



Model Based Continuous Integration of Automotive Embedded Systems

Henrik Lönn, Technology Specialist, Embedded Software, AB Volvo.

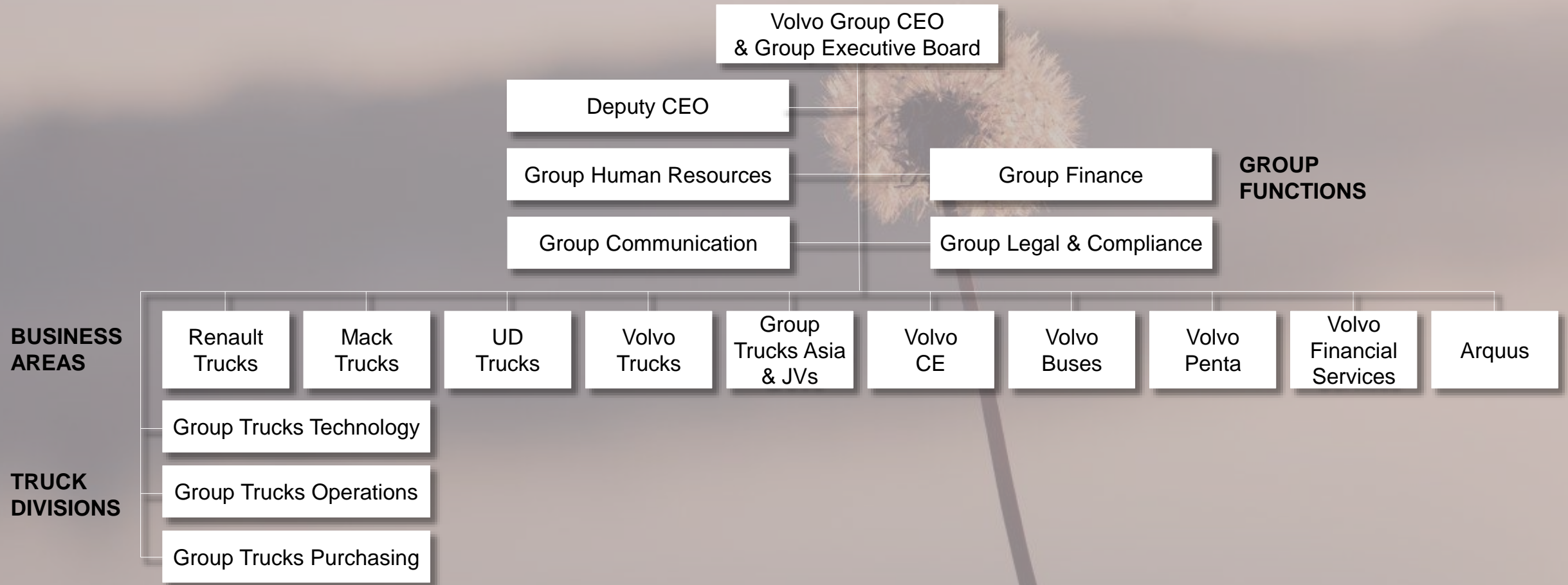
Volvo Group

We are one of the world's leading manufacturers of trucks, buses, construction equipment and marine and industrial engines.

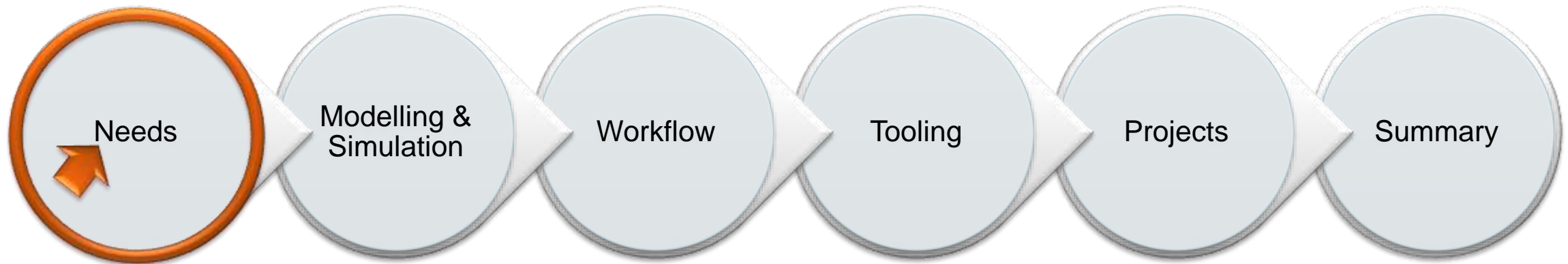
We also provide complete solutions for financing and service.



Our organization



Background and Needs







Product Challenges

- Reduced Lead Times
- Continuous Deployment
- Continuous Integration
- Quality
- Reuse

Process Challenges

- Multiple cycle times
- Multiple Aspects
- Multiple Domains
- Multiple Teams

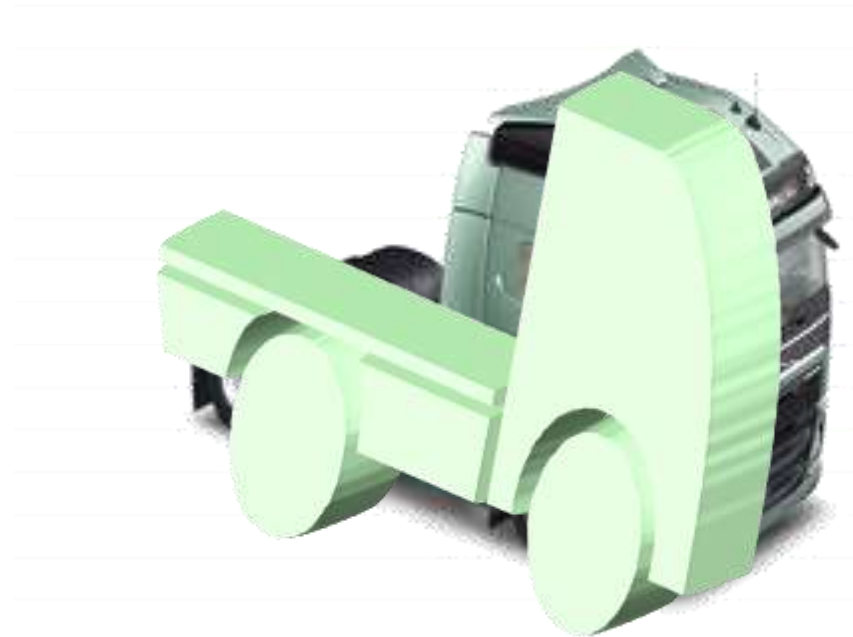
- Automation
- Connectivity
- Electrification
- Control Strategies
- Architecture (re)volution



Go Virtual

...to allow

- Daily Deliveries
- Maximize Verification Confidence
- Exercise Dangerous and Rare Events



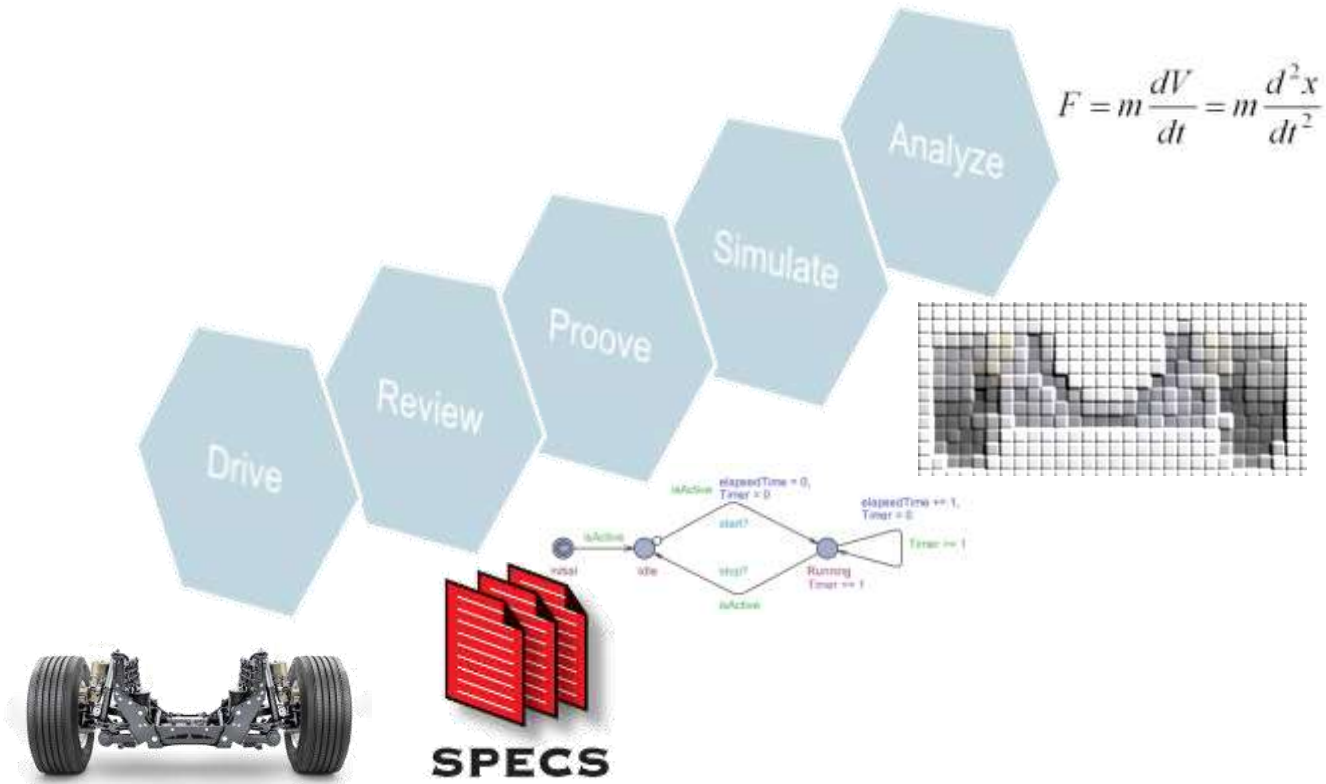
Go Rigorous



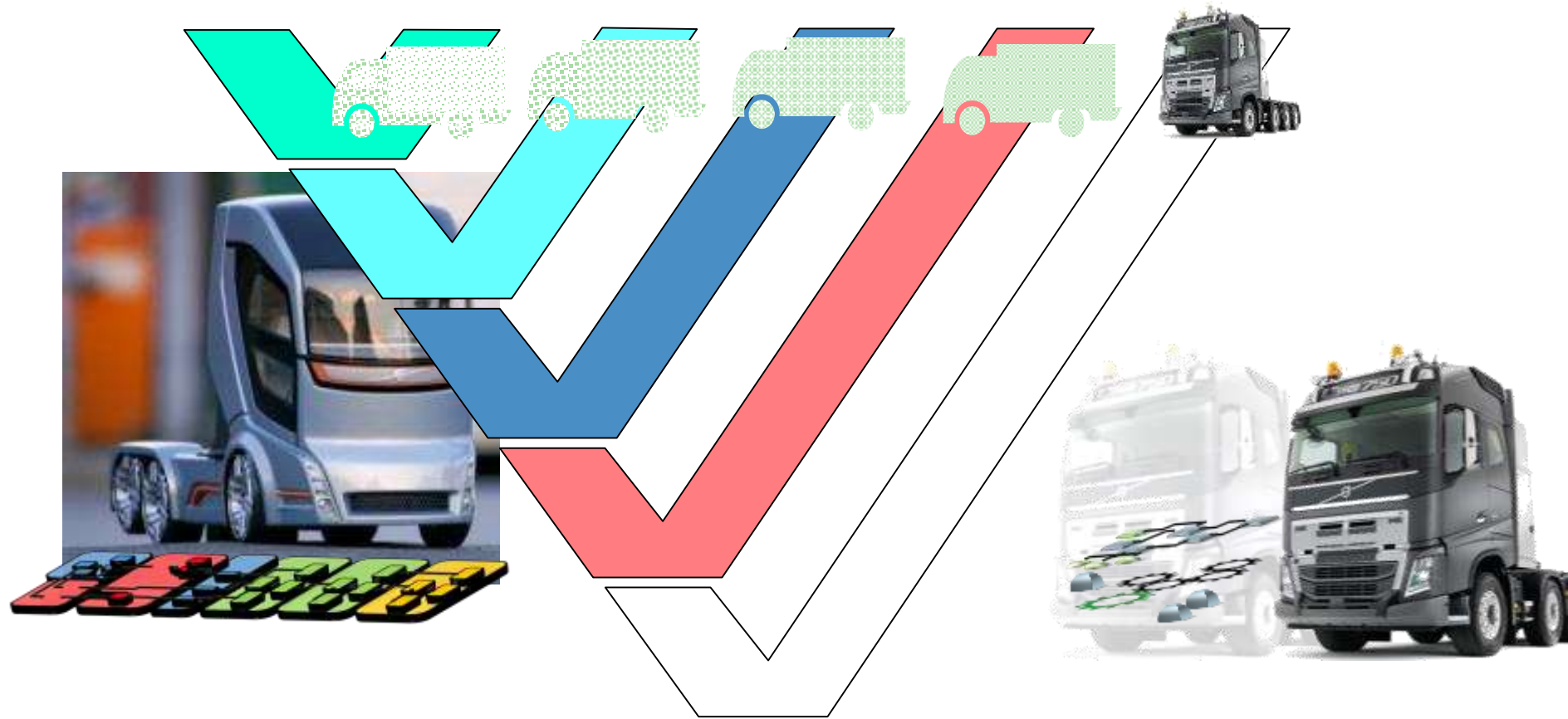
Use Models and Data to

- provides Means to Secure Product vs. Needs and Requirements
- allow engineering rigor and automation

Go Multi-Method



Go Consistent

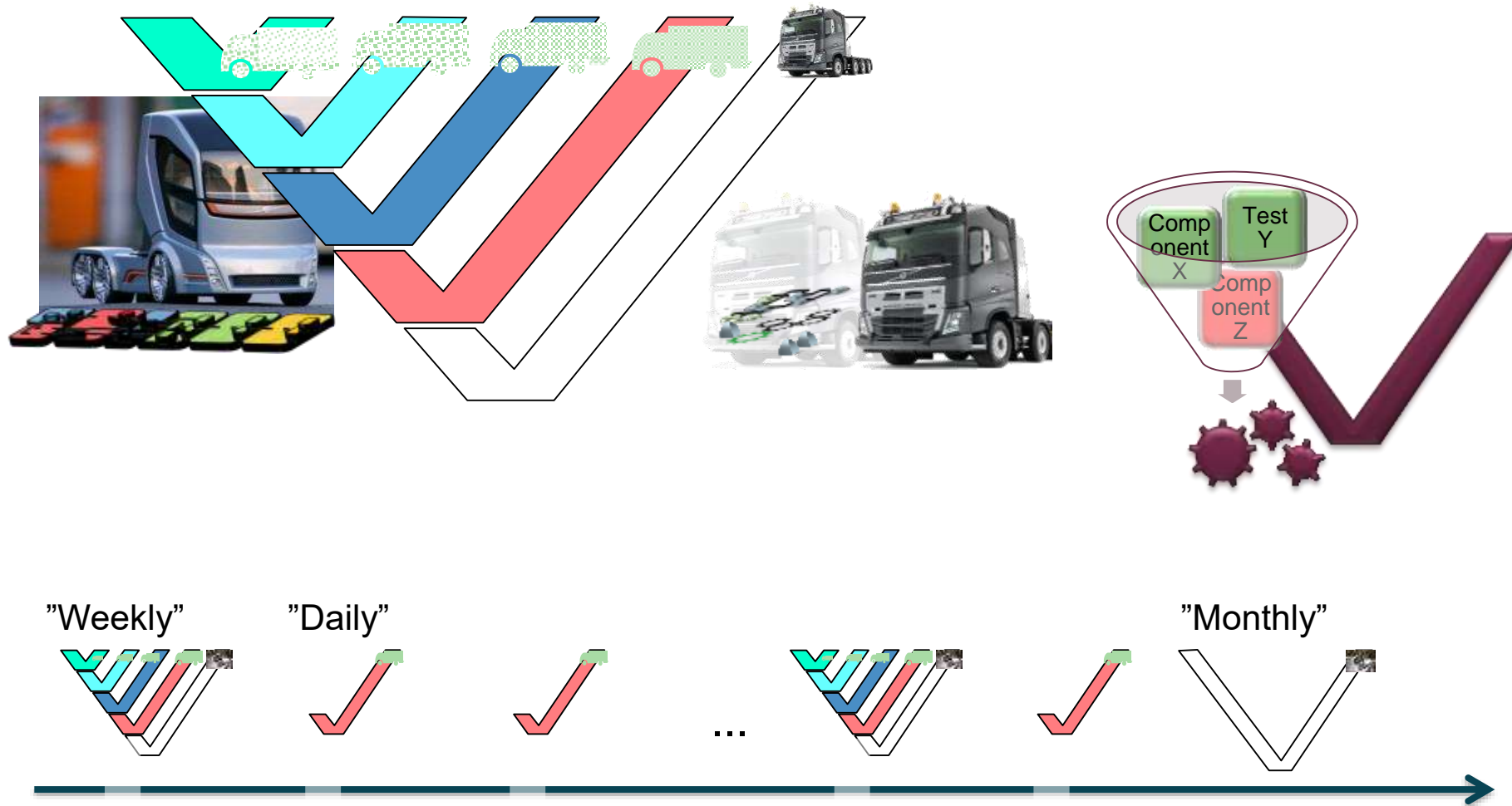


Models & Code

Binaries & Components

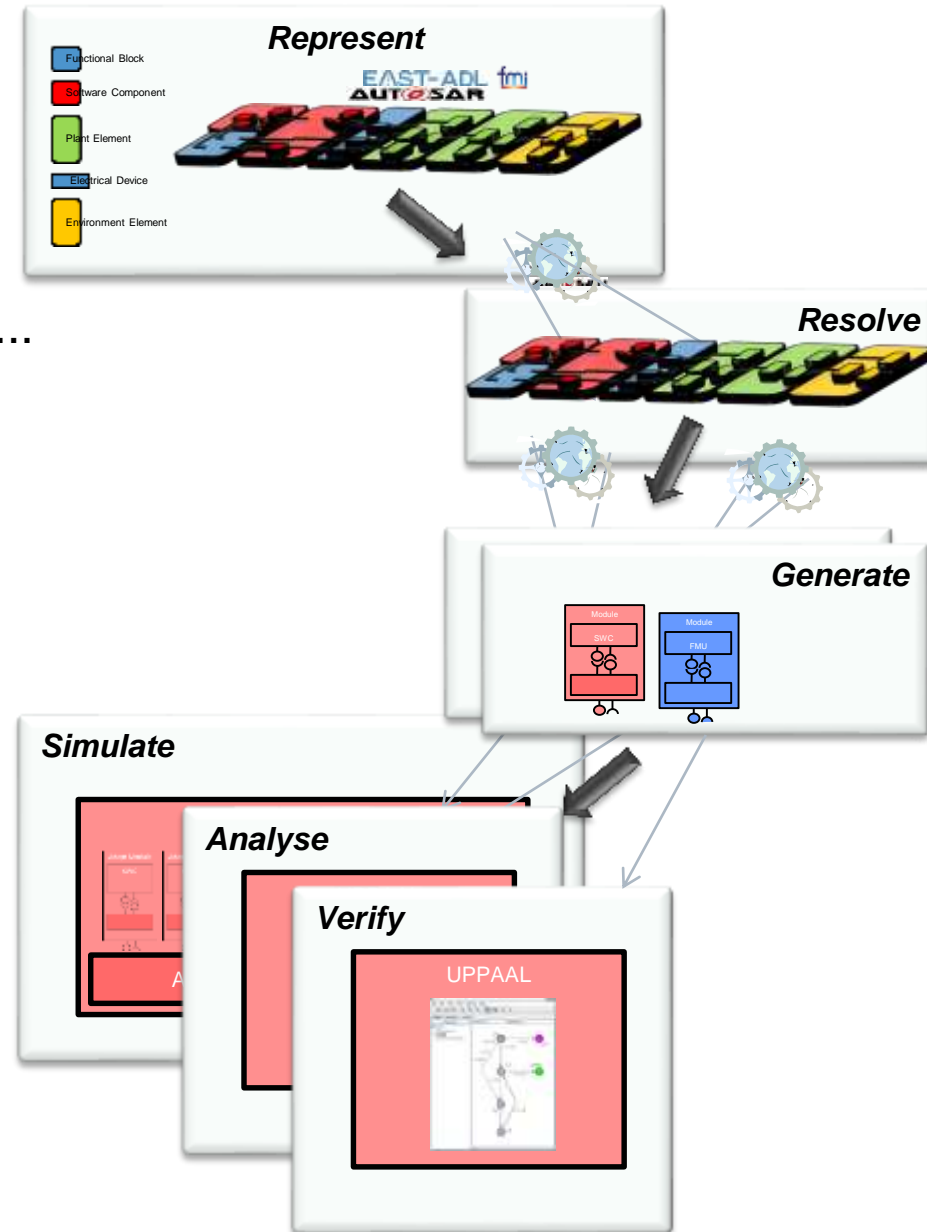


Go Continuous

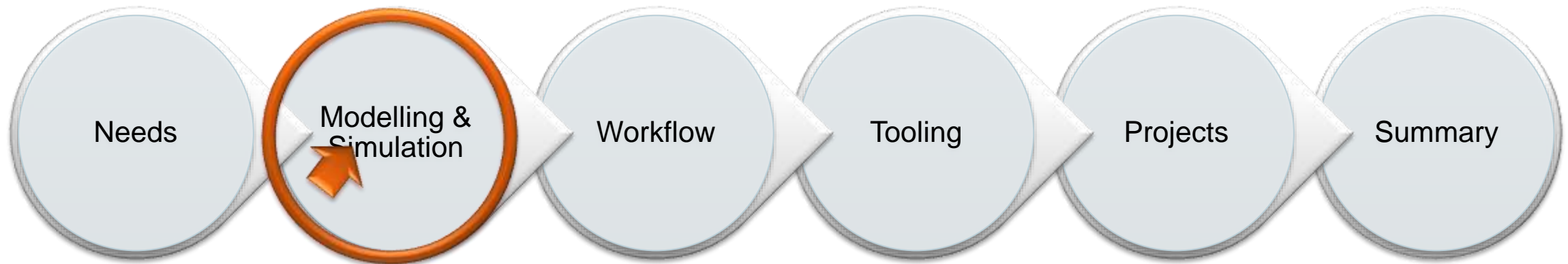


Engineering Workflow

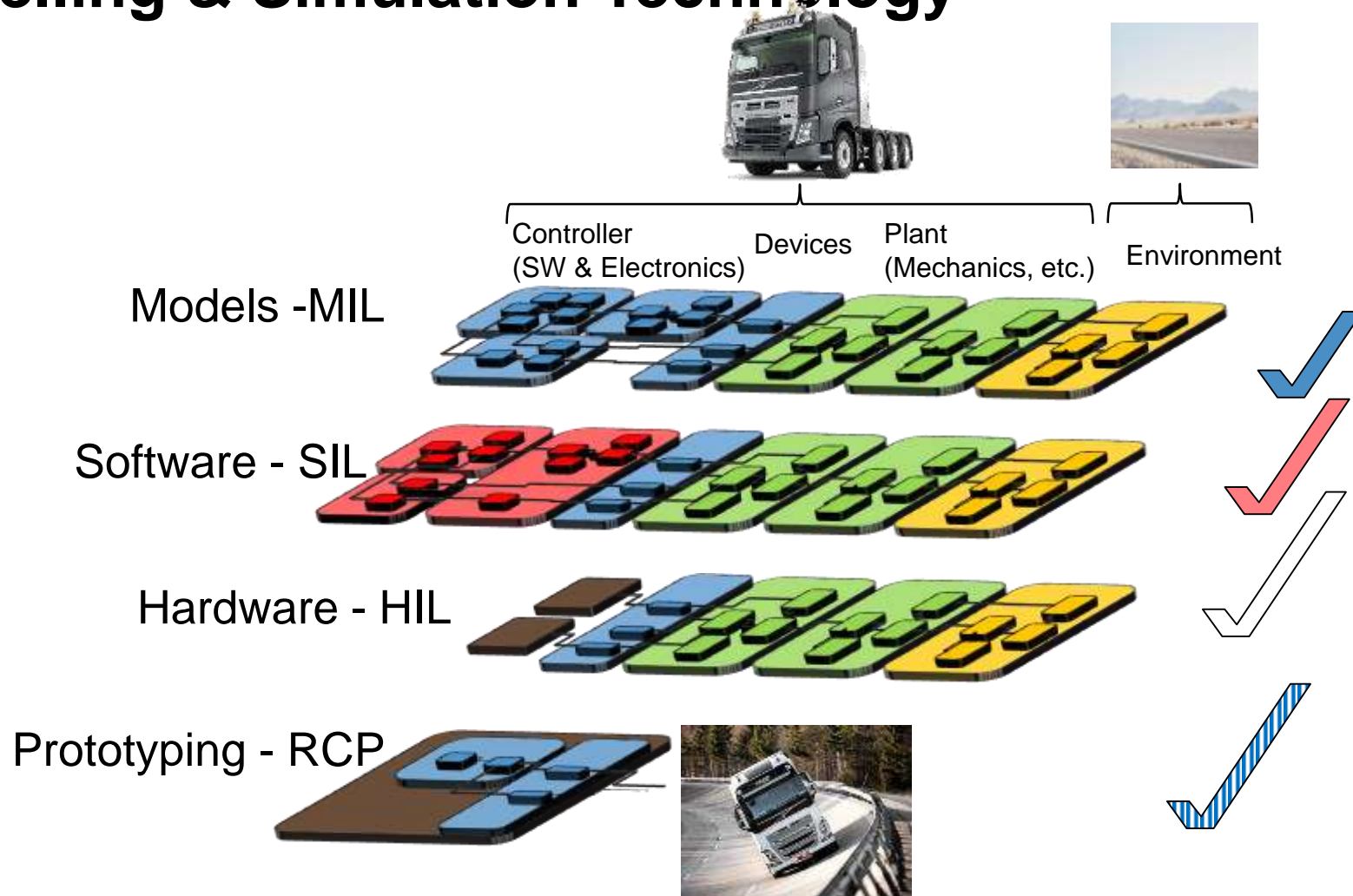
- Represent
 - AUTOSAR/EAST-ADL/FMI/UppAAL/Modelica/...
- Resolve
 - Configure and Resolve variability
- Generate
 - Automatic preparation for each tool
- Simulate/Analyze/Verify
 - Software centric simulations
 - Physics centric simulations
 - Arithmetic analysis
 - Formal verification
 - ...



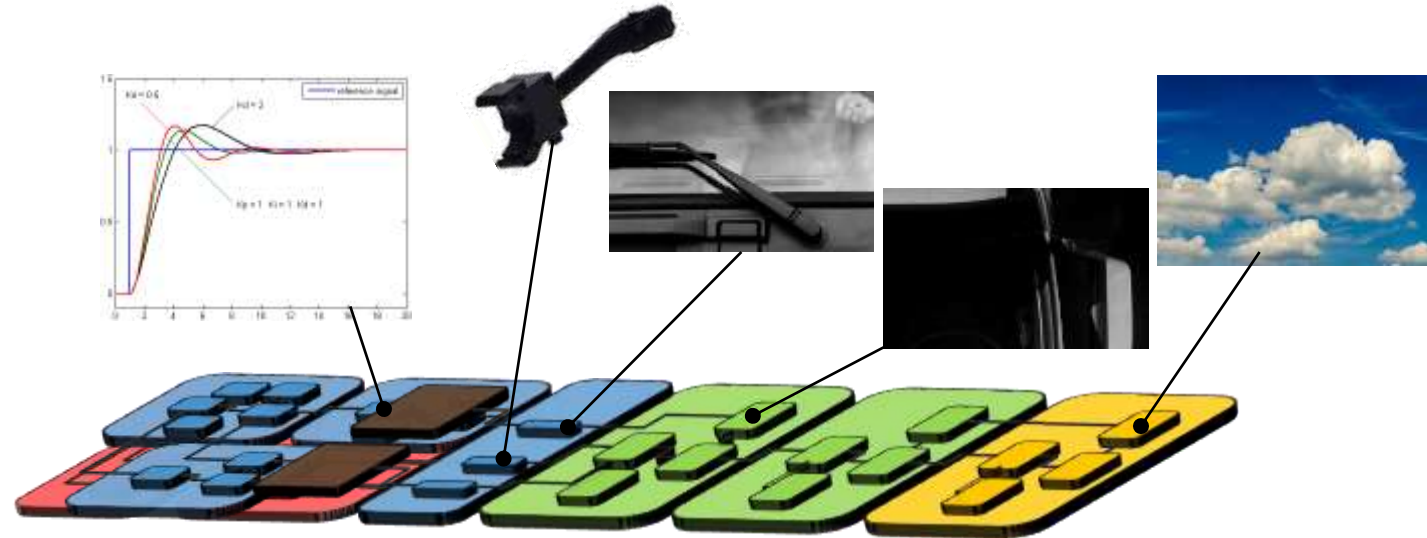
Modelling and Simulation



Modelling & Simulation Technology

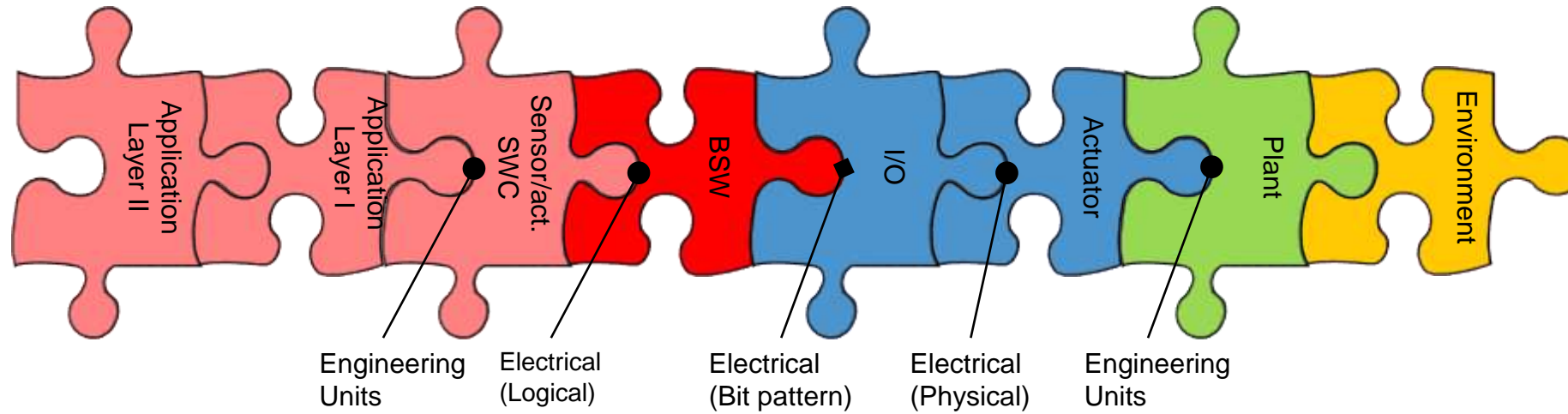


Modelling Pattern to Support Integration

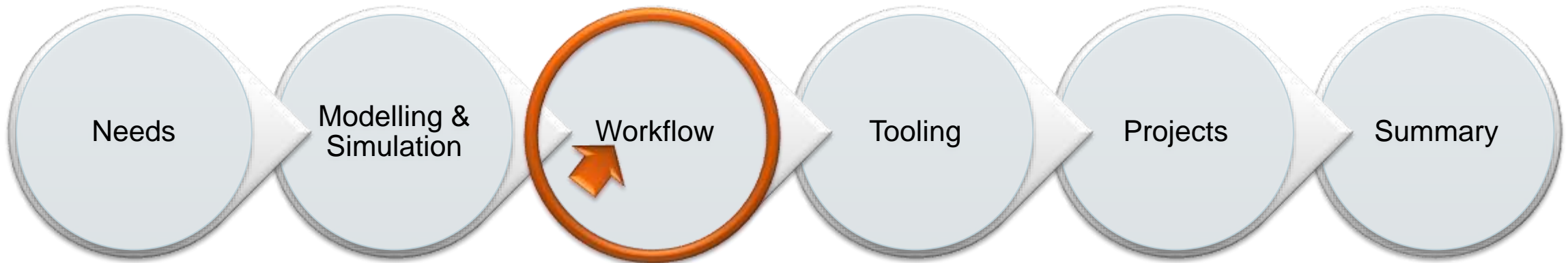


- Model-in-the-loop: **Controller model** interfaces to models of sensors and actuators
- Software-in-the-loop: **Software** interfaces to models of electronics
- Hardware-in-the-loop: **ECU** interfaces to models of sensors and actuators
- Hardware⁺-in-the-loop: Sensors and actuators interfaces to models of plant

Model Structure



Overall Workflow



Configuration

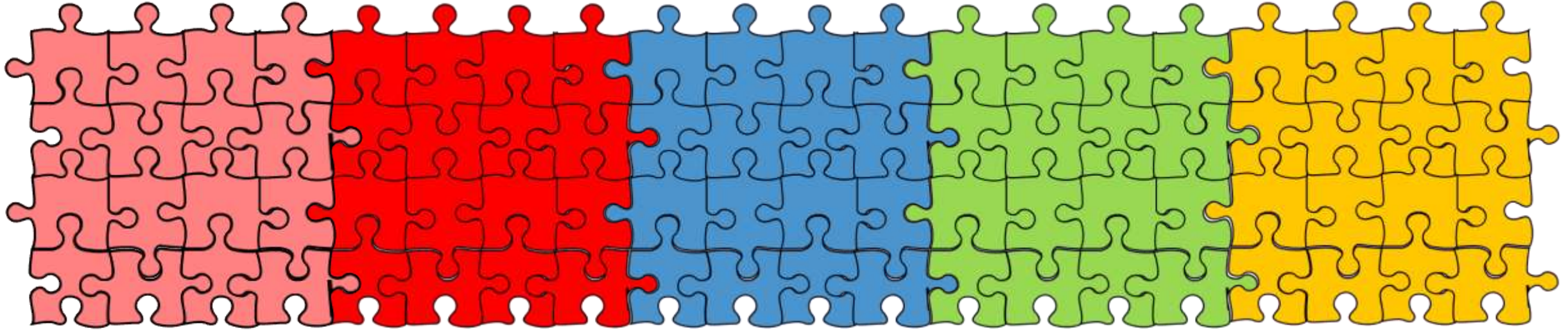
Application SW
Integration

Platform SW
Integration

ECU, I/O,
Sensors & Actuators

Plant
Integration

Environment
Integration



Configuration

Software:

AUTOSAR SWC Selection
AUTOSAR SWC Parameterization
Configuration ports
Initialization values

Non-Software

Logical Component Selection
Function Mockup Unit Parameterization
Configuration Ports
Initialization values

Environment:

Traffic Scenario:
OpenScenario Selection & Parameterization
Roads:
OpenRoad Selection and Parameterization

Generation

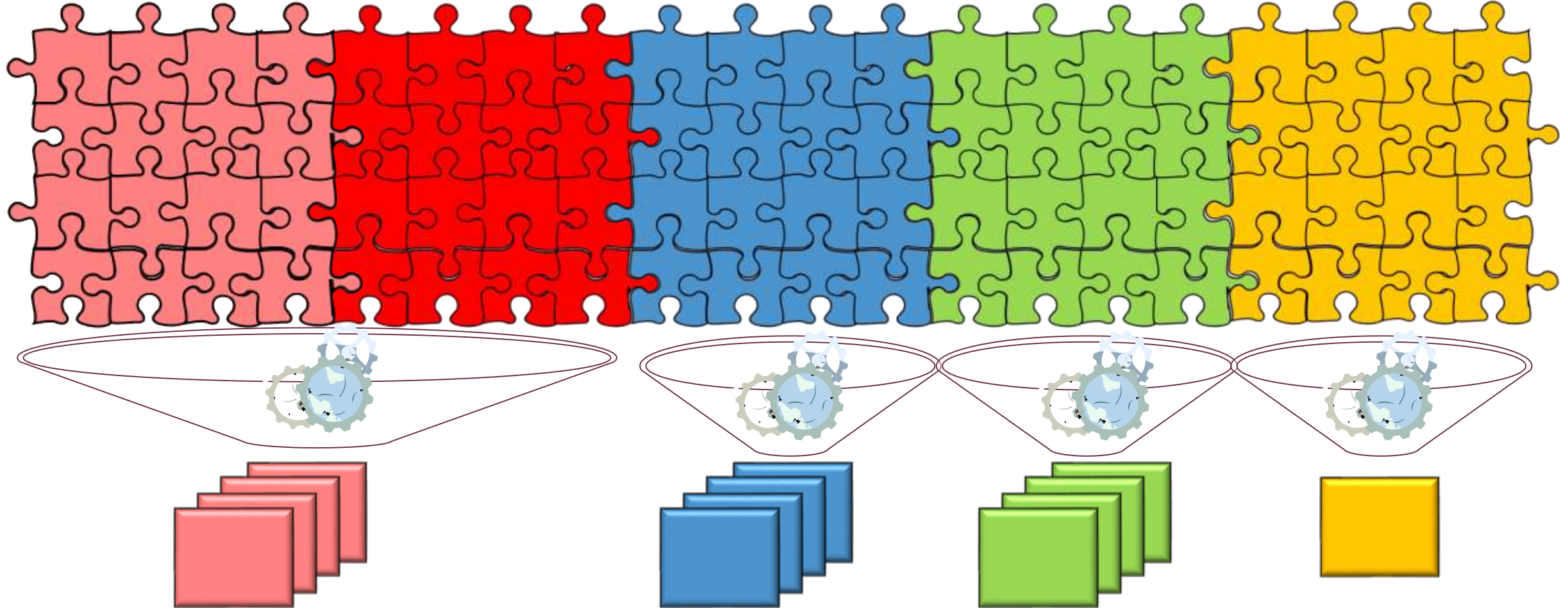
Application SW
Integration

Platform SW
Integration

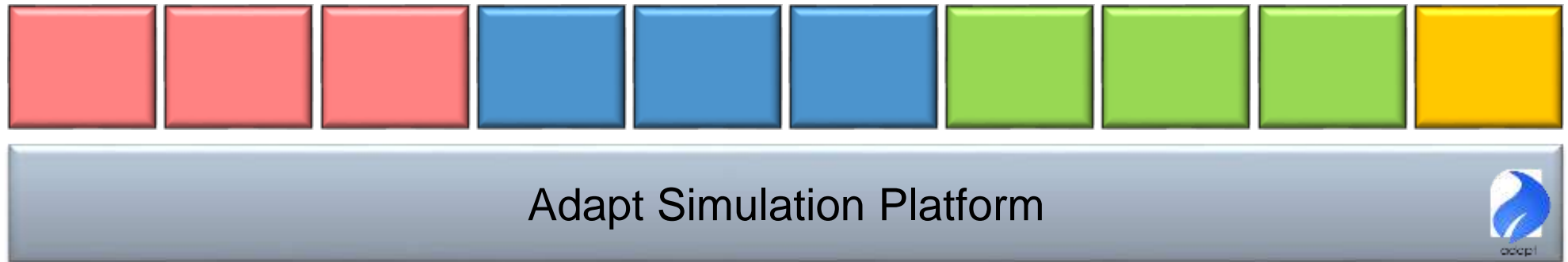
ECU, I/O,
Sensors & Actuators

Plant
Integration

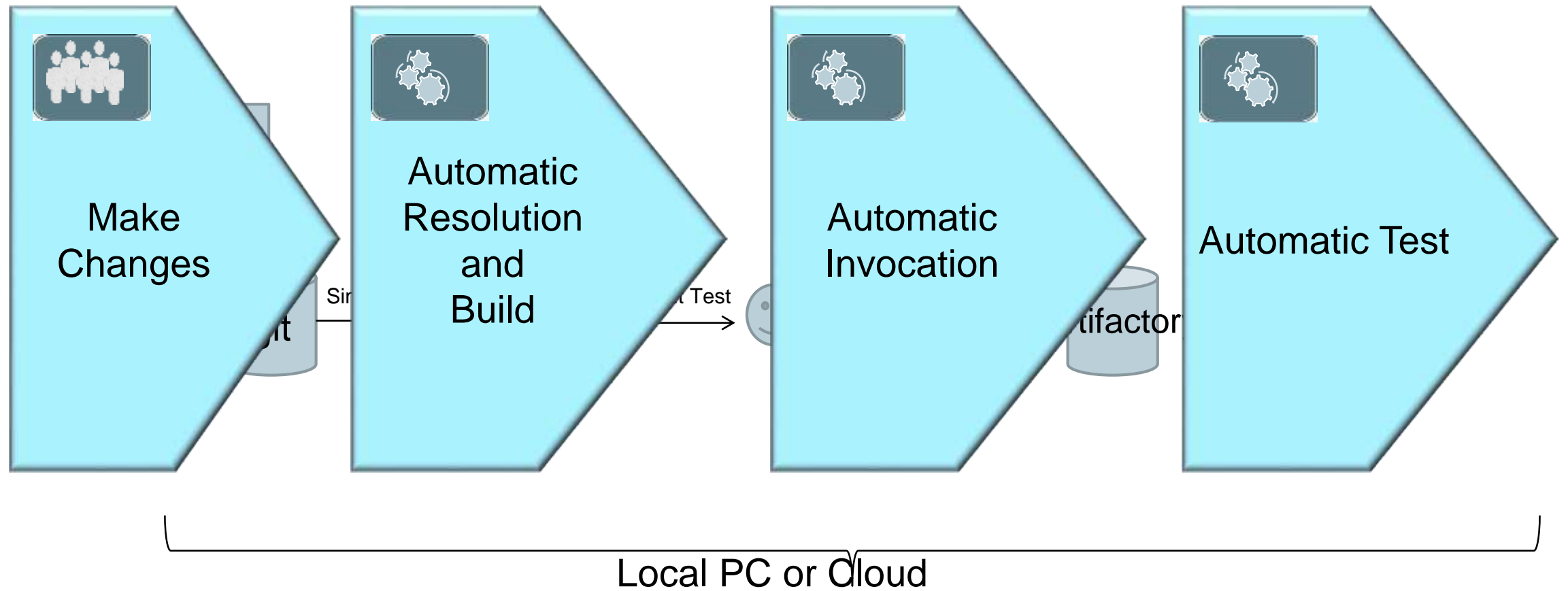
Environment
Integration



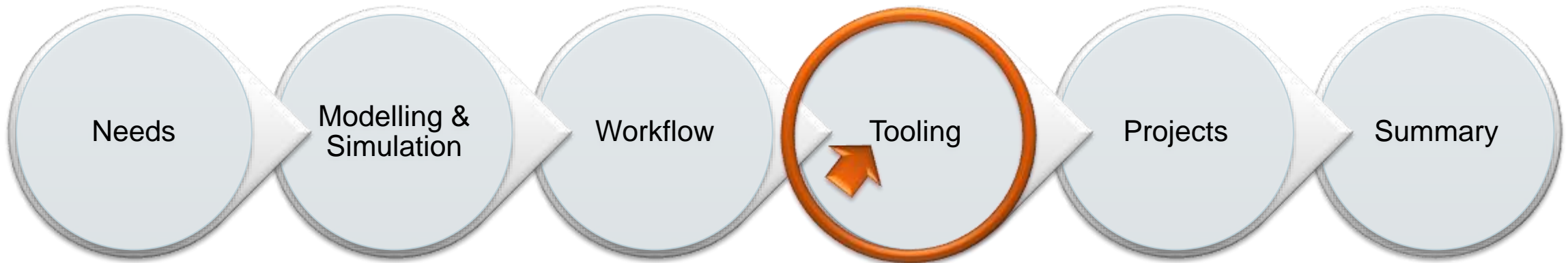
Simulation



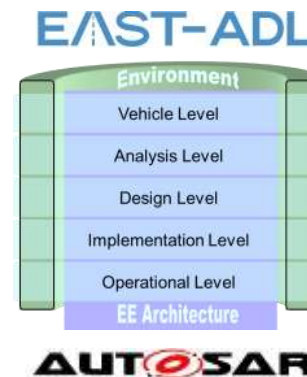
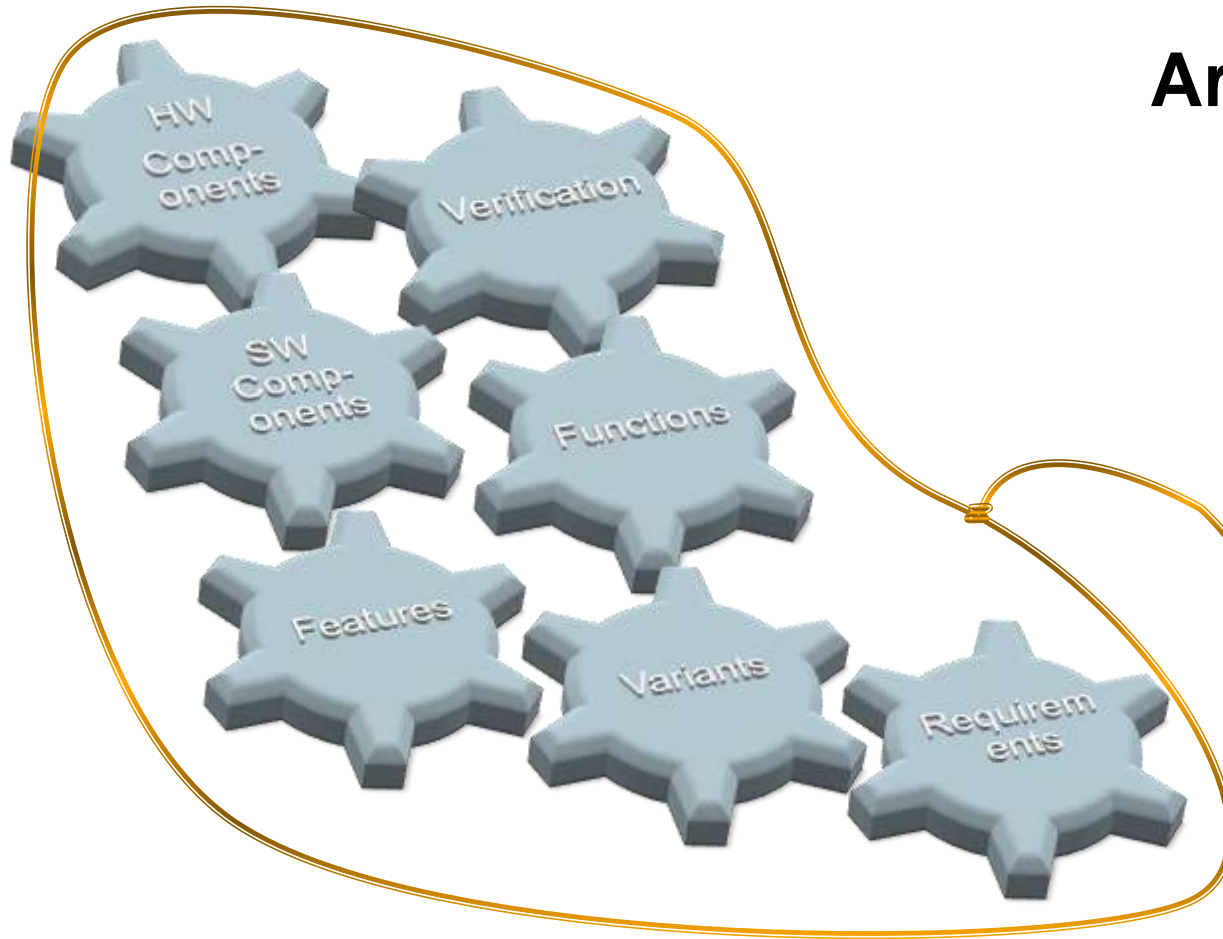
Engineering Automation



Tooling for Simulation, Modelling and Integration

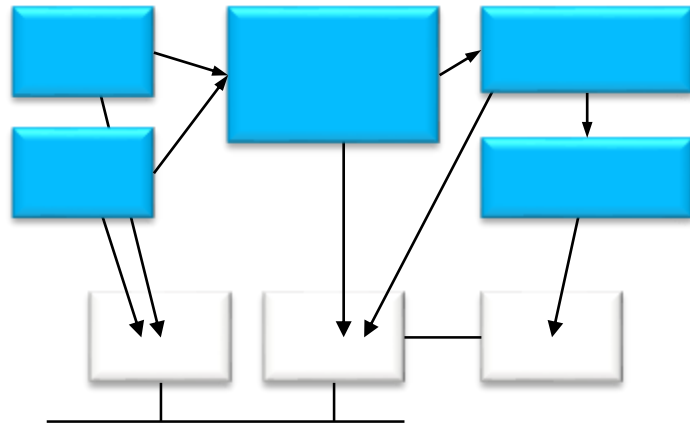


Architecture Description Language



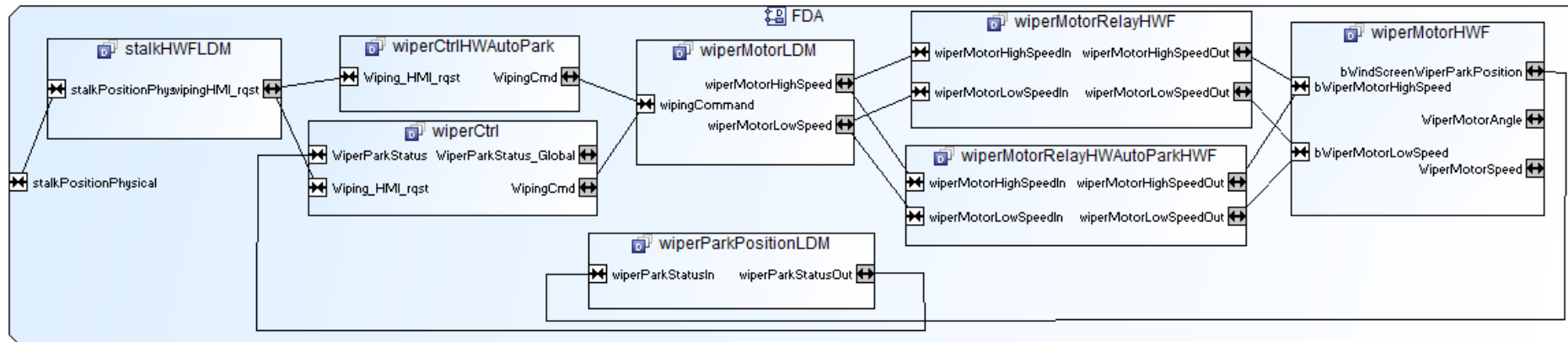
An information model that captures engineering information in a standardized way

Functional & Software Architecture

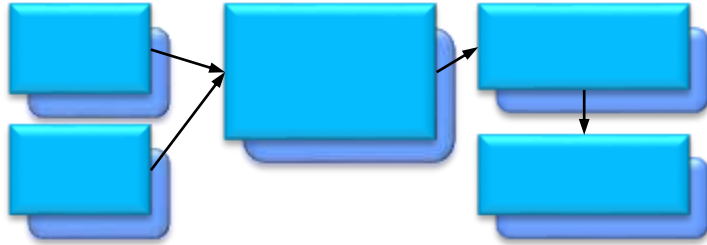


Structure

Function Components
SW Components
HW Topology

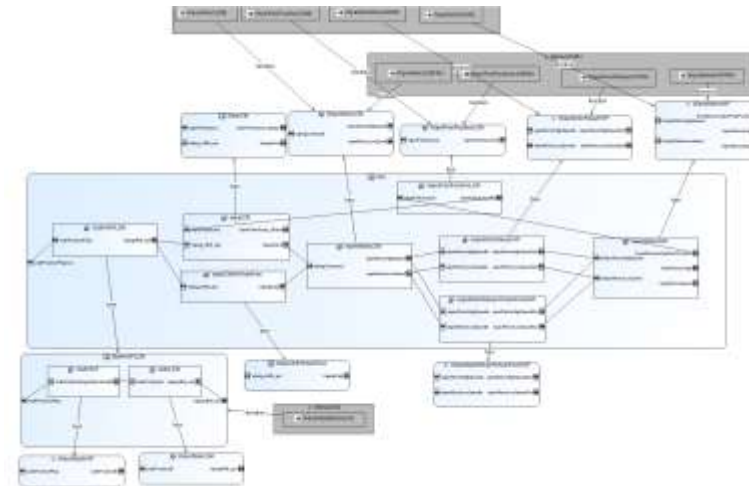


Simulation

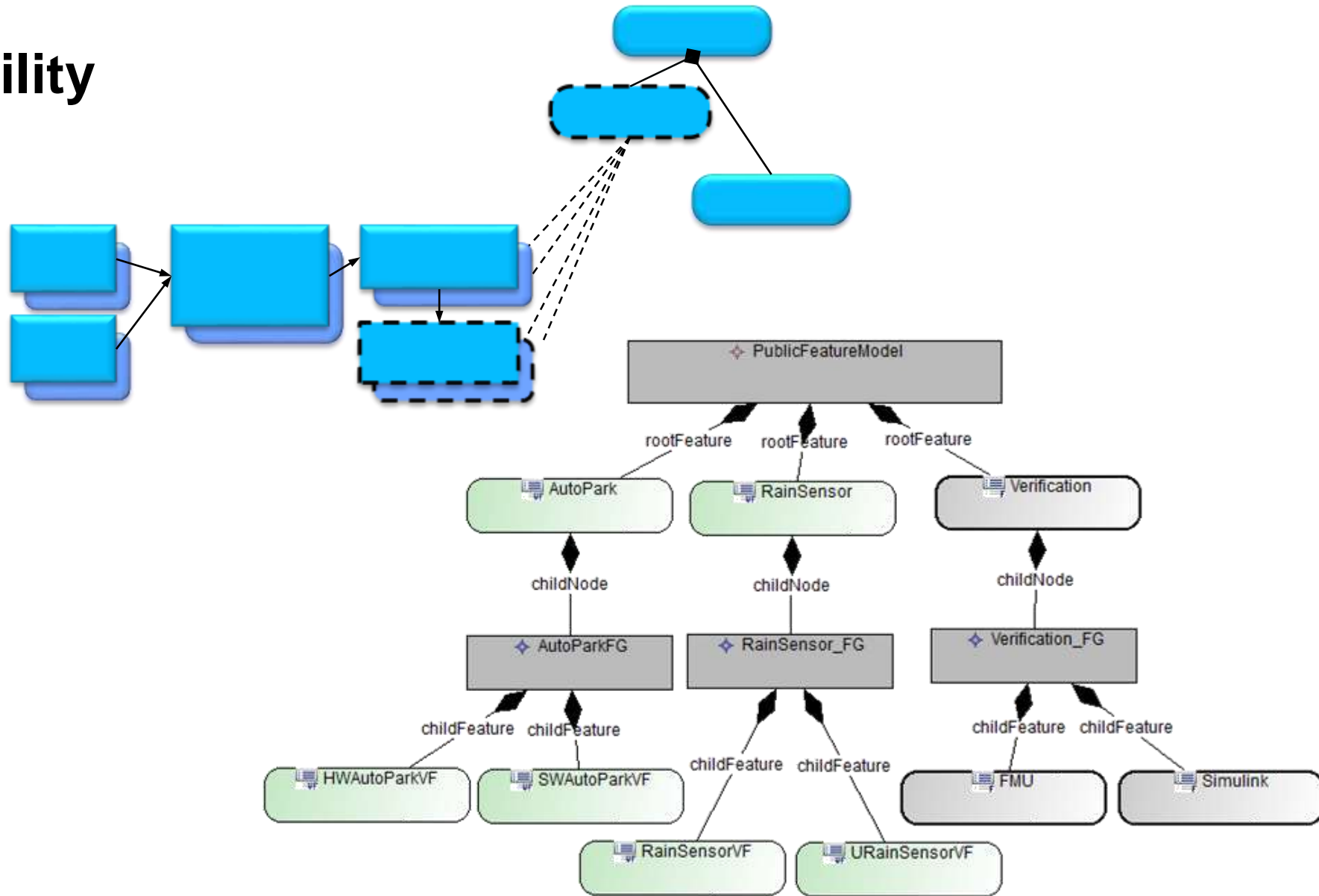


Behavior/Timing

Function Mockup Units+Execution Definition
Source Code+Execution Definition

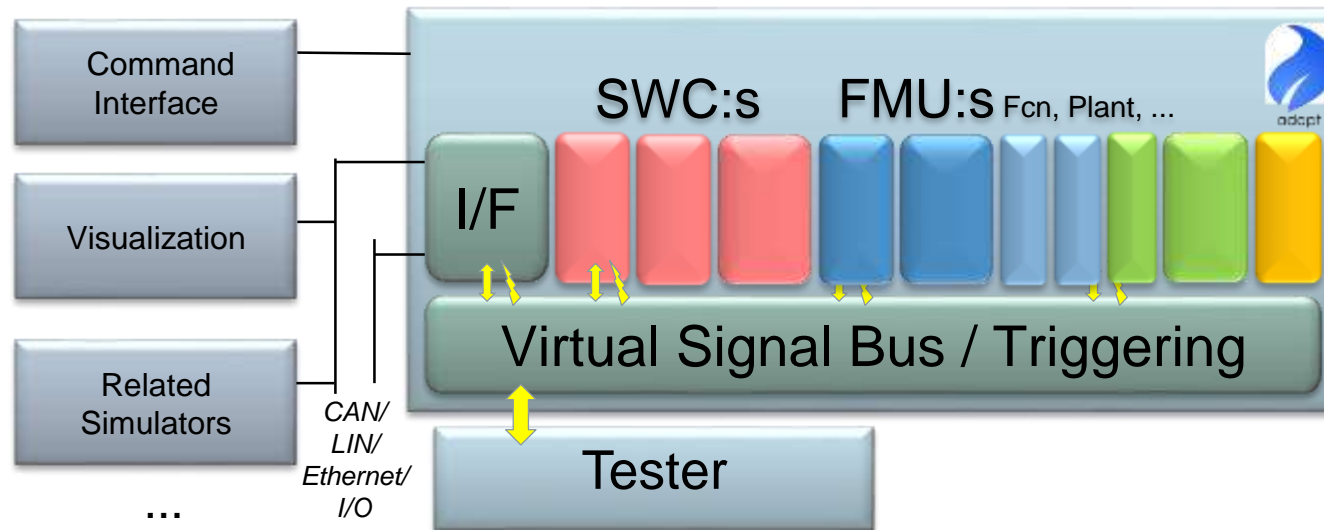
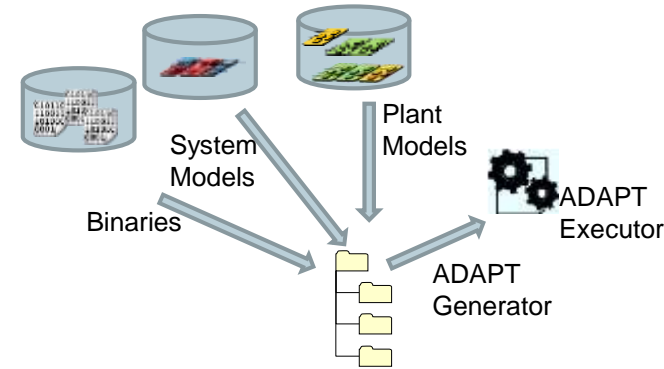


Variability



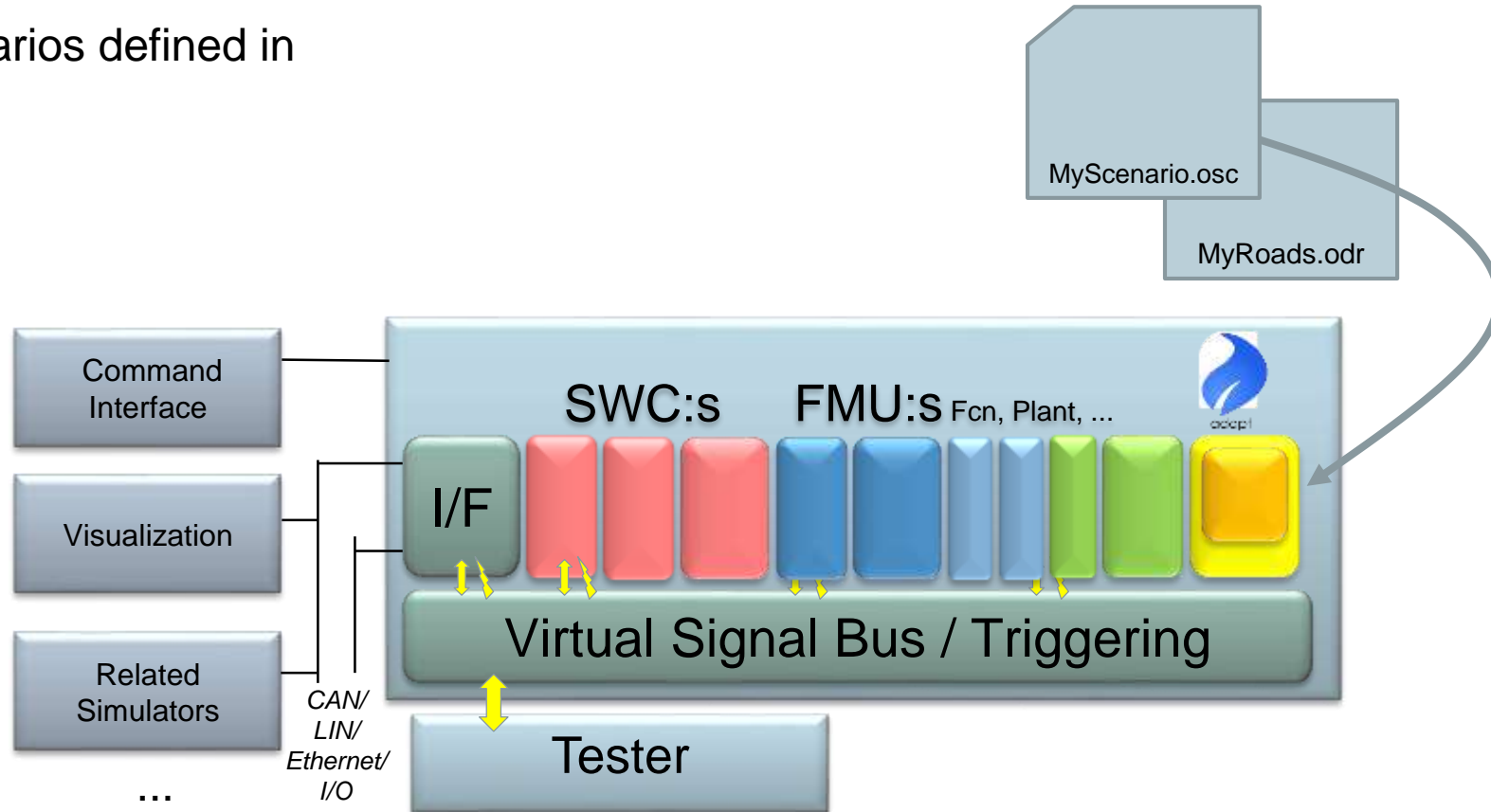
ADAPT Integration Environment

- Framework for Continuous Integration and Delivery
- Simulation Environment for Code and Models
- Used for GTT Integration and Verification



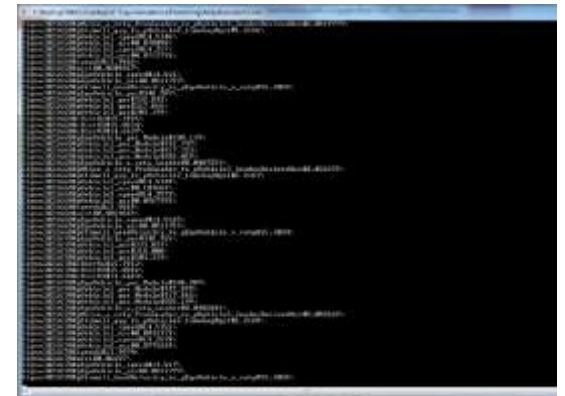
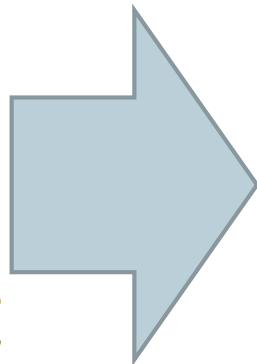
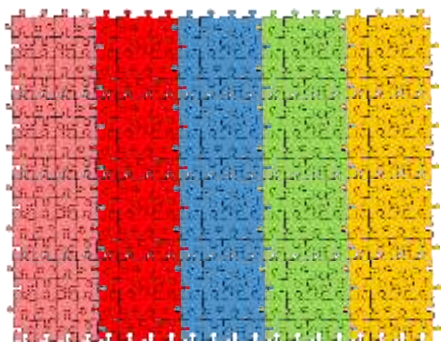
Adding Environment Simulator to ADAPT

- Roads and Scenarios defined in
 - OpenDrive
 - OpenScenario



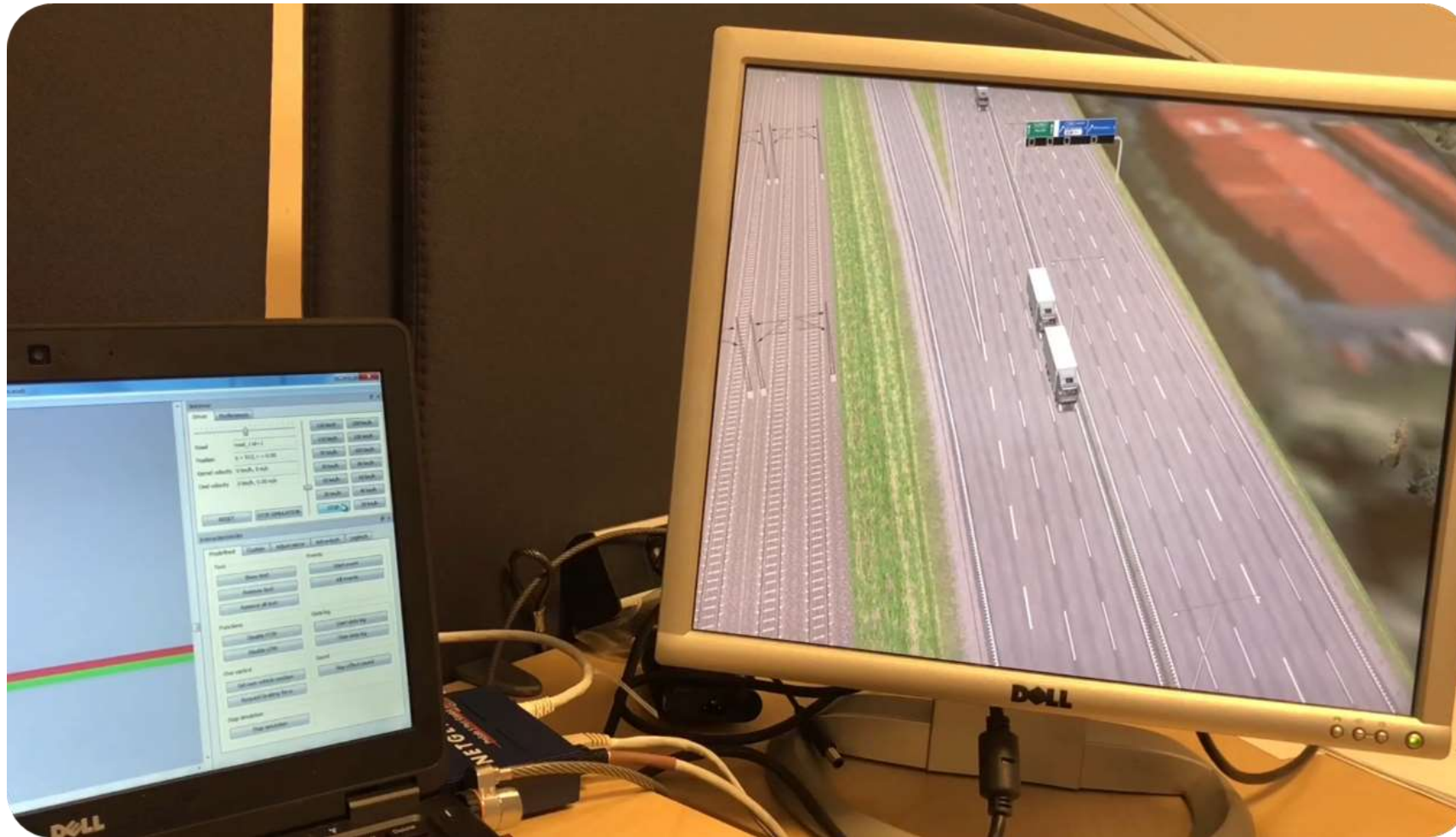
Example

- Autogenerated Experiment from Model
- Configuration of
 - Software
 - Electronics
 - Plant
 - Environment

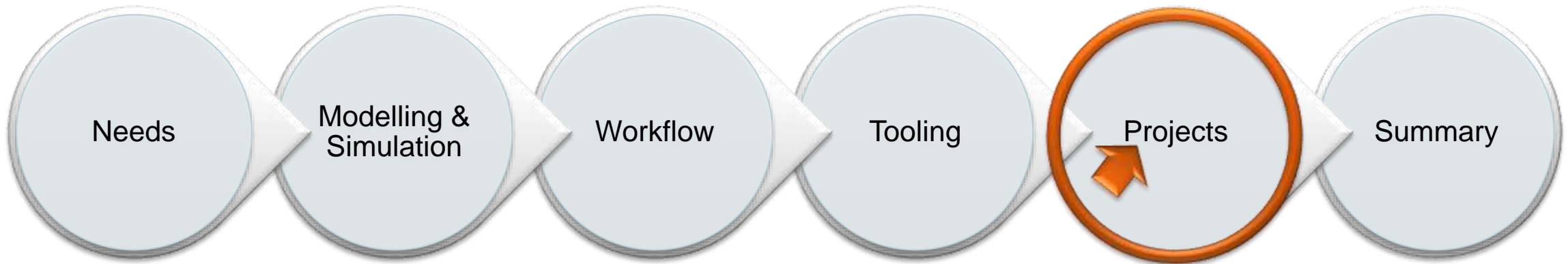


Adapt
Simulation 

Example



Ongoing and Emerging Projects



FFI Open Innovation Lab & FFI Simulation Scenarios

Government Funded Projects

- Open Innovation Lab
 - Third-Party Development of
 - Internal vehicle functions
 - External vehicle functions
 - Simulation Models
- Simulation Scenarios
 - Use of scripted roads and environment
 - OpenScenario
 - OpenDrive



ASTAZERO
ACTIVE SAFETY TEST AREA

vti

hiQ

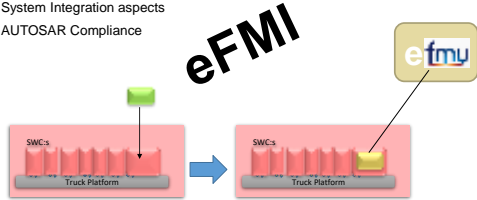
SWEDISH ICT VIKTORIA



EMISYS

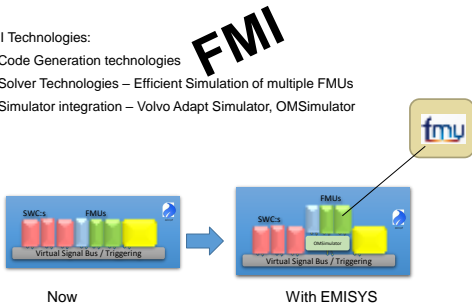
EMISYS Technology: Execution of Embedded Functional Mock-up Units in vehicle

- eFMI Technologies
- Compiler technologies
 - System Integration aspects
 - AUTOSAR Compliance

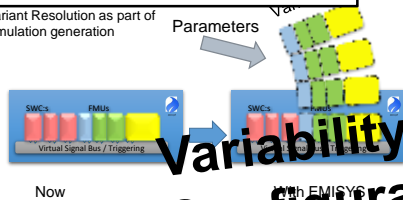


EMISYS Technology: Execution of Functional Mock-up Units in Simulator/PC

- FMI Technologies:
- Code Generation technologies
 - Solver Technologies – Efficient Simulation of multiple FMUs
 - Simulator integration – Volvo Adapt Simulator, OMSimulator



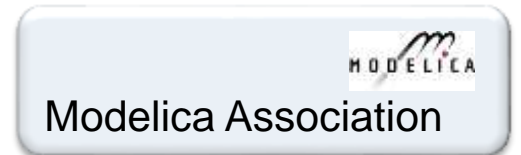
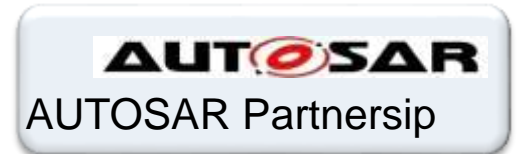
- Variant Resolution as part of simulation generation



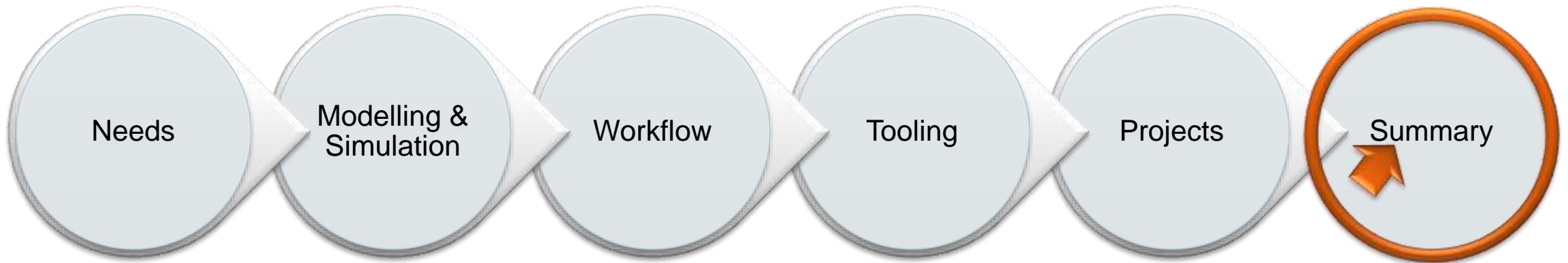
Variability and Configuration

Volvo Group Trucks Technology

Henrik Lönn, ESA AE: Model Based Continuous Integration of Automotive Embedded Systems



Summary



Summary

