Team Sharing and Reusing of Model Artifacts – Simulink Cache

- Get simulation results faster by using pre-built model artifacts
- Share Simulink Cache easily with your team members
- Reduce unnecessary builds



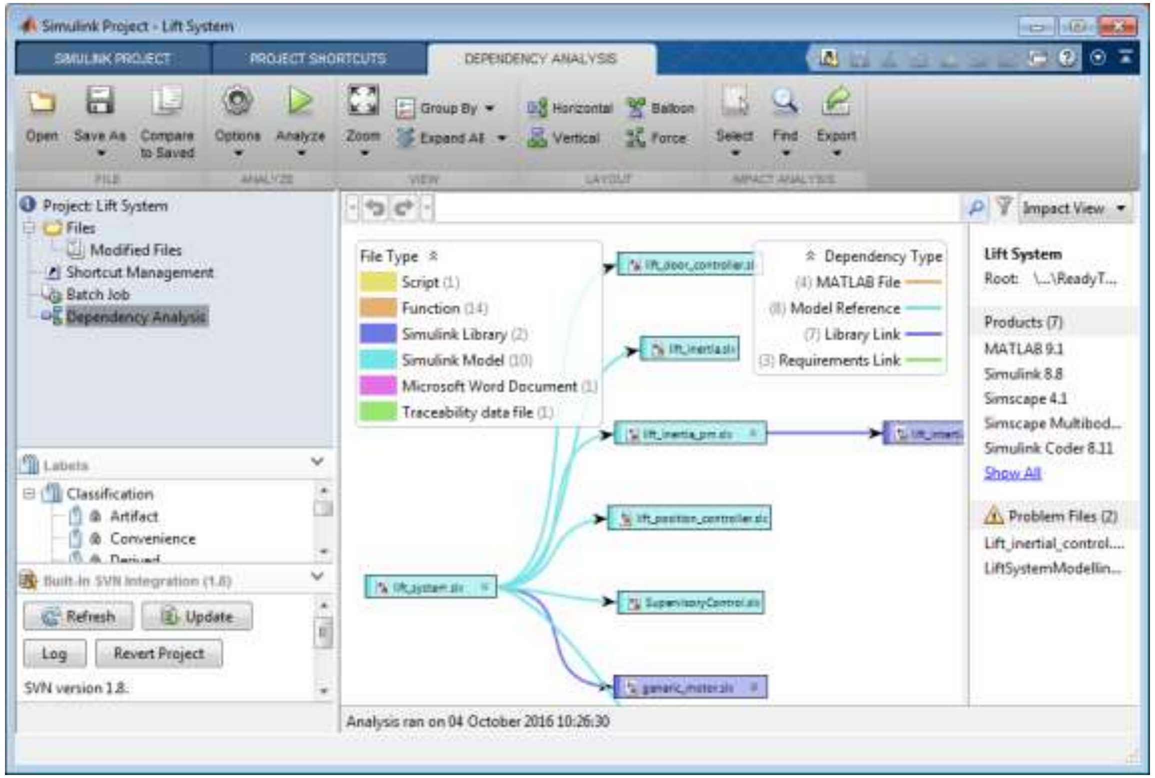
Scalability Challenges



Team Workflows

Capabilities Enabling Team Workflows

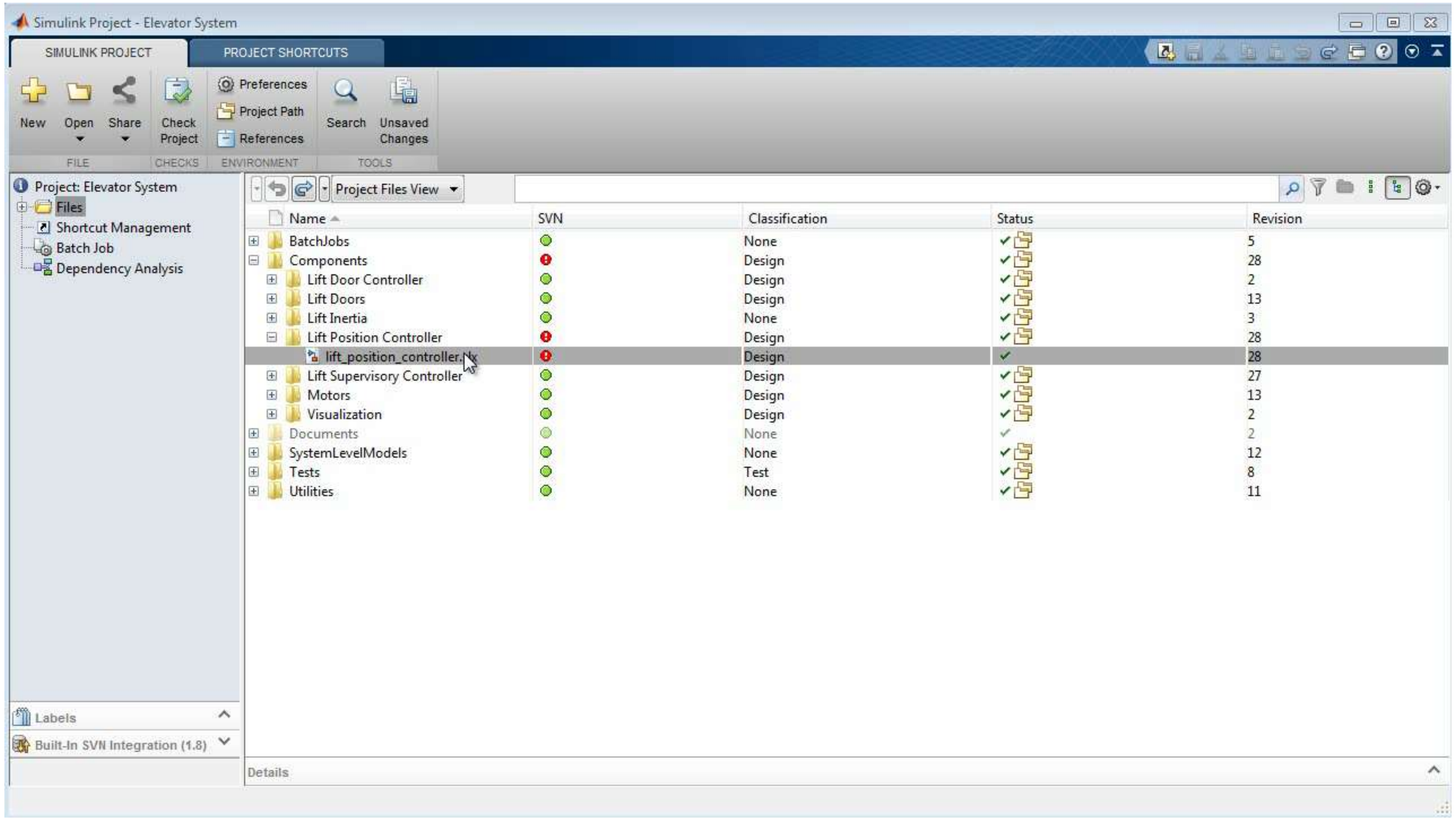
- Source control
- Design comparison and merging
- Dependency analysis
- Task automation



Source Control Integrations

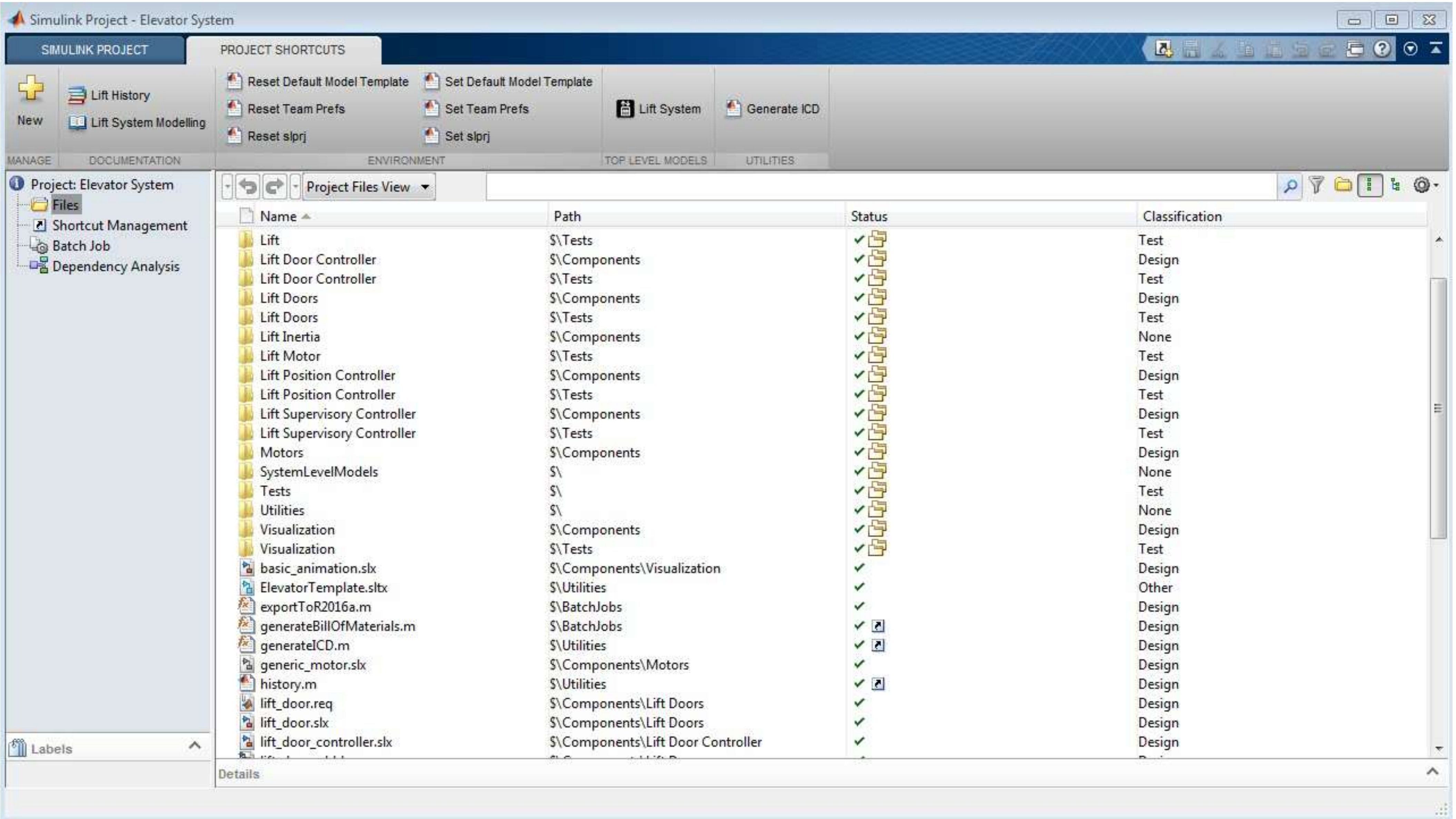
Microsoft Team Foundation Server (TFS) integration available <u>now</u> from MathWorks File Exchange

Integrating Work from Different Engineers via Merge

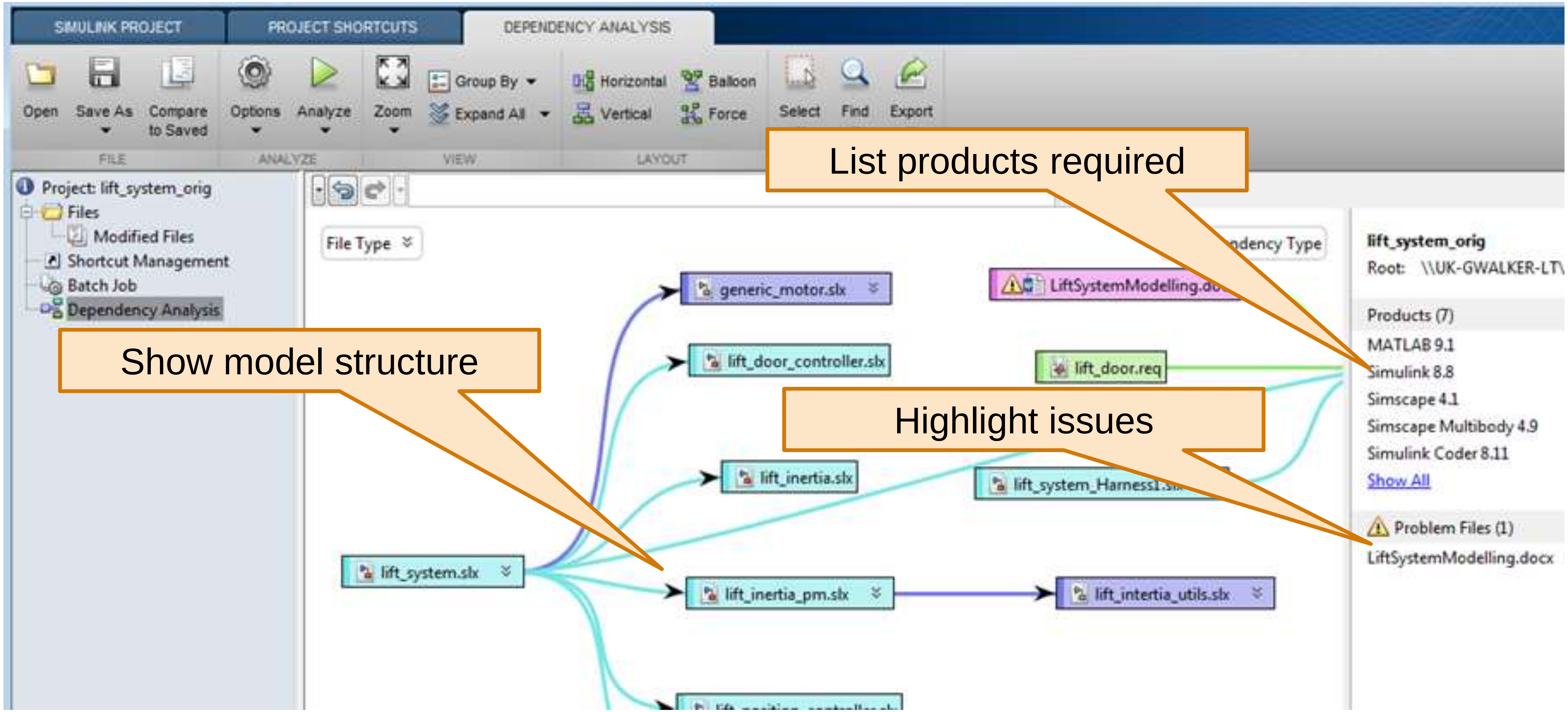


- Supports concurrent engineering
- Lets you concentrate on design

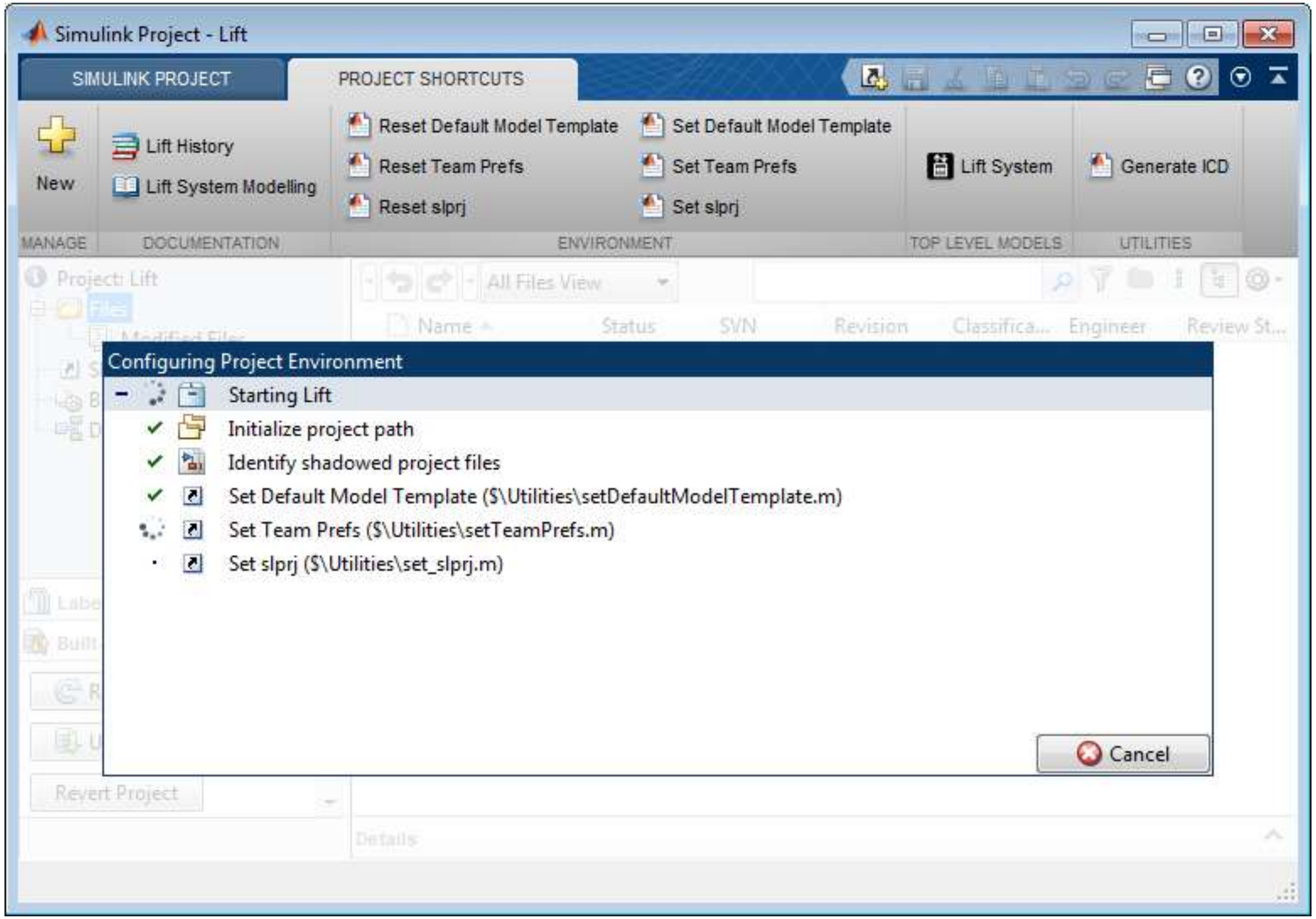
Dependency Analysis – Modular Development



Dependency Analysis – Modular Development

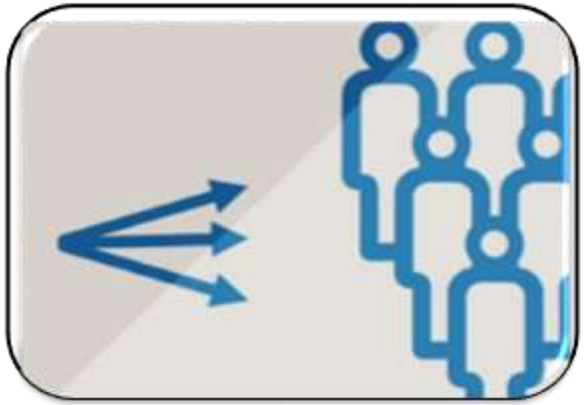


Task Automation – Configuring Project Environment



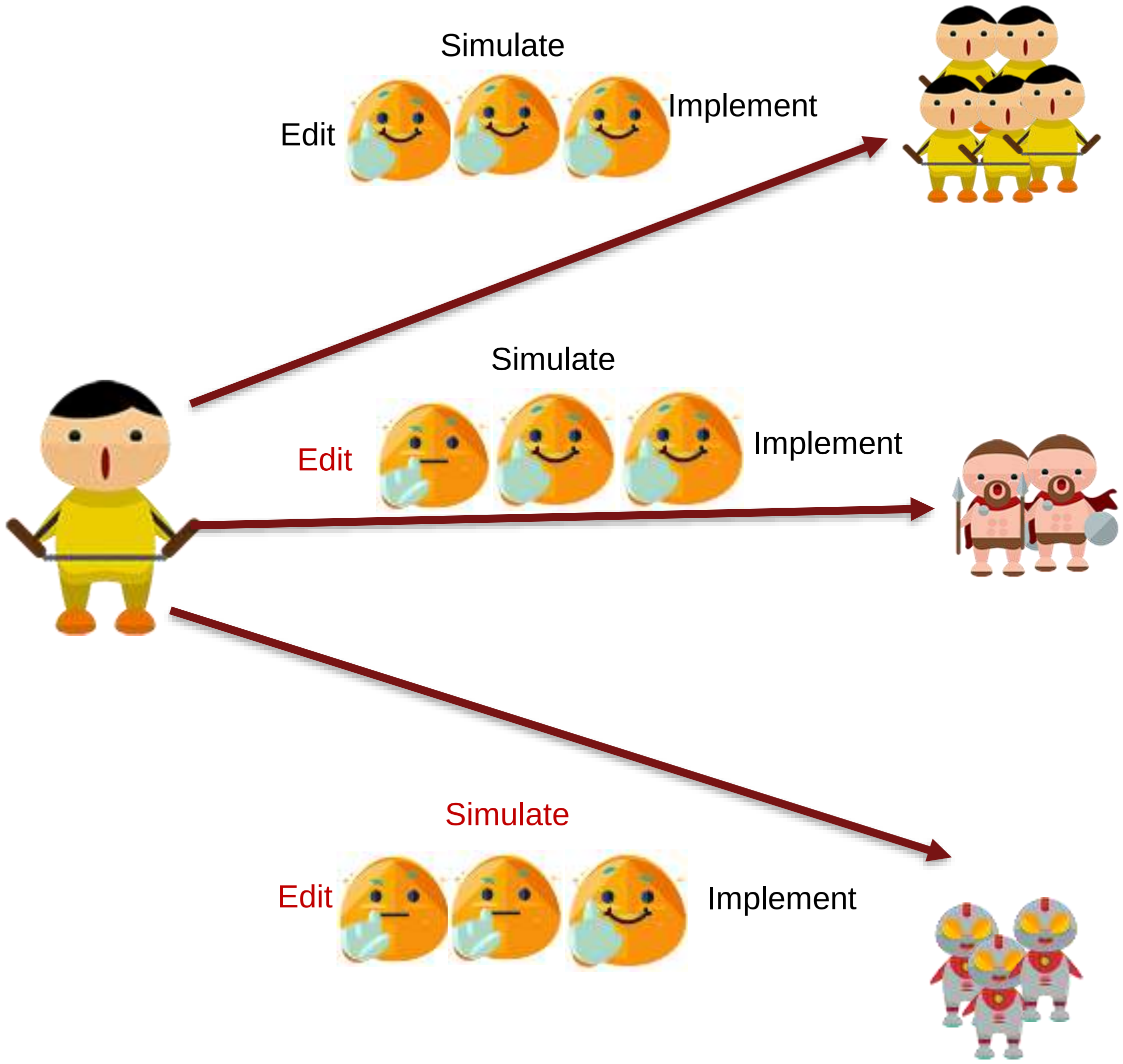
- Robustly configure the team environment
- For everyone
- Automatically

Scalability Challenges

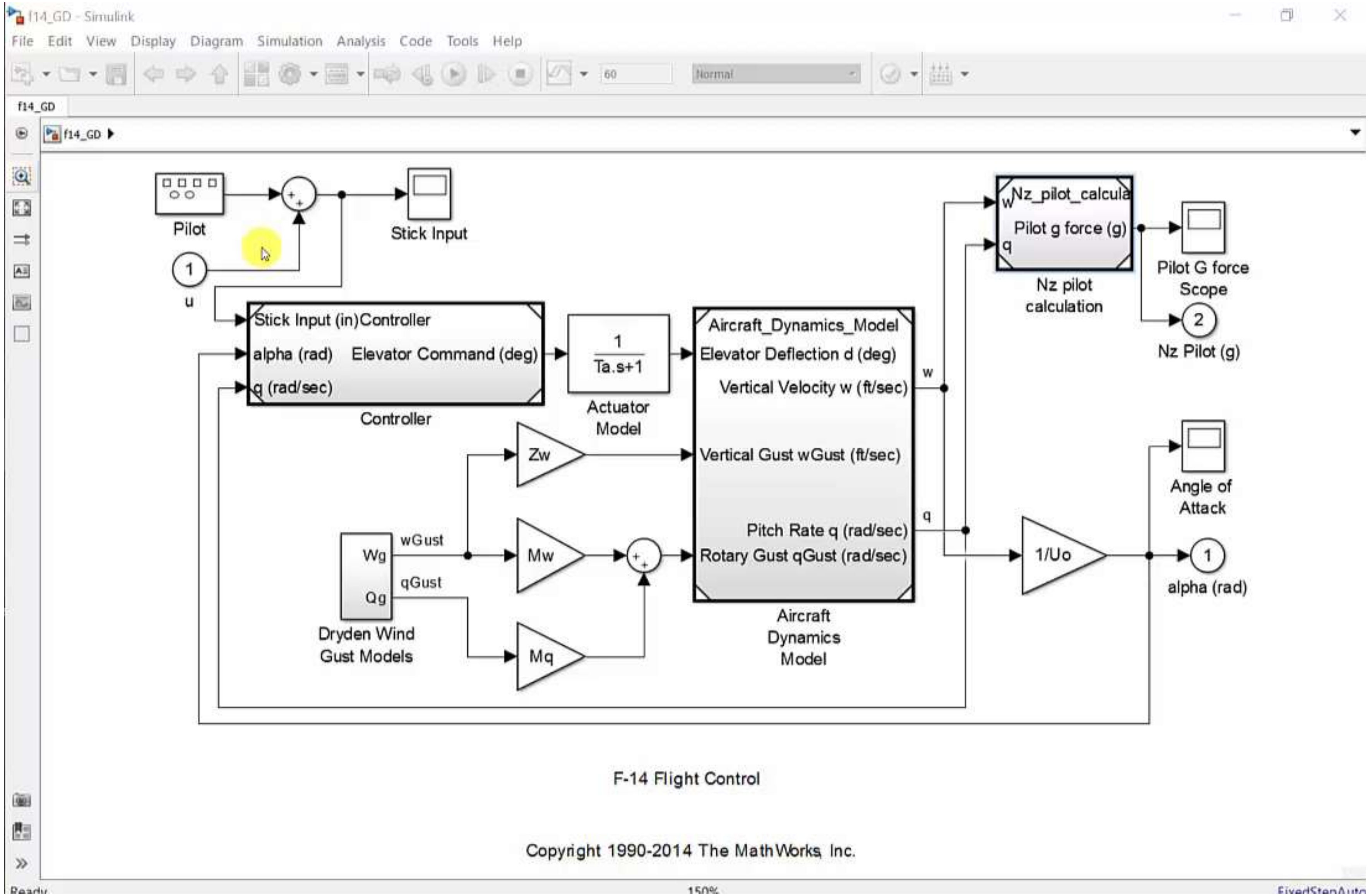


Sharing

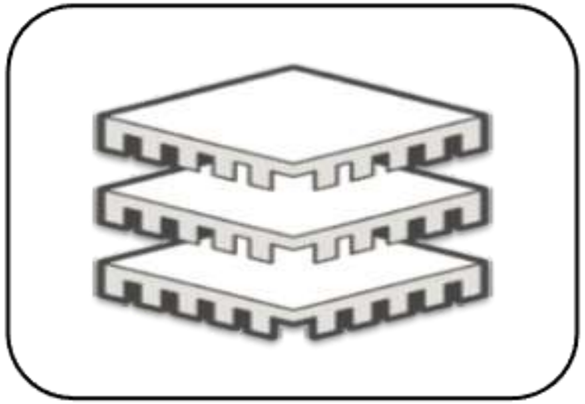
Sharing models with access control



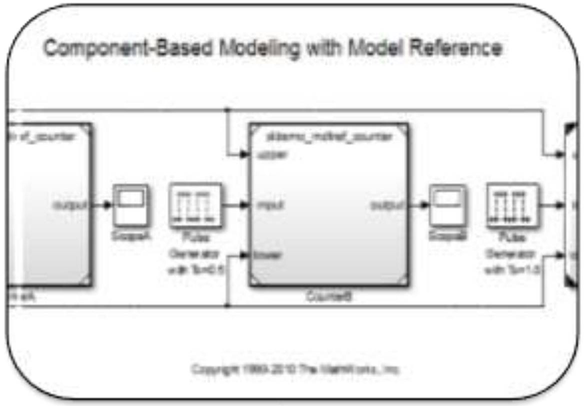
Protecting your Intellectual Property (IP)



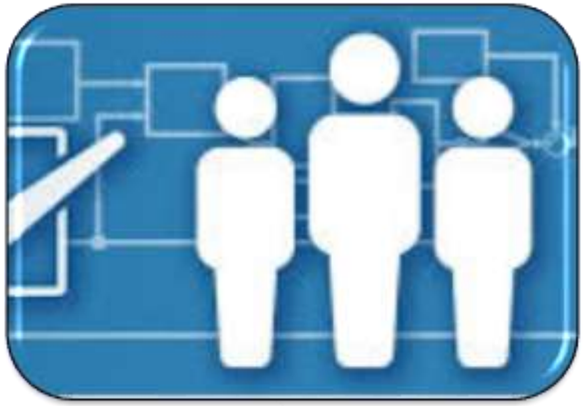
Simulink Addressing Scalability Challenges



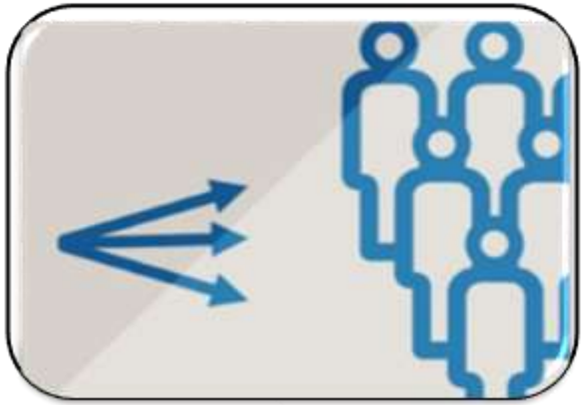
Performance



Componentization

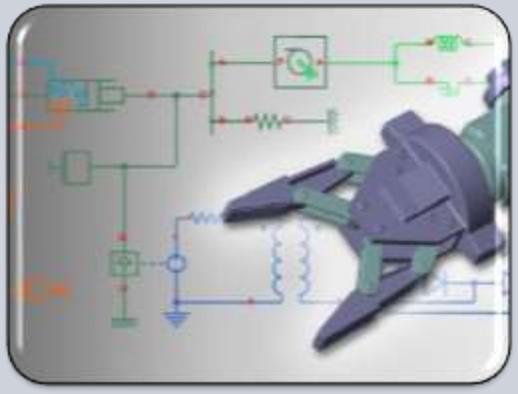


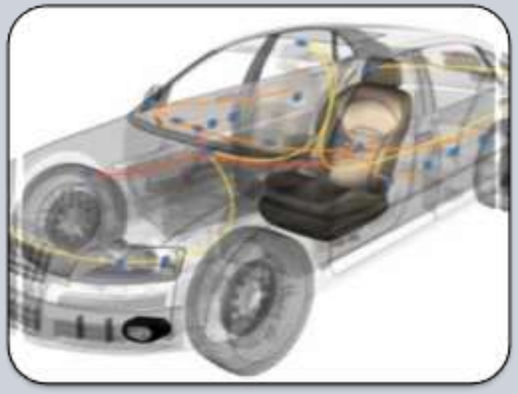
Team Workflows



Sharing

Enterprise Simulation Platform Enablers



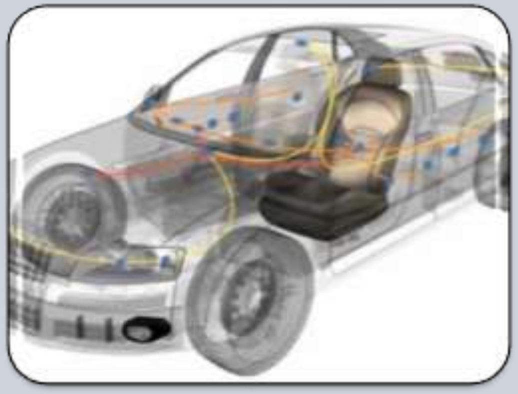


Multi-Domain Modeling

Scalability

Integration

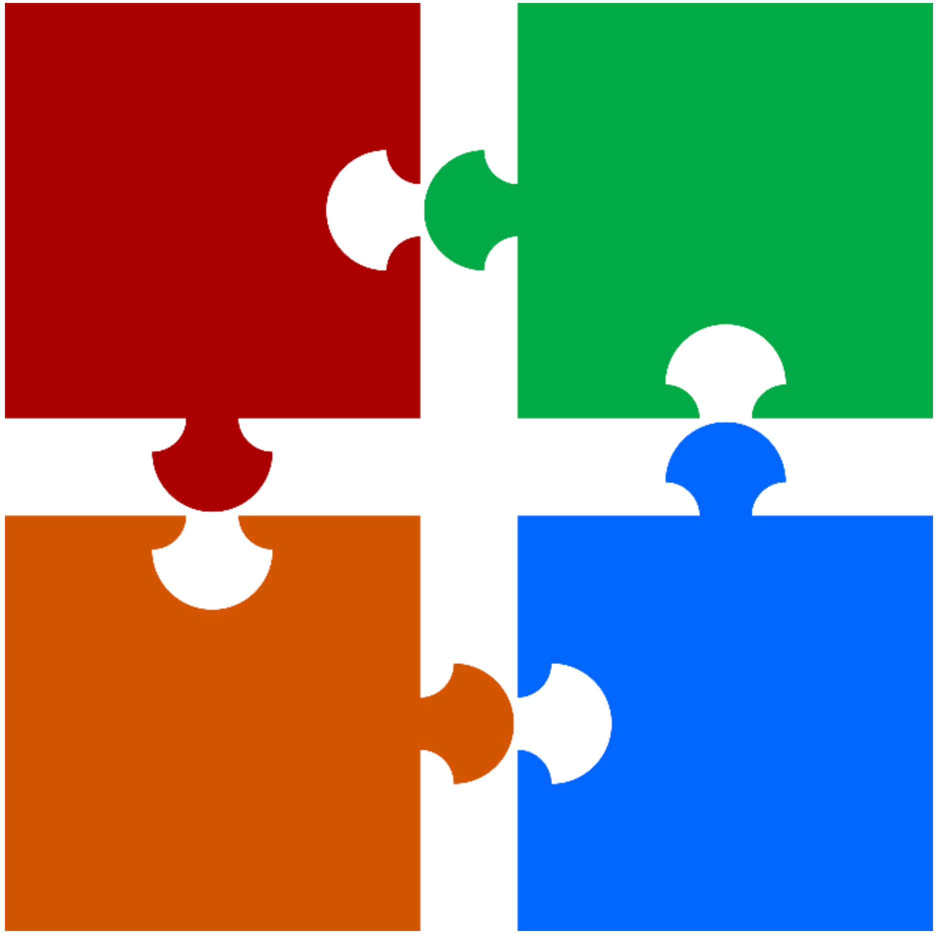
Enterprise Simulation Platform Enablers



Integration

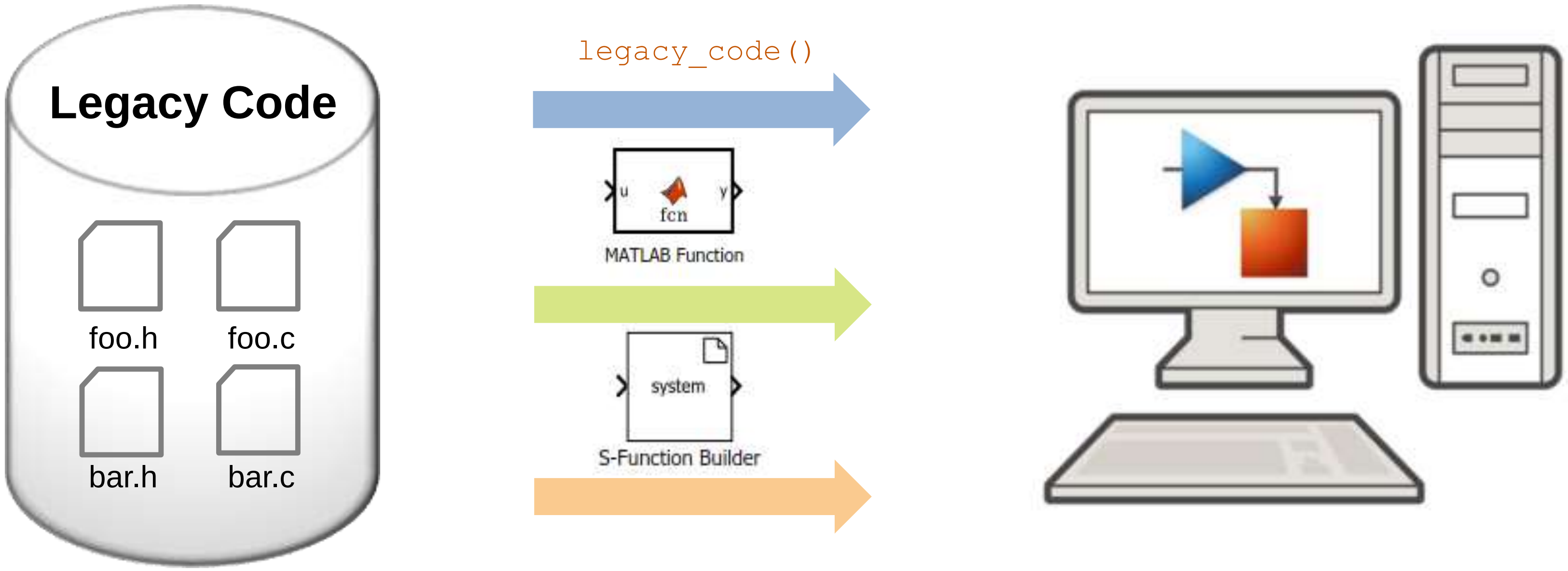
Disconnected Component Intellectual Property (IP)

Your IP exists in many forms and in many locations, making integration difficult



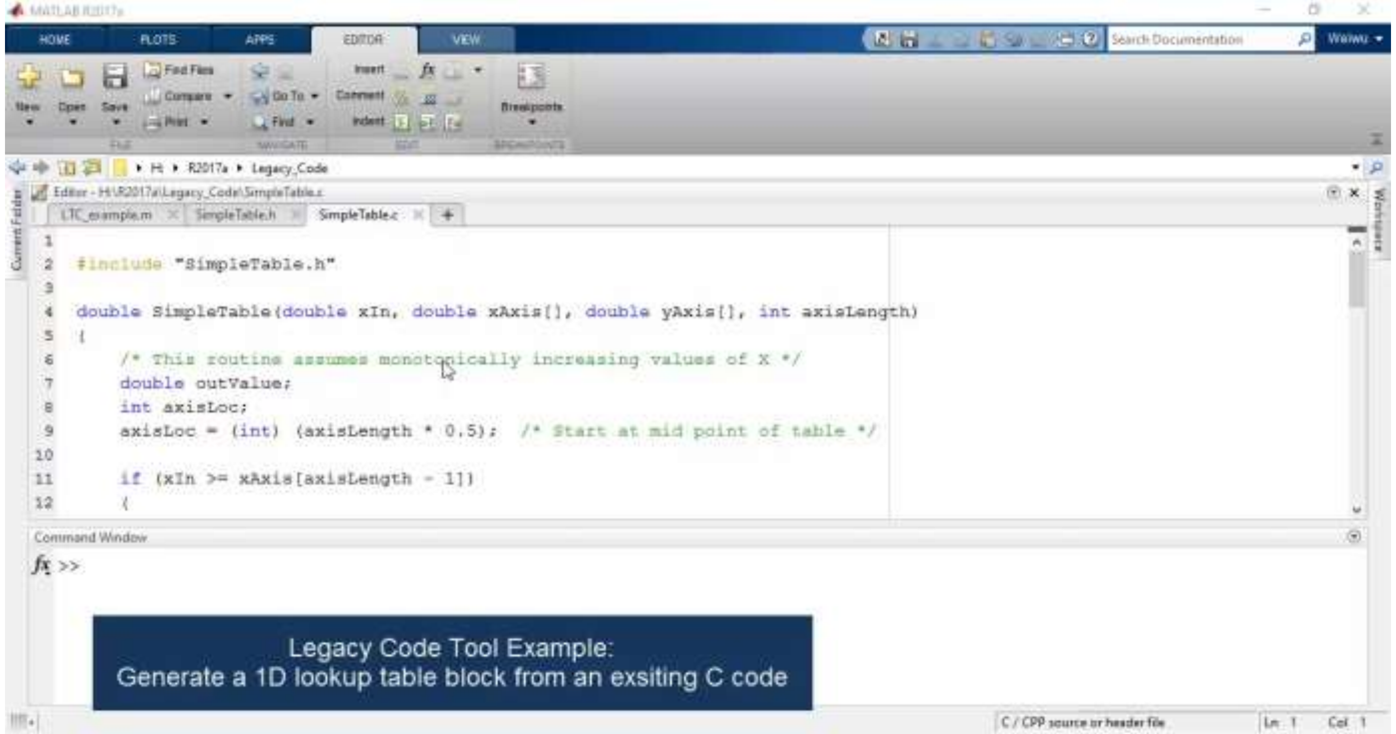
Integrating Your Code

Multiple ways to reuse your legacy code with Simulink



Legacy Code Tool

- Legacy Code Tool automates creation of S-Function block
- Call existing, external functions as part of a Simulink simulation
- Code generation is allowed with Legacy Code Tool blocks



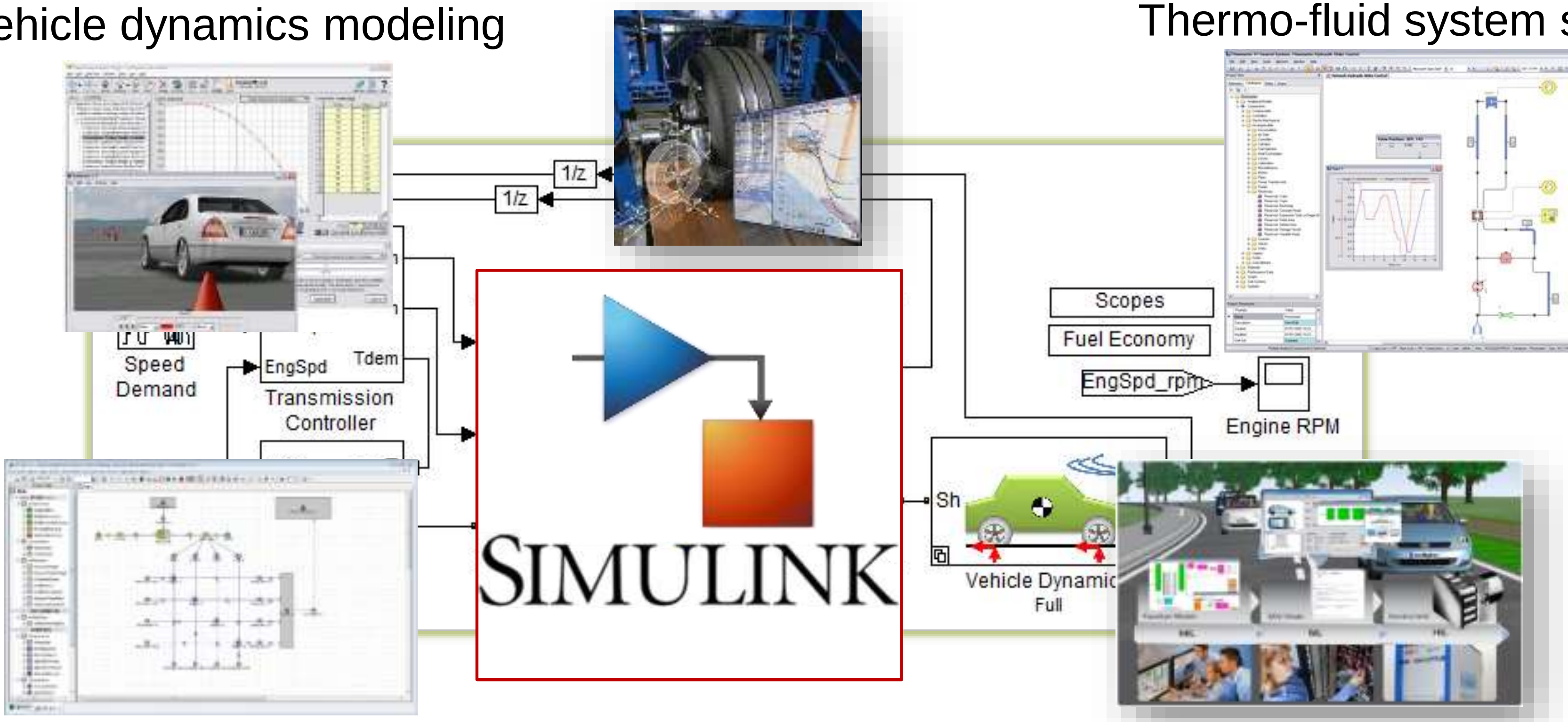
Integrating Third-Party Simulation Tools

Mature and extensive APIs for third-party tool integration

Tire behavior assessment

Vehicle dynamics modeling

Thermo-fluid system simulation



1D / 3D engine /exhaust simulation

Virtual test driving

Tool Integration Made Easy

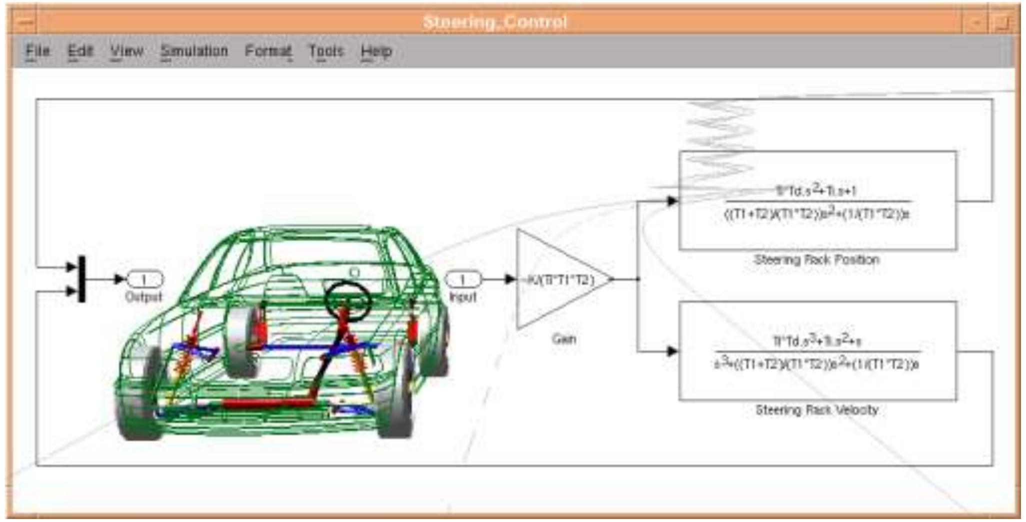
- Numerous tool integration interfaces with Simulink are maintained by our partners for you
- Typical interface can be one or all of the following:
  - Export of linear matrices from partner tool to Simulink
  - Export of non-linear partner tool model and solver to Simulink
  - Co-simulation of partner and Simulink

SIMPACK

Complete multibody simulation in combination with MATLAB

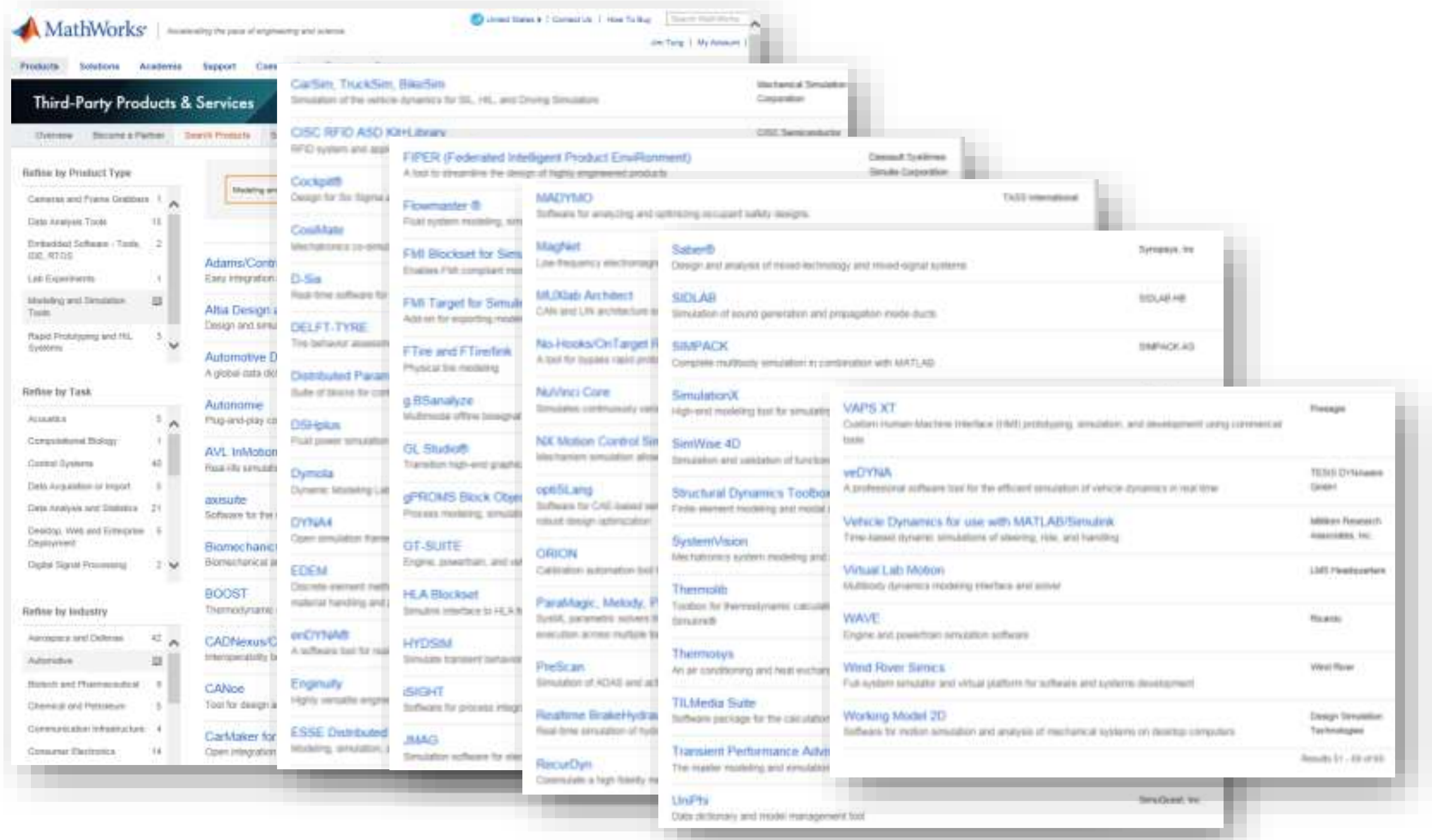
Highlights

- General 3D multibody simulation
- Export of ABCD matrices from SIMPACK to Simulink ®
- Cosimulation of SIMPACK and Simulink
- Import of Simulink model to SIMPACK
- Export of nonlinear SIMPACK model and solver to Simulink



Partner Ecosystem

Numerous partners provide interface to Simulink



Customer Success in Simulation Integration

Develop Integrated Vehicle Safety Applications

Siddharth D'Silva, Principal Engineer

Autoliv

Challenge

- Design and validate safety-critical algorithms before implementation

Solution

- Leverage Simulink as a platform by integrating third-party software

Customer Success In Simulation Integration

"Seamless integration with third party software solutions enables rigorous development in a safe environment. For application engineers or system engineers, it is very useful that you can export these complex third-party tool functionalities in the form of S-functions and run co-simulation."

Siddharth D'Silva, Autoliv

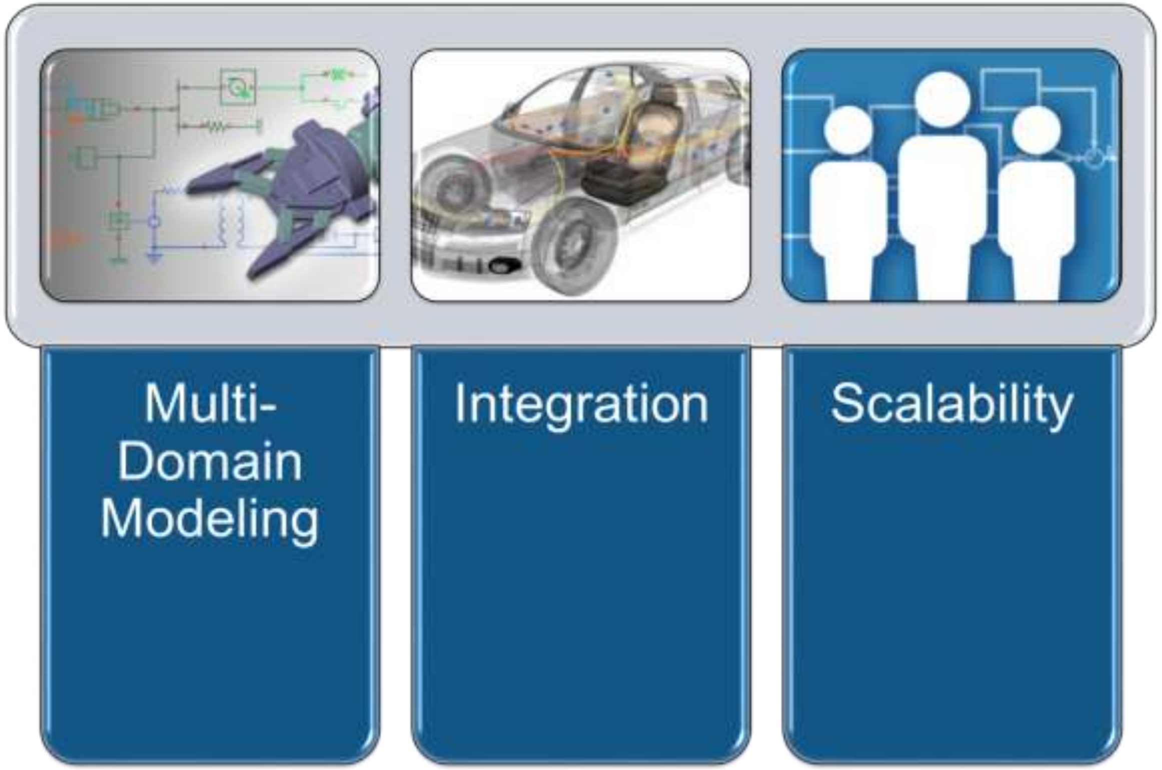
Results

- Industry first integration of stability control inertial sensor into airbag control unit
- Restraint control module software development time reduced by 30%

Simulink as Enterprise Simulation Platform

“There is no such tool, which gives the simulation environment as well as the hardware verification and validation. In a single environment, I am getting these together. ***That is why I use MATLAB and Simulink.****”*

Dr. Deepak Mishra,
Indian Space Research Organization



Training Services

Exploit the full potential of MathWorks products

Flexible delivery options:

- Public training available in several cities
- Onsite training with standard or customized courses
- Web-based training with live, interactive instructor-led courses

More than 48 course offerings:

- Introductory and intermediate training on MATLAB, Simulink, Stateflow, code generation, and Polyspace products
- Specialized courses in control design, signal processing, parallel computing, code generation, communications, financial analysis, and other areas

www.mathworks.in/training

Simulink as Your Enterprise Simulation Platform

- Simulink for System and Algorithm Modeling
  - This two-day course is for engineers who are new to system and algorithm modeling and design validation in Simulink. The course demonstrates how to apply basic modeling techniques and tools to develop Simulink block diagrams

- Stateflow for Logic-Driven System Modeling
  - This two-day course shows how to implement complex decision flows and finite-state machines using Stateflow®. The course focuses on how to employ flow charts, state machines, truth tables, and state transition tables in Simulink designs

- Simulink Model Management and Architecture
  - This two-day course describes techniques for applying Model-Based Design in a common design workflow. It provides guidance on managing and sharing Simulink models when working in a large-scale project environment

Accelerating the pace of engineering and science

Speaker Details

Email: Prasanna.Deshpande@mathworks.in

LinkedIn: https://in.linkedin.com/in/deshprasan

Twitter: @InfPrasanna

Contact MathWorks India

Products/Training Enquiry Booth

Call: 080-6632-6000

Email: info@mathworks.in

Your feedback is valued.

Please complete the feedback form provided to you.