

# COLLABORATIVE MODEL DEVELOPMENT FOR SYSTEM SIMULATION

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Groupe PSA - Opel Automobile GmbH

XiL Simulation & Software Test Methods

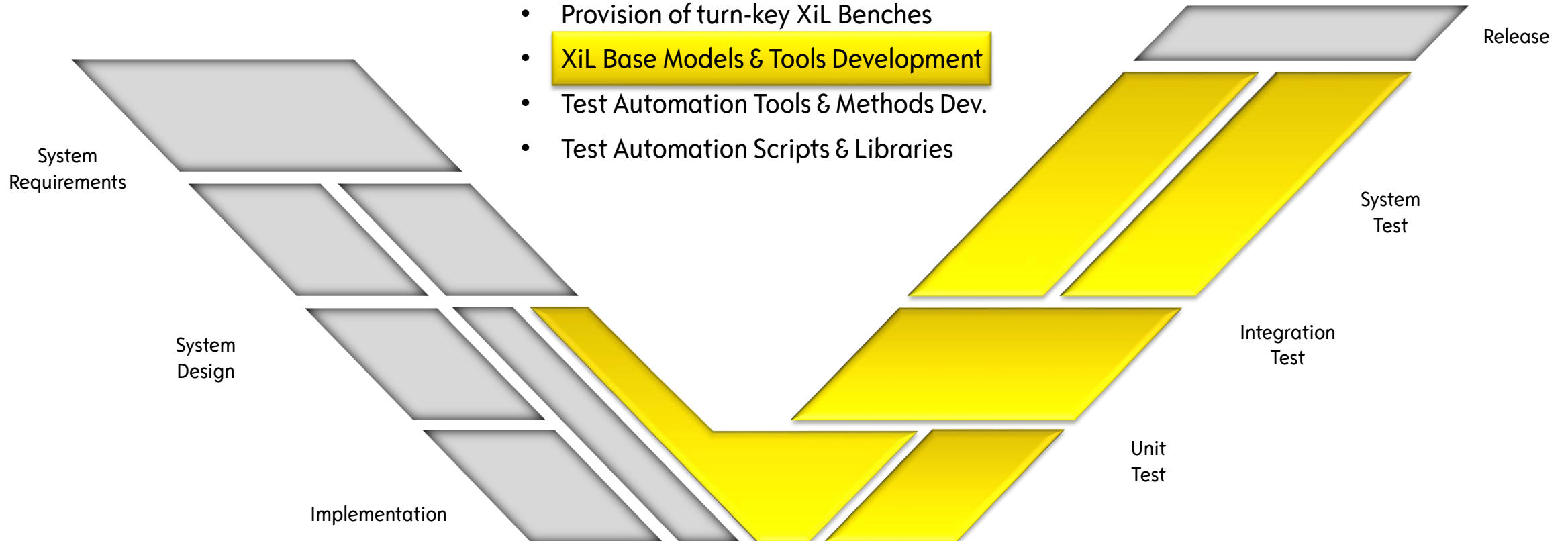
Stuttgart, MathWorks AUTOMOTIVE CONFERENCE 2019 EUROPE, 11. April 2019



Department: Controls Development & Validation

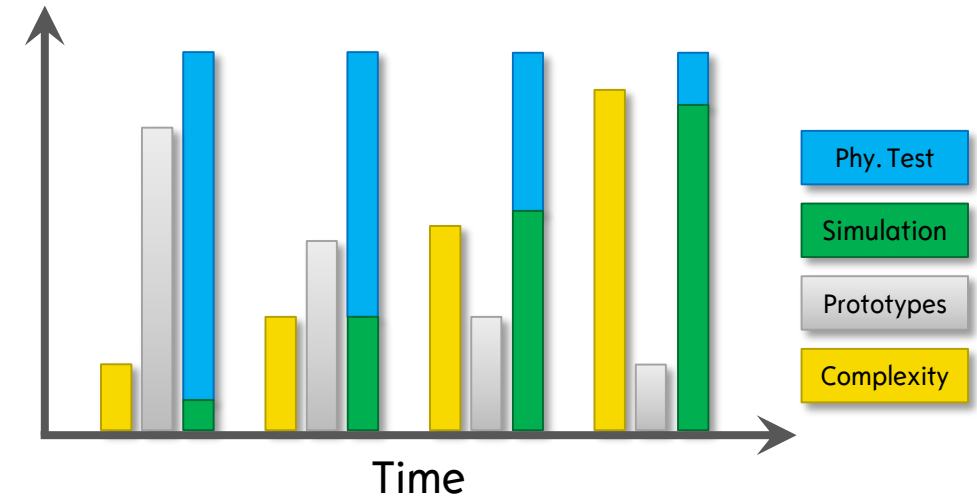
Team: XiL Simulation & Software Test Methods

- Provision of turn-key XiL Benches
- XiL Base Models & Tools Development
- Test Automation Tools & Methods Dev.
- Test Automation Scripts & Libraries



# WHAT IS THE CHALLENGE TO SYSTEM SIMULATION?

- Dramatically increasing system complexity
- Reduction of development costs
- Strong move towards virtual development methods



- Simulation based engineering is getting more and more important
- Collaboration between departments becomes a prerequisite
- Common fundament for model development, methods & tools
- **Need of collaborative Simulation Framework**

- What is a Simulation Framework?
- Characteristics of a collaborative framework?
- Modular system modeling approach
- Practical examples for model integration
  - Model Interface Management
  - Model Configurator
- Summary

# SYSTEM SIMULATION APPROACH

## Turn-key Application Models

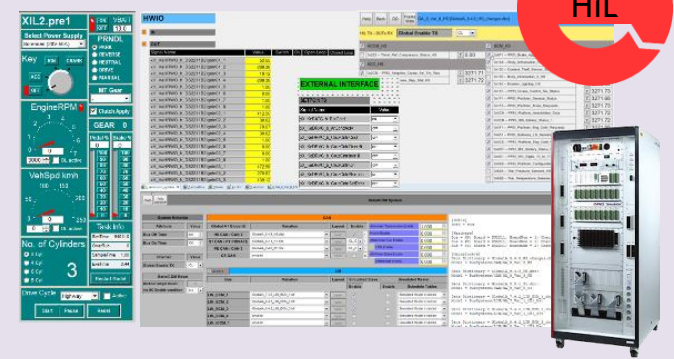
MIL Models



SIL Models



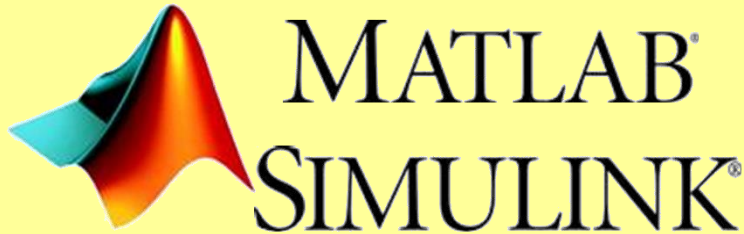
HIL Models



# Which way to choose?

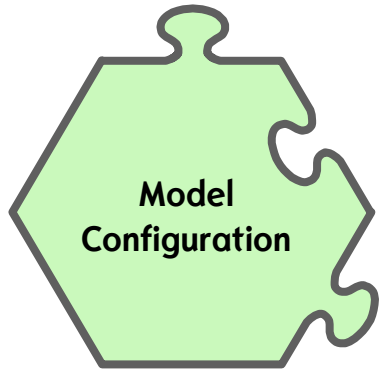


Base Software



# WHAT IS A SIMULATION FRAMEWORK?

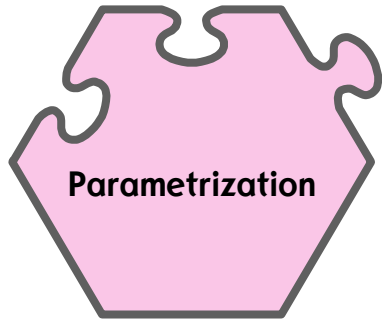
A framework is a puzzle of solutions for various disciplines



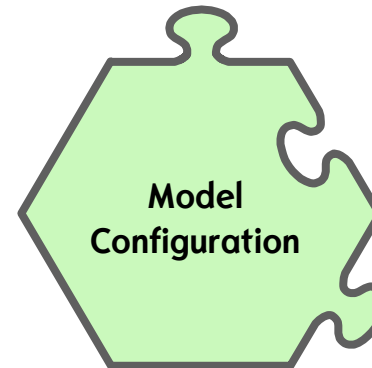
- Library concept
- Model integration
- Variant handling

# WHAT IS A SIMULATION FRAMEWORK?

A framework is a puzzle of solutions for various disciplines

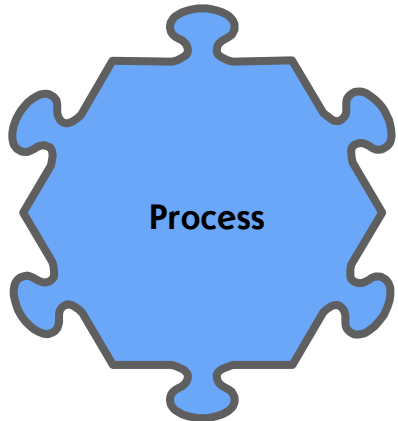


- Parameter initialization
- Definition of tunable parameters
- Parameter inheritance
- Maintenance of meta data

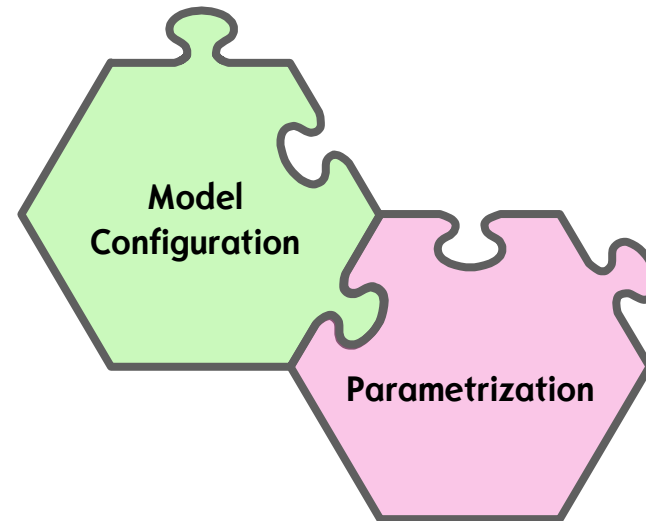


# WHAT IS A SIMULATION FRAMEWORK?

A framework is a puzzle of solutions for various disciplines



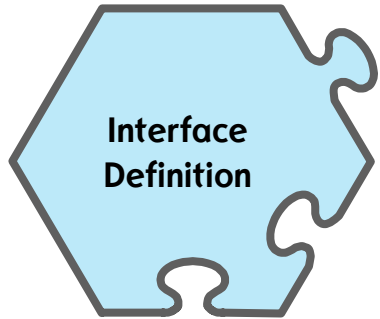
- Following agile principles
- Git for version control
- JIRA for planning & issue tracking
- Continuous Integration & Testing



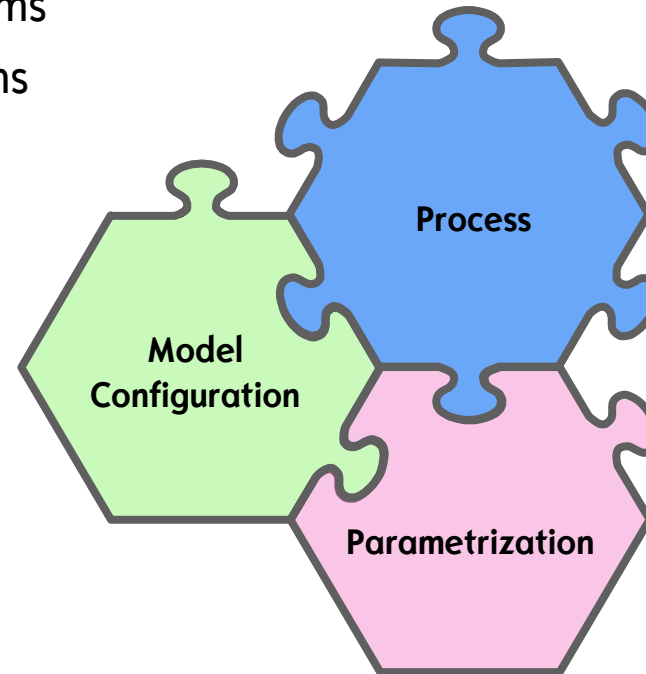


# WHAT IS A SIMULATION FRAMEWORK?

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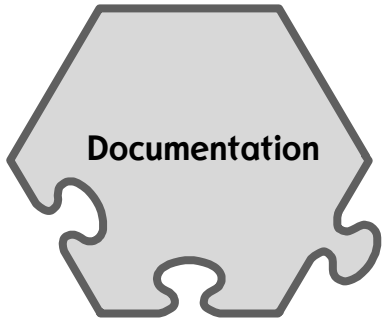


- Standards for model interface (e.g. FMU/FMI) and co-simulation methods
- Interface to external test automation tools
- Standard interfaces to RCP/HIL systems
- Data exchange with PLM/ALM systems

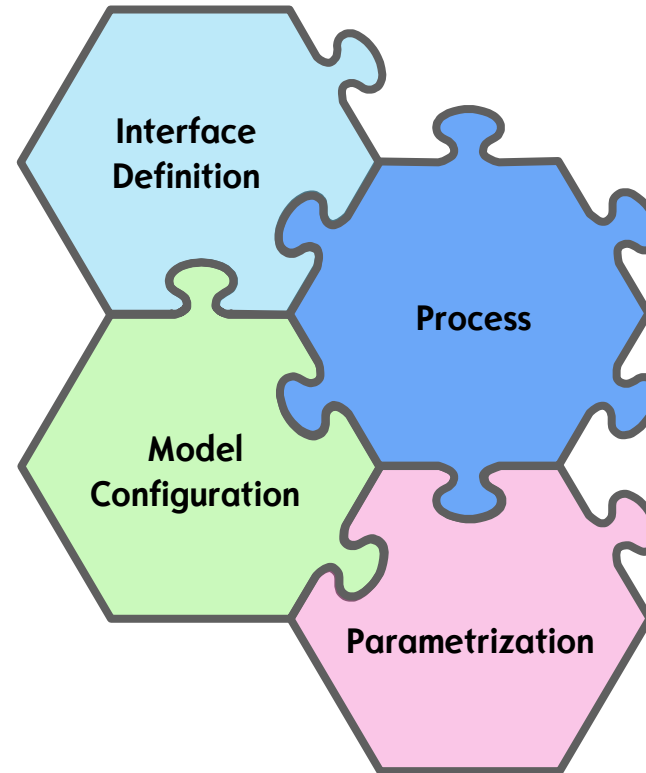


# WHAT IS A SIMULATION FRAMEWORK?

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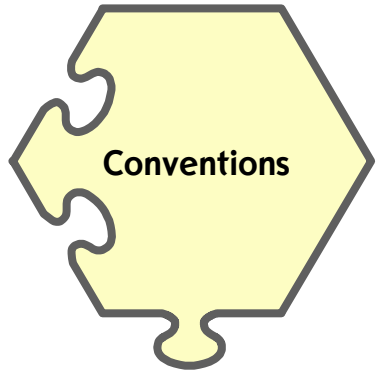


- Common documentation for tools & models

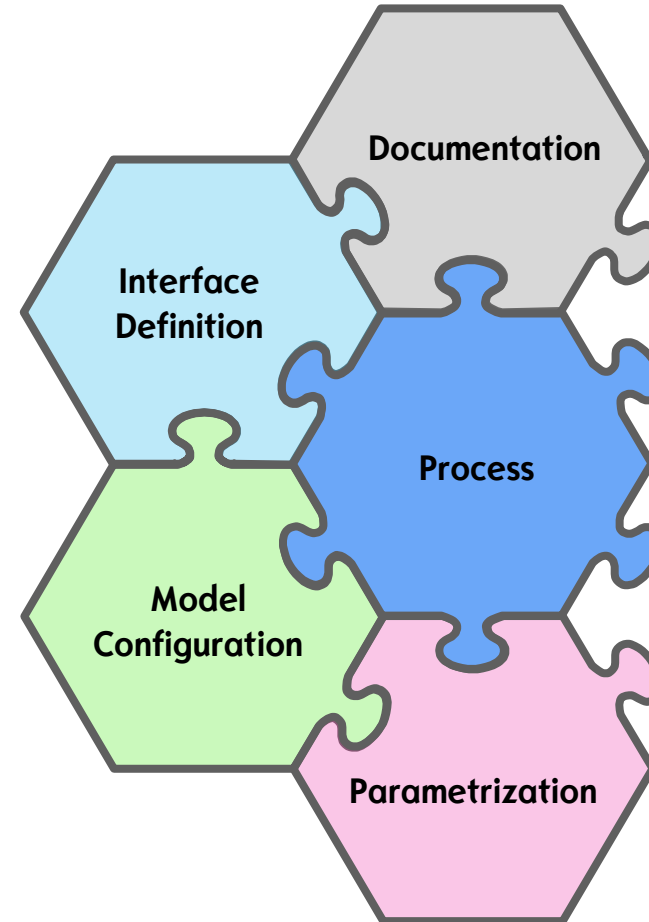


# WHAT IS A SIMULATION FRAMEWORK?

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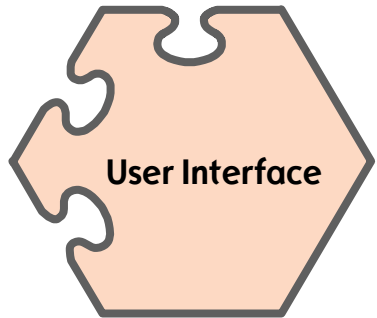


- Naming convention
- Modeling rules & style guides
- MAAB Standard

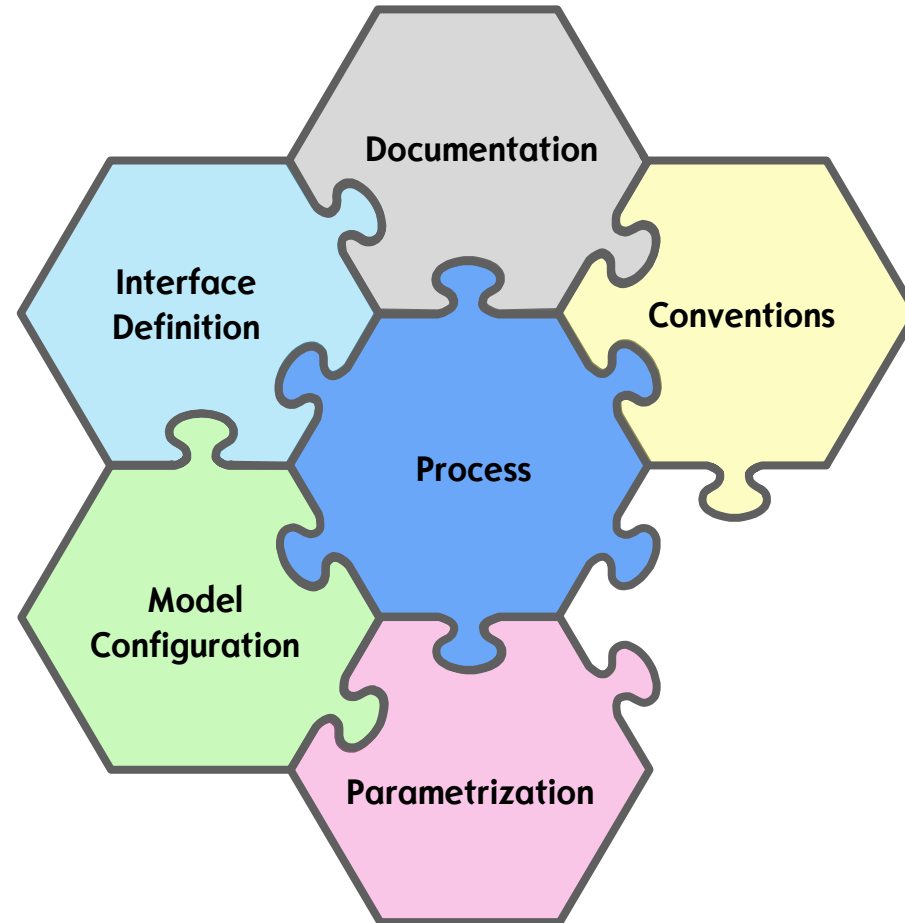


# WHAT IS A SIMULATION FRAMEWORK?

A framework is a puzzle of solutions for various disciplines



- Common Look & Feel
- Automatic UI generation

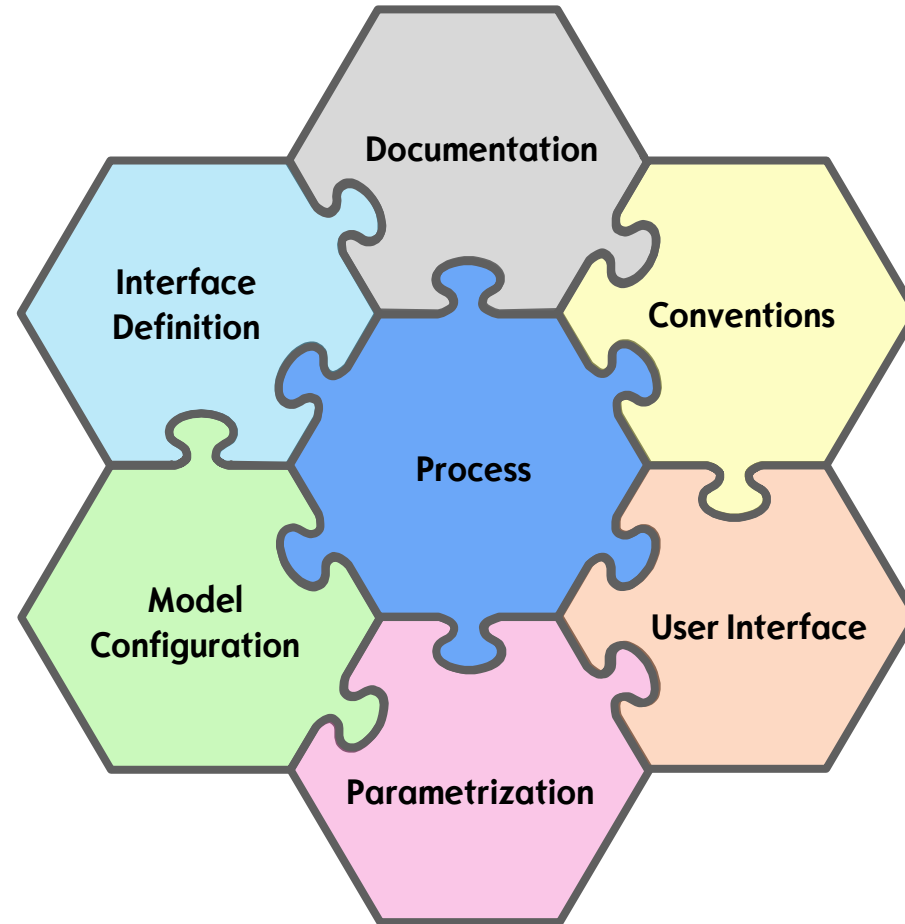


# WHAT IS A SIMULATION FRAMEWORK?

A framework is a puzzle of solutions for various disciplines

**It's not the What  
It's the How to ...**

**It's not the content  
It's the method**



# COLLABORATIVE FRAMEWORK

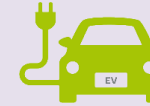
Turn-key Application Models  
(with different purpose)



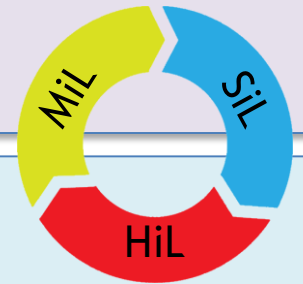
Powertrain



ADAS

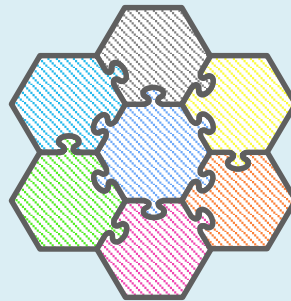


Alternative Propulsion

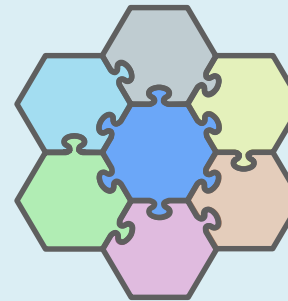


Various Simulation Frameworks  
(tailored to purpose)

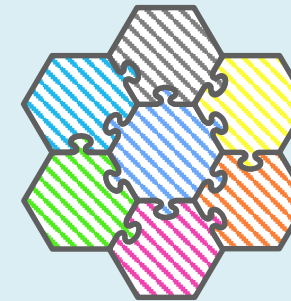
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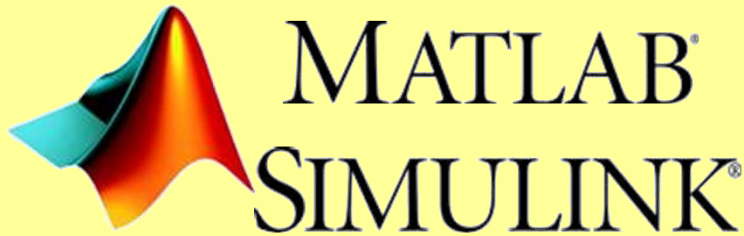


Alternative Propulsion



and more

Base Software



# COLLABORATIVE FRAMEWORK

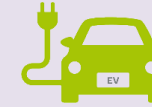
Turn-key Application Models  
(with different purpose)



Powertrain



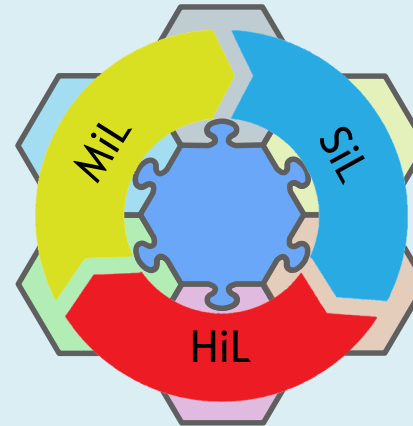
ADAS



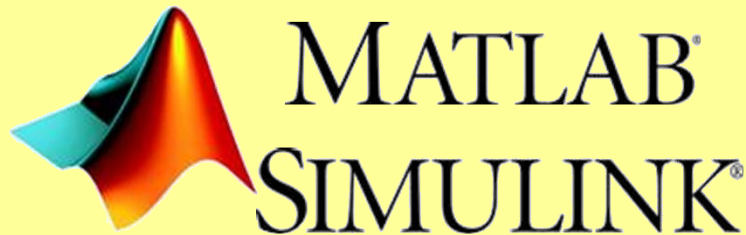
Alternative Propulsion

Common Simulation Framework  
(across various domains and departments)

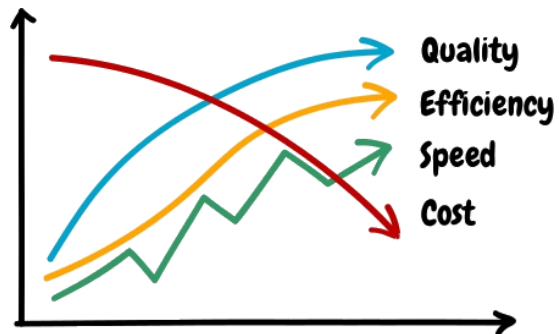
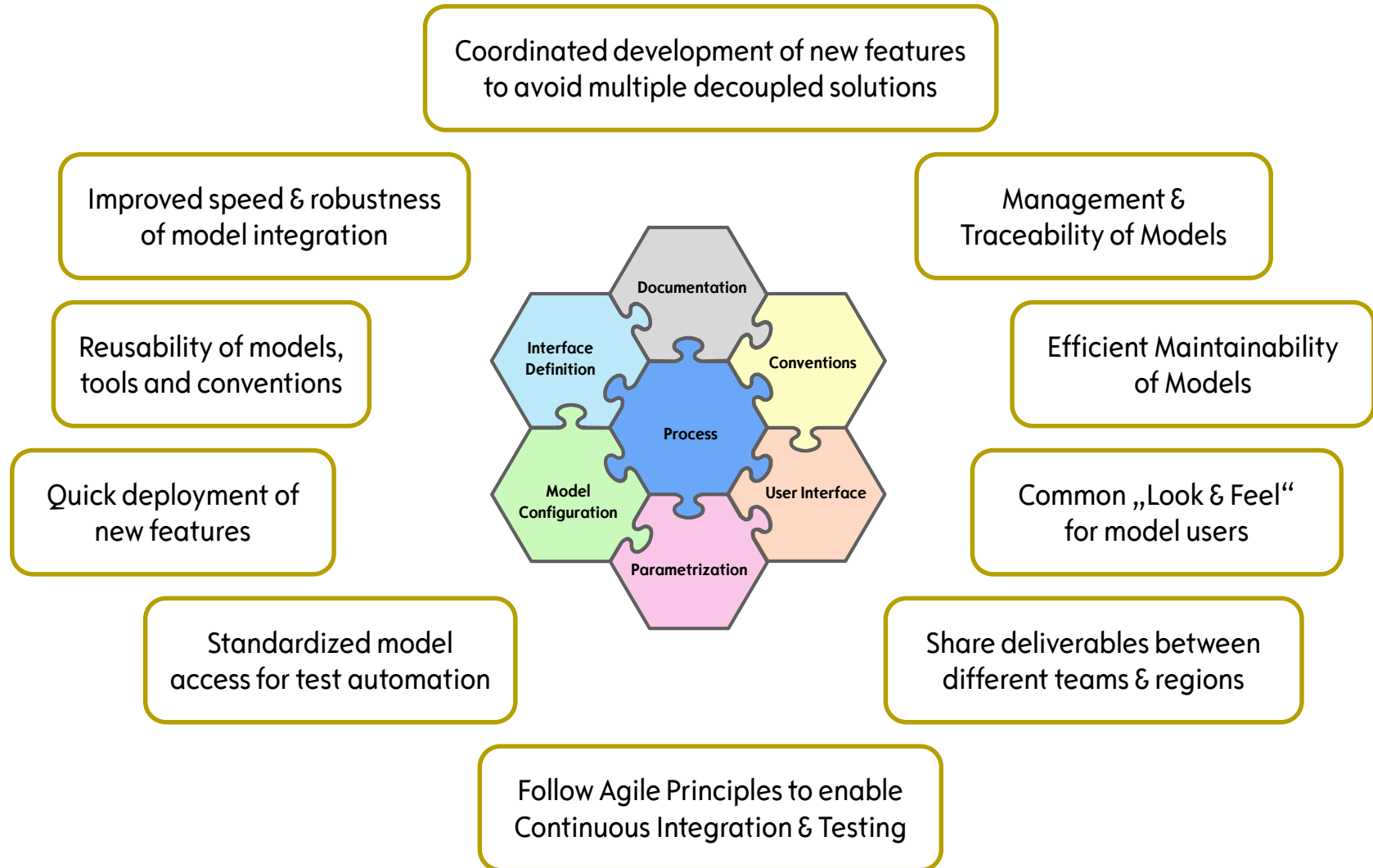
Automotive  
XIL  
Objectoriented  
Modelframework



Base Software



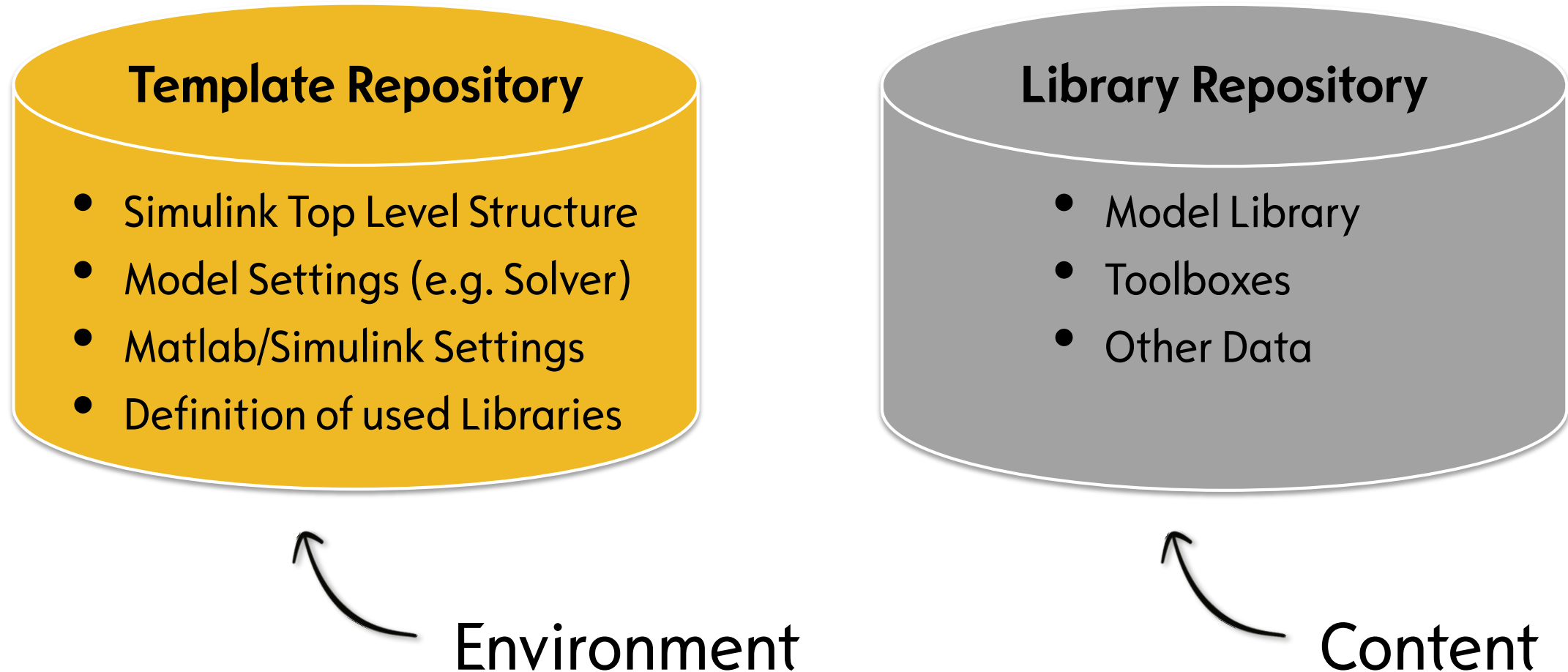
# WHAT ARE THE GOALS OF AXIOM?





# HOW TO SPECIFY AXIOM ENVIRONMENT?

## Template vs. Library repository



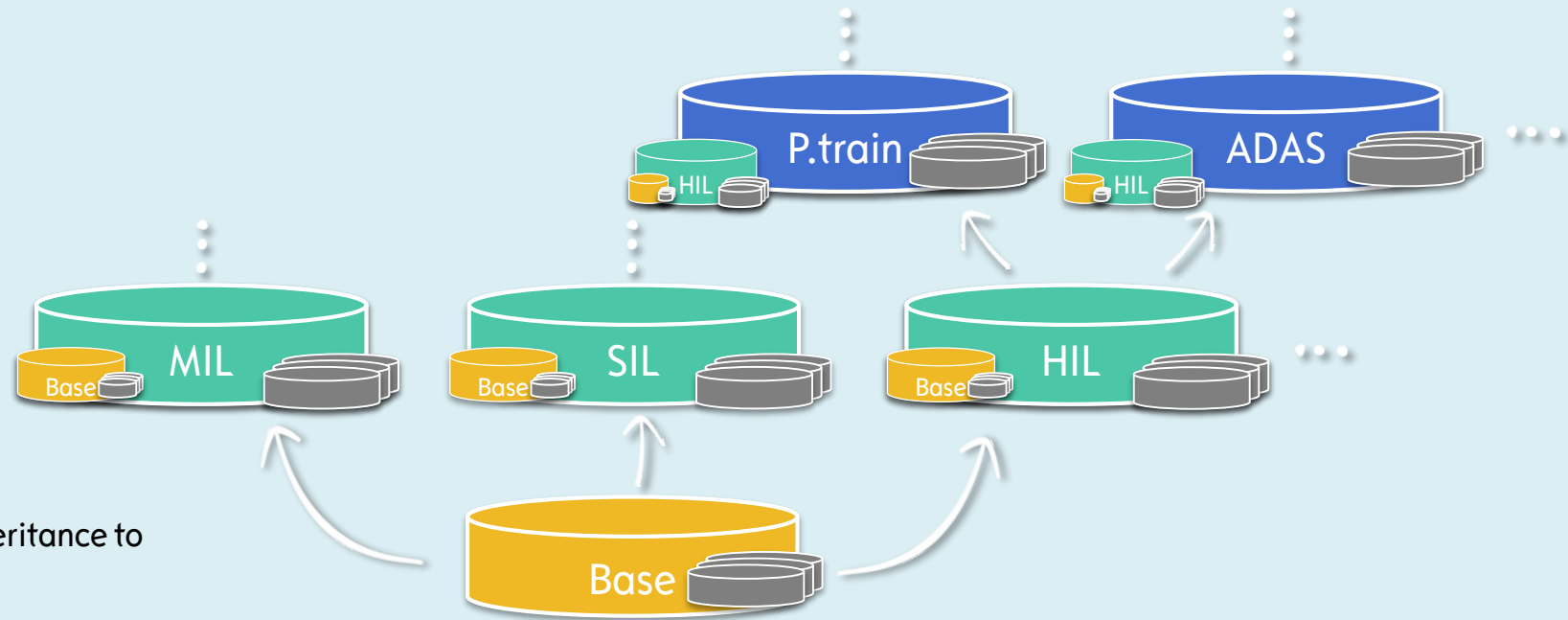
# HOW TO SPECIFY AXIOM ENVIRONMENT?

Turn-key Application Models

Application 1

Application 2

Application 3 ...



Template approach

Usage of object orientation and inheritance to create various stages of expansion

Base Software

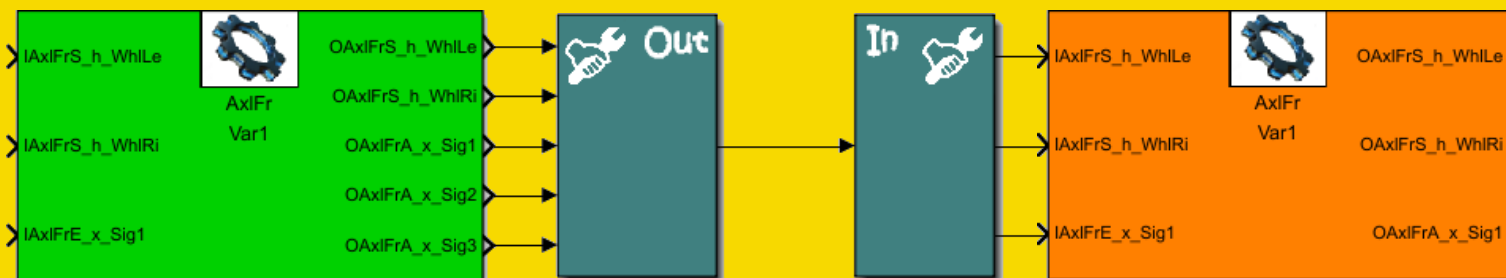
- Modular approach as main principle of Axiom
  - Key enabler for collaborative work
  - Module consists of a model together with its parameters and interface definition
    - It is standalone capable and completely independent of other modules
    - Module interfaces are tunable parameters and signal ports
- Powerful toolchain required to...
- connect modules to each other
  - load application specific parametrization
  - maintain different configurations (variants)

# EXAMPLE 1: CONNECTION MANAGER

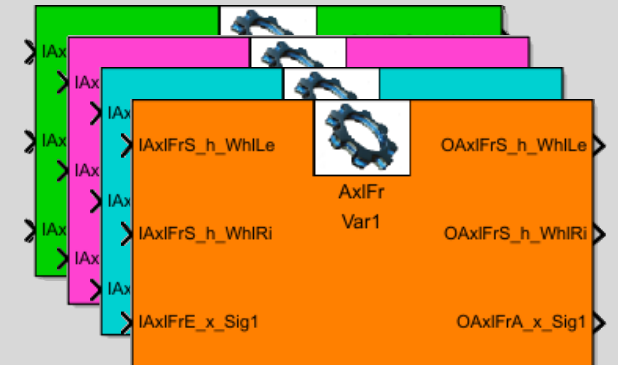
## Adapter to connect multiple models

- Enabler for decoupled model development
- Well defined interface: prerequisite for model split
- Small busses realized by intelligent bus creation
- automatic satisfaction of open module interfaces

### Application Model



### Model Component Libraries

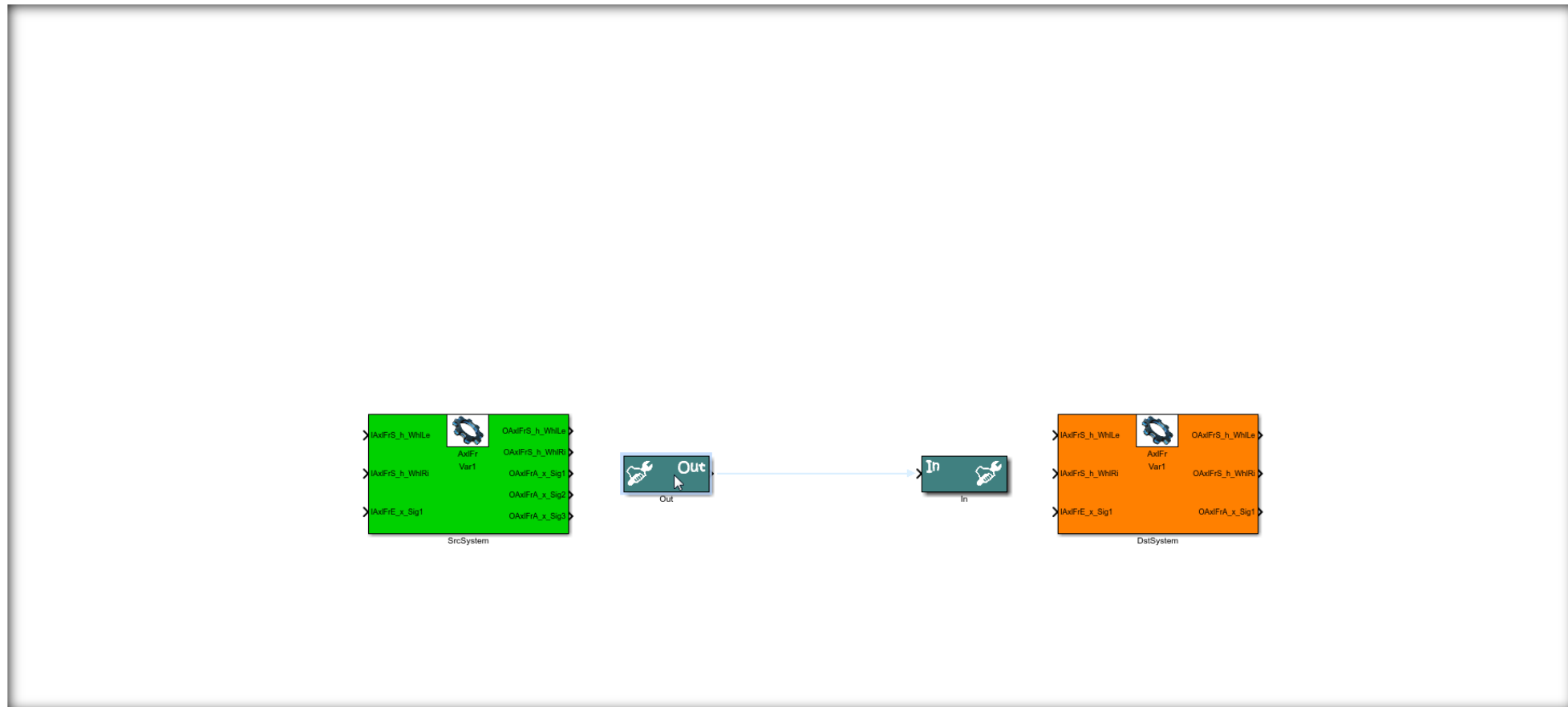


# EXAMPLE 1: CONNECTION MANAGER

## Demo

### Step 1

Add Connection Manager Blockset



# EXAMPLE 1: CONNECTION MANAGER

## Demo

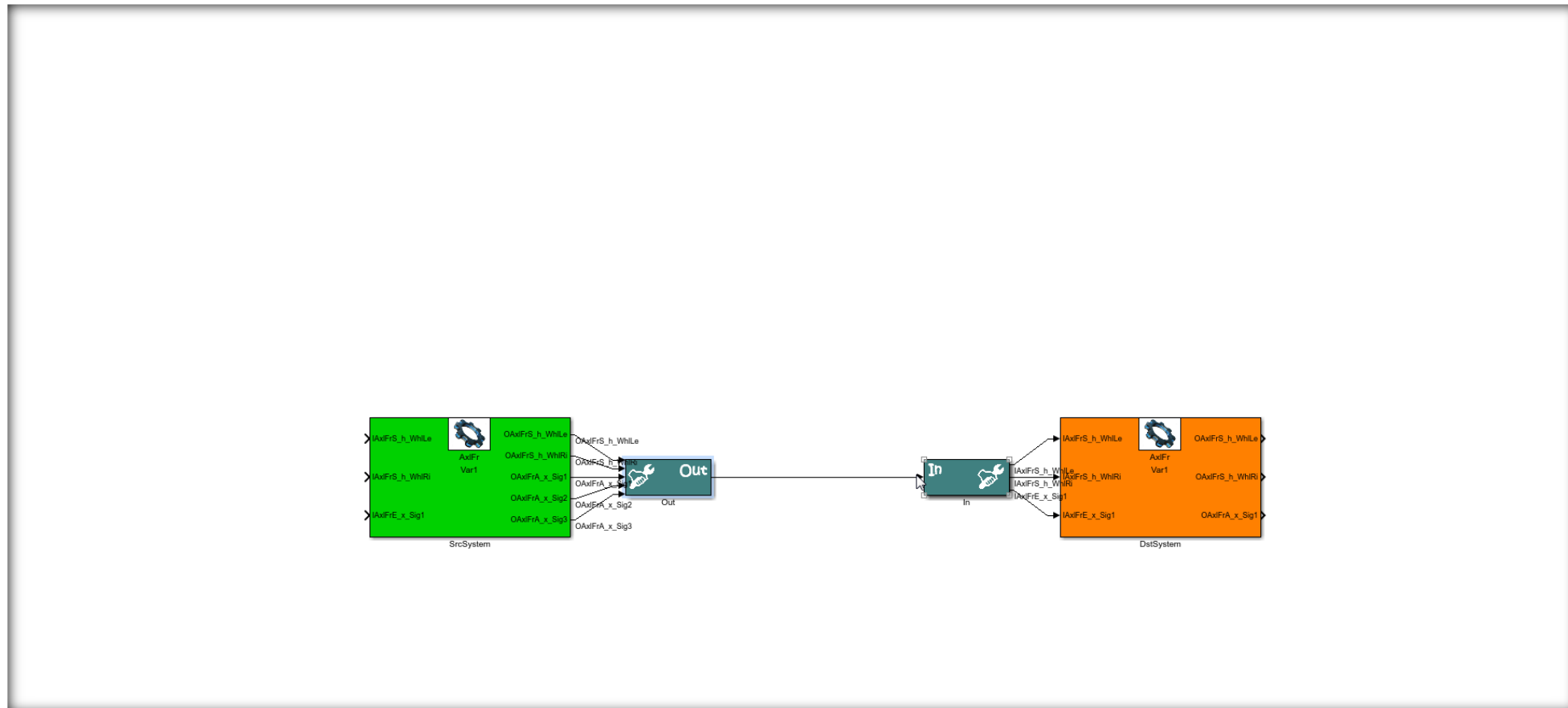
### Step 1

Add Connection Manager Blockset



### Step 2

Assign Connection Manager



# EXAMPLE 1: CONNECTION MANAGER

## Demo

### Step 1

Add Connection Manager Blockset



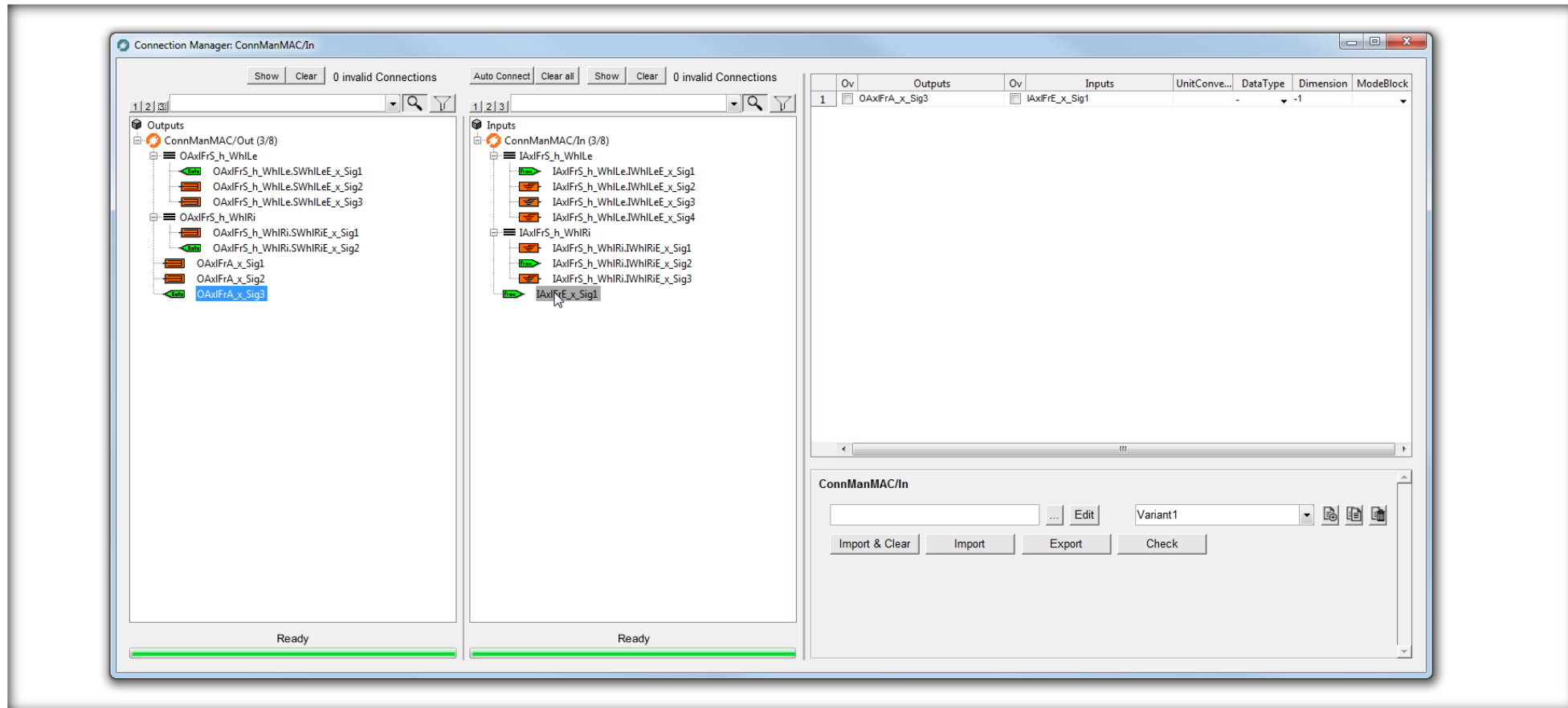
### Step 2

Assign Connection Manager



### Step 3

Open Connection Manager



## EXAMPLE 2: MODEL CONFIGURATOR

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### Management of parametrization

- Maintenance of parameter files (auto-generation, checks etc.)
- Apply specific parameterization by
  - Tunable parameter files
  - Overrides
  - References
- Automatic workspace initialization

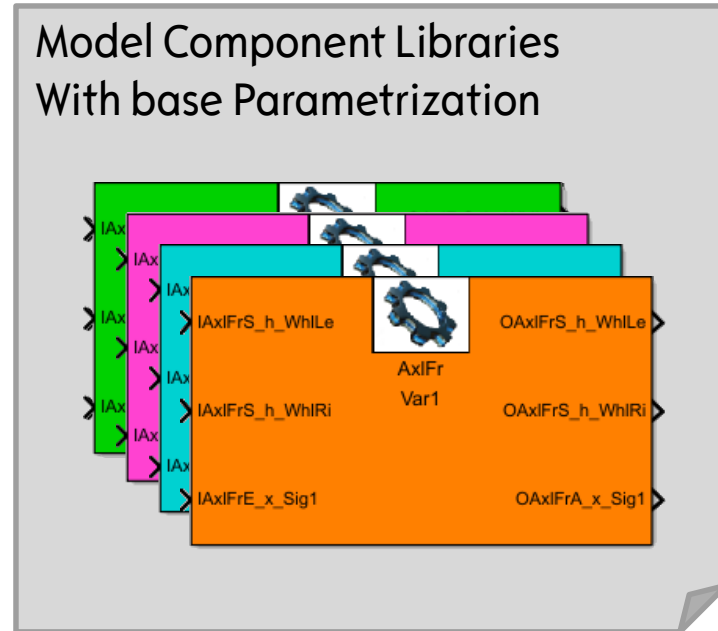
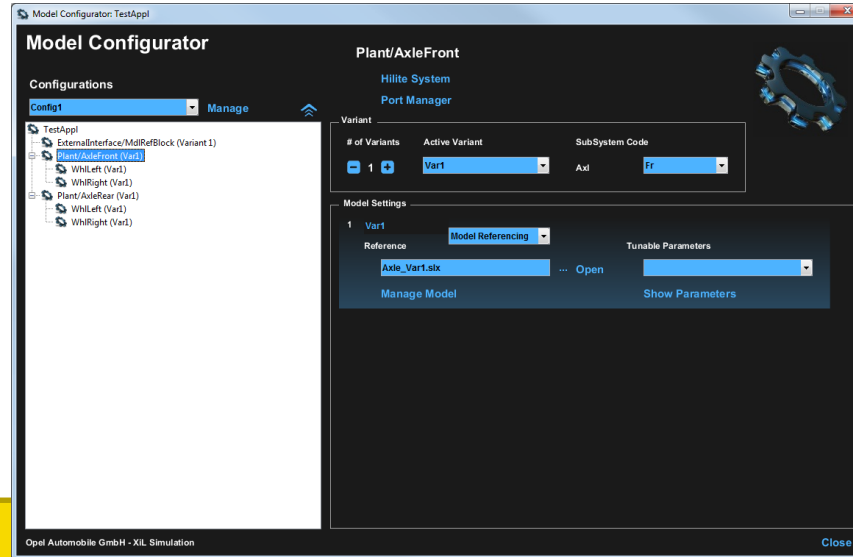
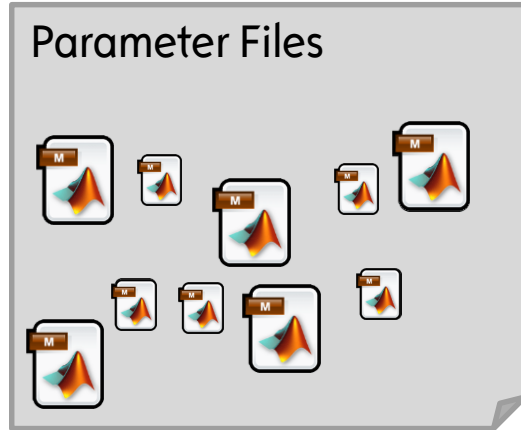
### Management of model variants

- Runtime switchable
- Provide functionality to store configurations → traceability, reuse
- Support of “Model Referencing”

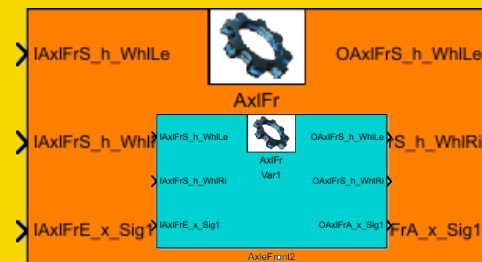


# EXAMPLE 2: MODEL CONFIGURATOR

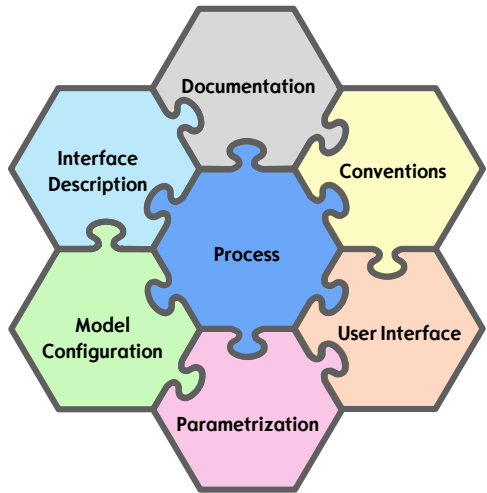
## Parametrization via GUI



## Application Model



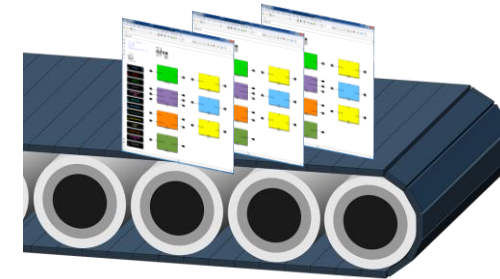
# SUMMARY



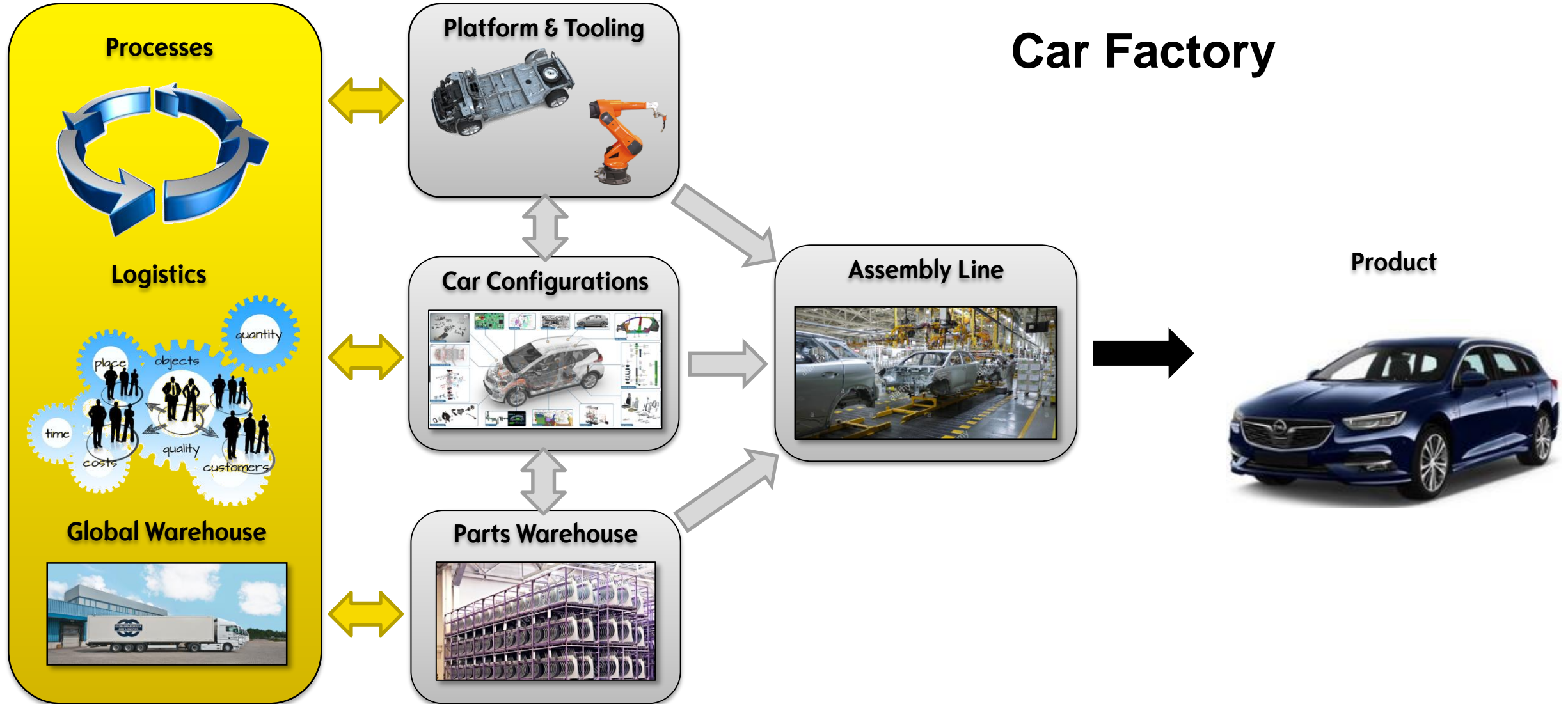
<p>Work across domains</p>	<p>Compatibility Test Automation Simulation</p>
<p>Reusability</p>	<p>Powerful Toolchain</p>
<p>Agile principles</p>	<p>Continuous Integration</p>



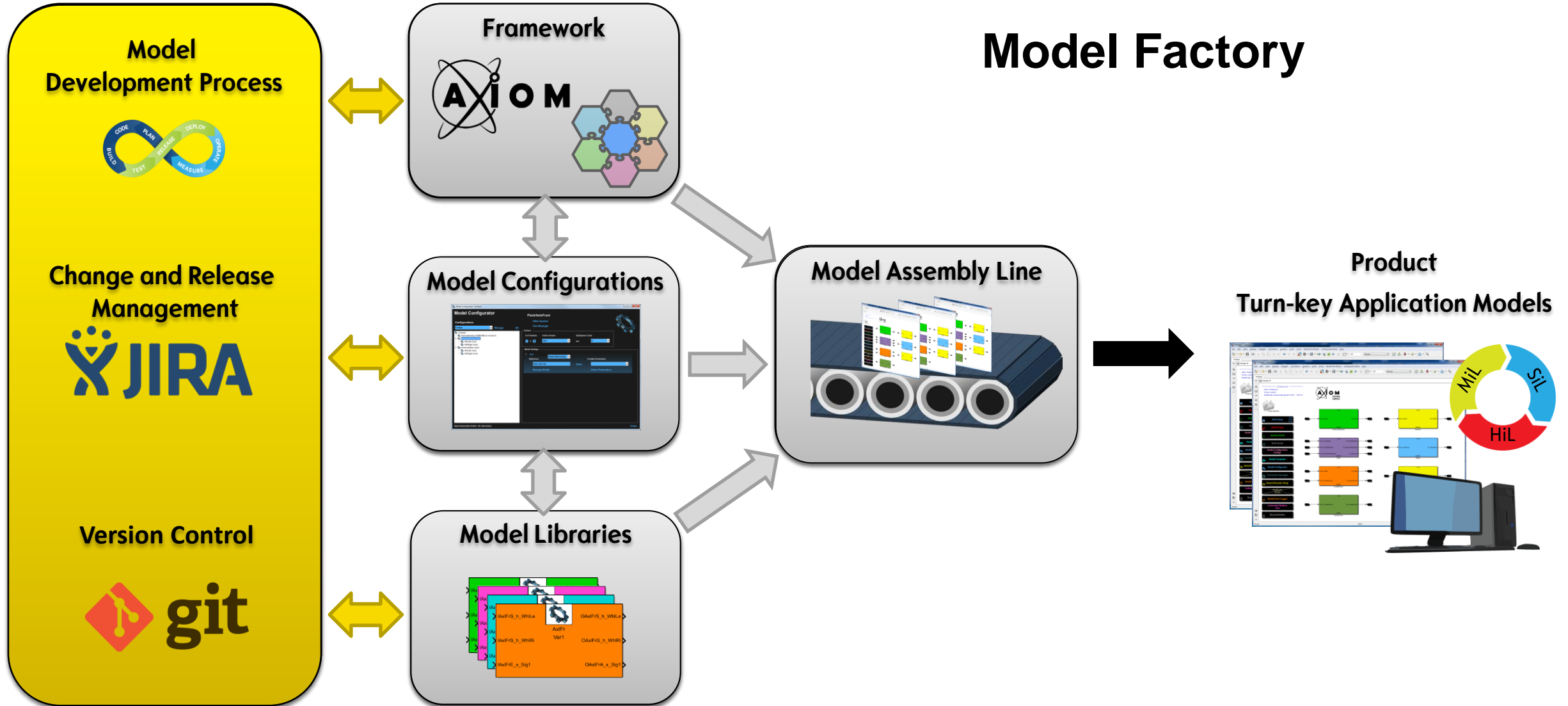
Model assembly line



# SUMMARY



# SUMMARY



## Collaborative Model Development for System Simulation

# THANK YOU

## Q & A