Challenges in Model Based Development

Mathworks Automotive Conference
April, 17th 2018
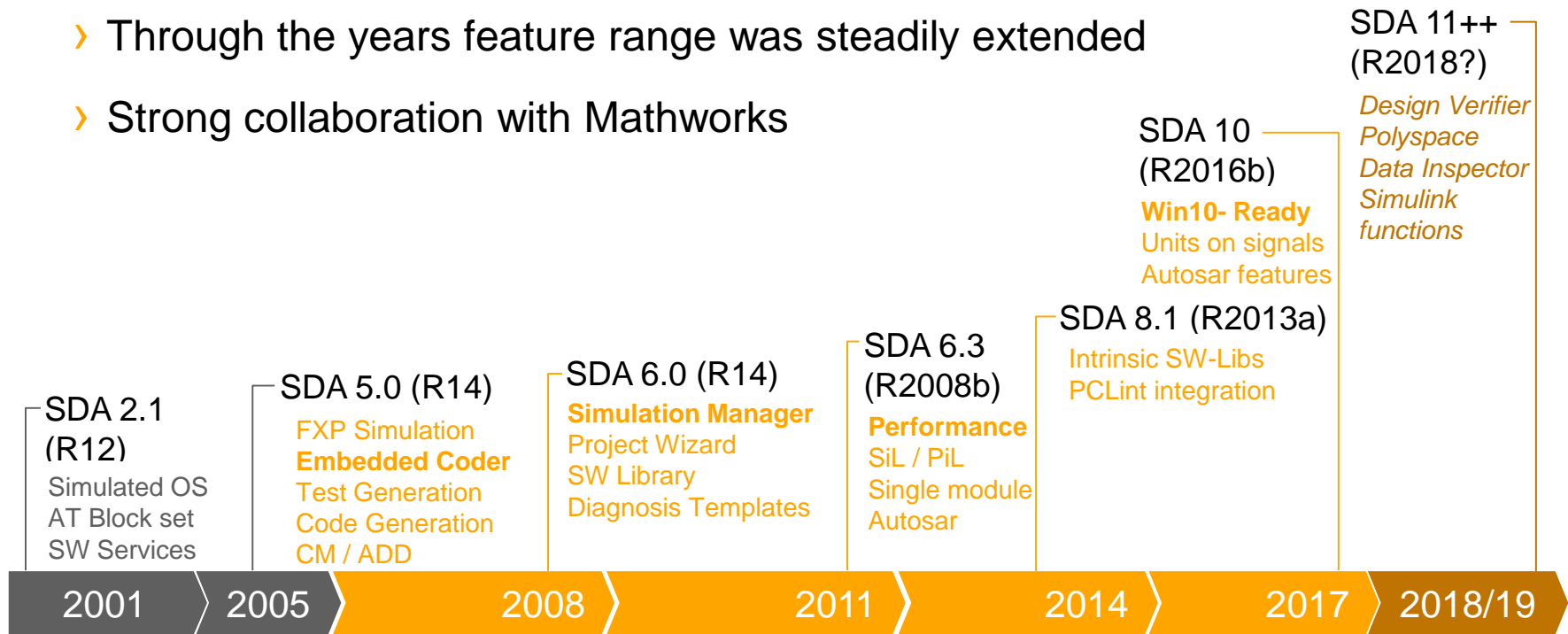
Powertrain Division

Outline

› History of Model Based Design at Continental Powertrain Engine Systems

› System Design Automation (SDA) – our MBD tool chain

› Future strategy

› Architecture Centric Development (ACD)

› From V–Cycle to agile development

› Conclusion

MBD at Continental Powertrain Engine Systems
With Close Technical Partnership Since 17 Years…

> First version of System Design Automation (SDA) in 2001

> Through the years feature range was steadily extended
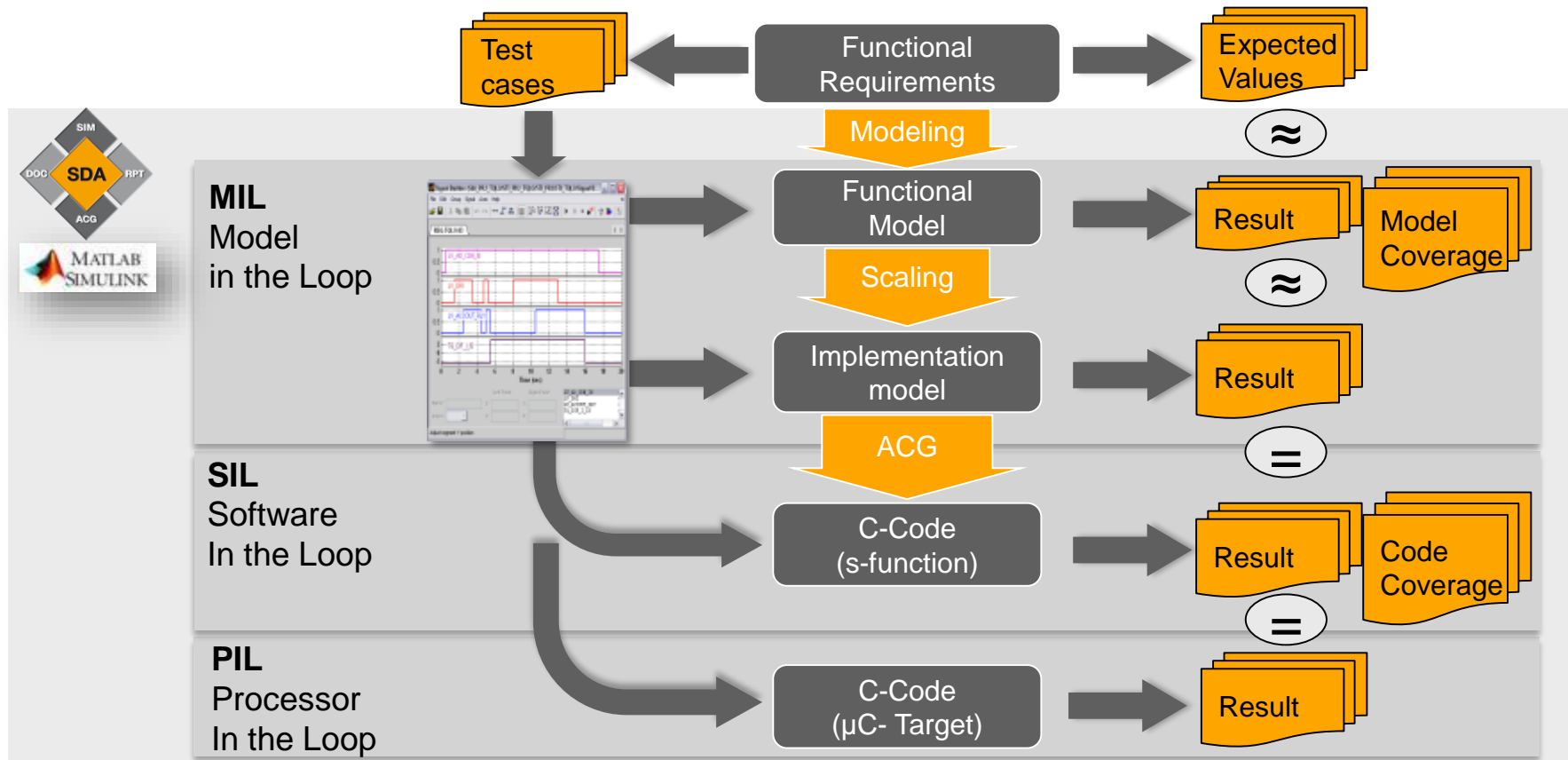
> Strong collaboration with Mathworks

SDA 11++ (R2018?)

Design Verifier
Polyspace
Data Inspector
Simulink functions

SDA 10 (R2016b)

Win10- Ready
Units on signals
Autosar features

SDA 8.1 (R2013a)

Intrinsic SW-Libs
PCLint integration

SDA 6.3 (R2008b)

Performance
SiL / PiL
Single module
Autosar

SDA 6.0 (R14)

Simulation Manager
Project Wizard
SW Library
Diagnosis Templates

SDA 5.0 (R14)

FXP Simulation
Embedded Coder
Test Generation
Code Generation
CM / ADD

SDA 2.1 (R12)

Simulated OS
AT Block set
SW Services

| 2001 | 2005 | 2008 | 2011 | 2014 | 2017 | 2018/19 |

… to increased efficiency and usability

!

System Design Automation
Guide Easily From Functional Requirements…

		Test cases	←	Functional Requirements	→	Expected Values

Modeling

≈

MIL
Model
in the Loop

Functional Model → Result | Model Coverage

Scaling

≈

Implementation model → Result

ACG

=

SIL
Software
In the Loop

C-Code (s-function) → Result | Code Coverage

=

PIL
Processor
In the Loop

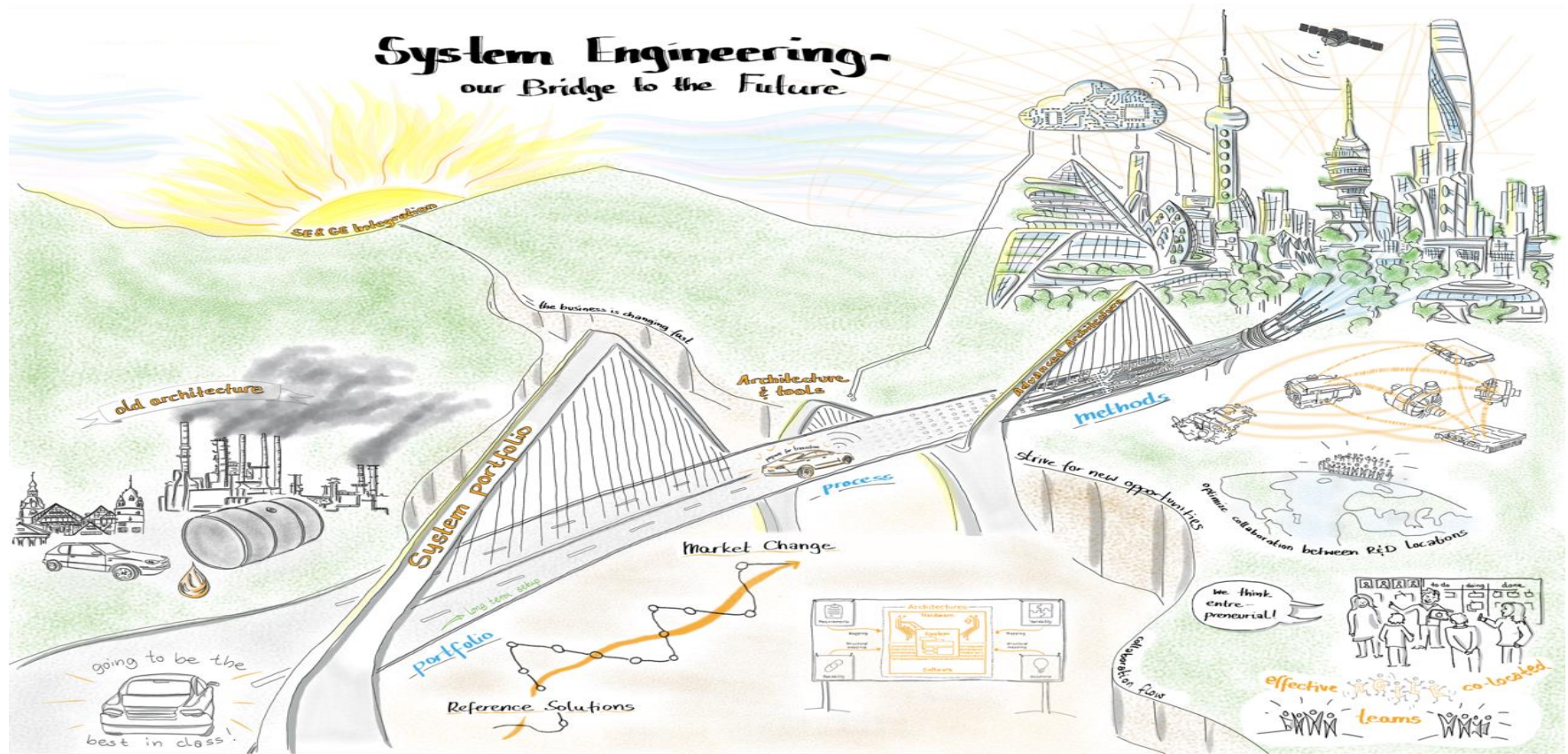C-Code (µC- Target) → Result

… to validated code in one single integrated environment   !

System Engineering Strategy
Architecture With Processes, Methods And Tools…
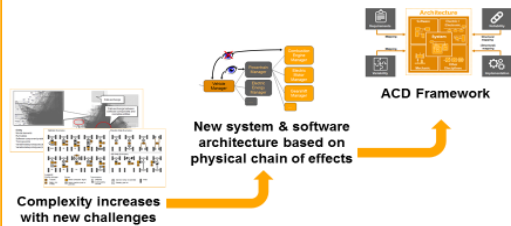

… are the pillars of the bridge to our future !

The Next Steps
Establish New Methods…

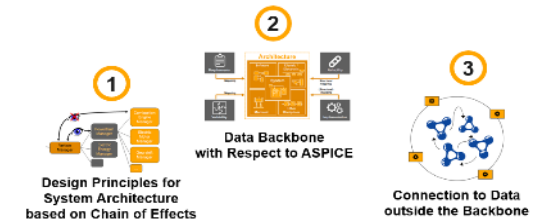**1) ACD Authoring Framework**

Introduction
From Needs for Architecture…

New system & software architecture based on physical chain of effects

ACD Framework

Complexity increases with new challenges

…to the Architecture Centric Development Framework

Close the gap from MBSE to MBD

Integrate legacy data

2) Architecture Design Rules

ACD Framework
The Framework Provides…

Design Principles for System Architecture based on Chain of Effects

Data Backbone with Respect to ASPICE

Connection to Data outside the Backbone

…the Common Boundaries for our Development

Model Based Development Process
Seamless MBD workflow…

MIL : Model in the Loop
SIL : Software in the Loop
PIL : Processor in the Loop
RPT : Rapid Prototyping
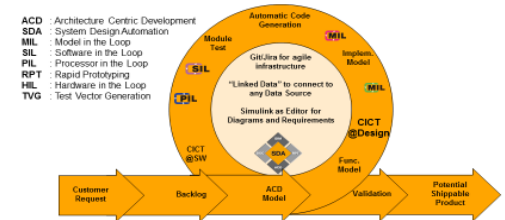HIL : Hardware in the Loop
TVG : Test Vector Generation
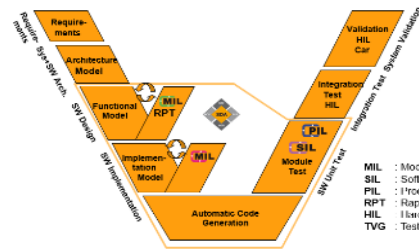
Use latest Simulink features

Establish CI/CT already in design phase

Agile Model Based Development Process
Use Matlab Simulink Environment …

ACD : Architecture Centric Development
SDA : System Design Automation
MIL : Model in the Loop
SIL : Software in the Loop
PIL : Processor in the Loop
RPT : Rapid Prototyping
HIL : Hardware in the Loop
TVG : Test Vector Generation

Git/Jira for agile infrastructure
"Linked Data" to connect to any Data Source
Simulink as Editor for Diagrams and Requirements

Customer Request — Backlog — ACD Model — Validation — Potential Shippable Product

…to Integrate ACD, MBD and Agile Development
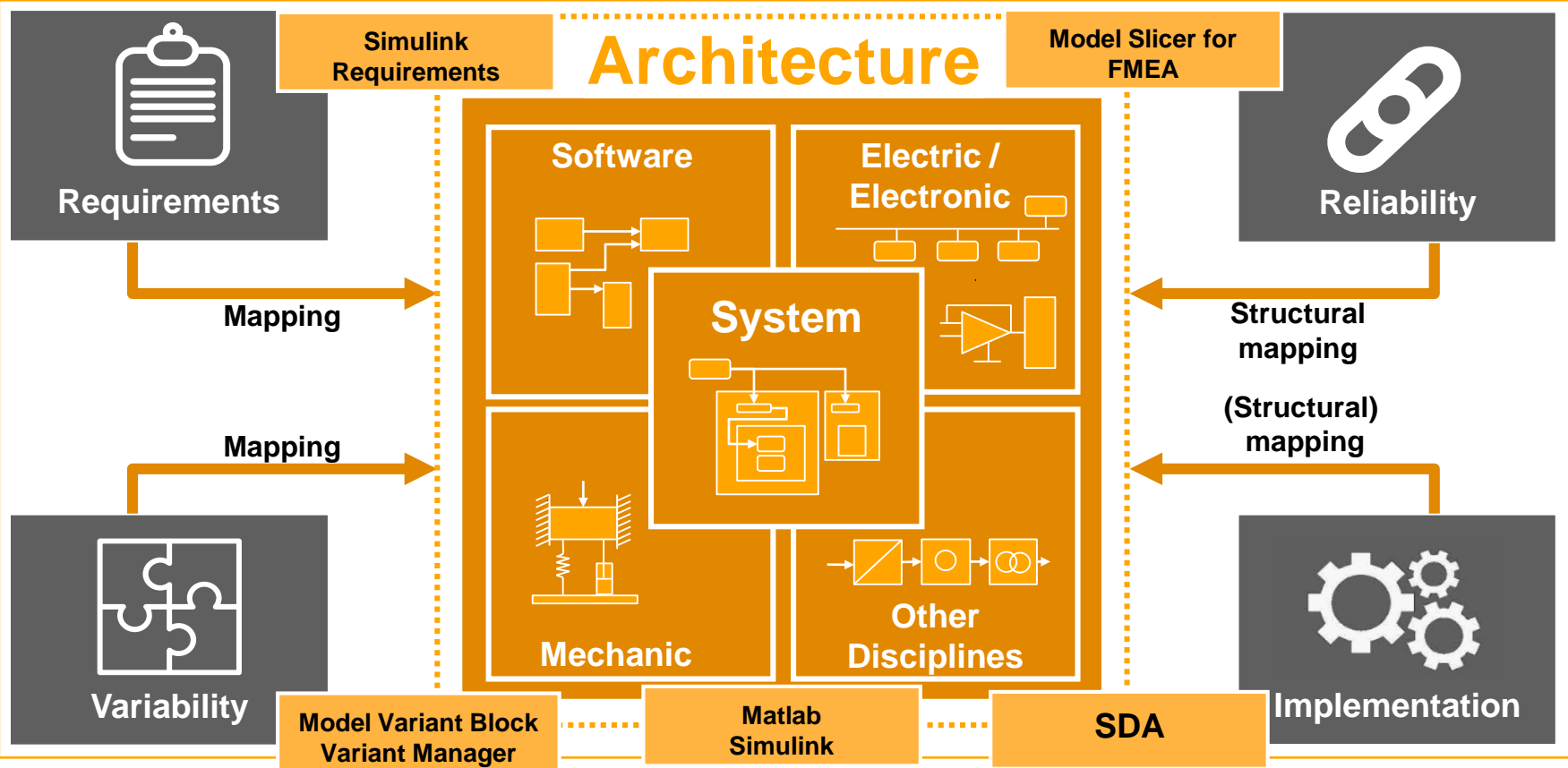
3) Optimize From Classical Process…

… down to Lean Agile Development

… to cope with future challenges !

Backbone with Intrinsic ASPICE Capability
System Architecture as…

Architecture

Simulink Requirements

Model Slicer for FMEA

Requirements

Reliability

Software

Electric / Electronic

System

Mapping

Structural mapping

Mapping

(Structural) mapping

Mechanic

Other Disciplines

Variability

Implementation

Model Variant Block Variant Manager
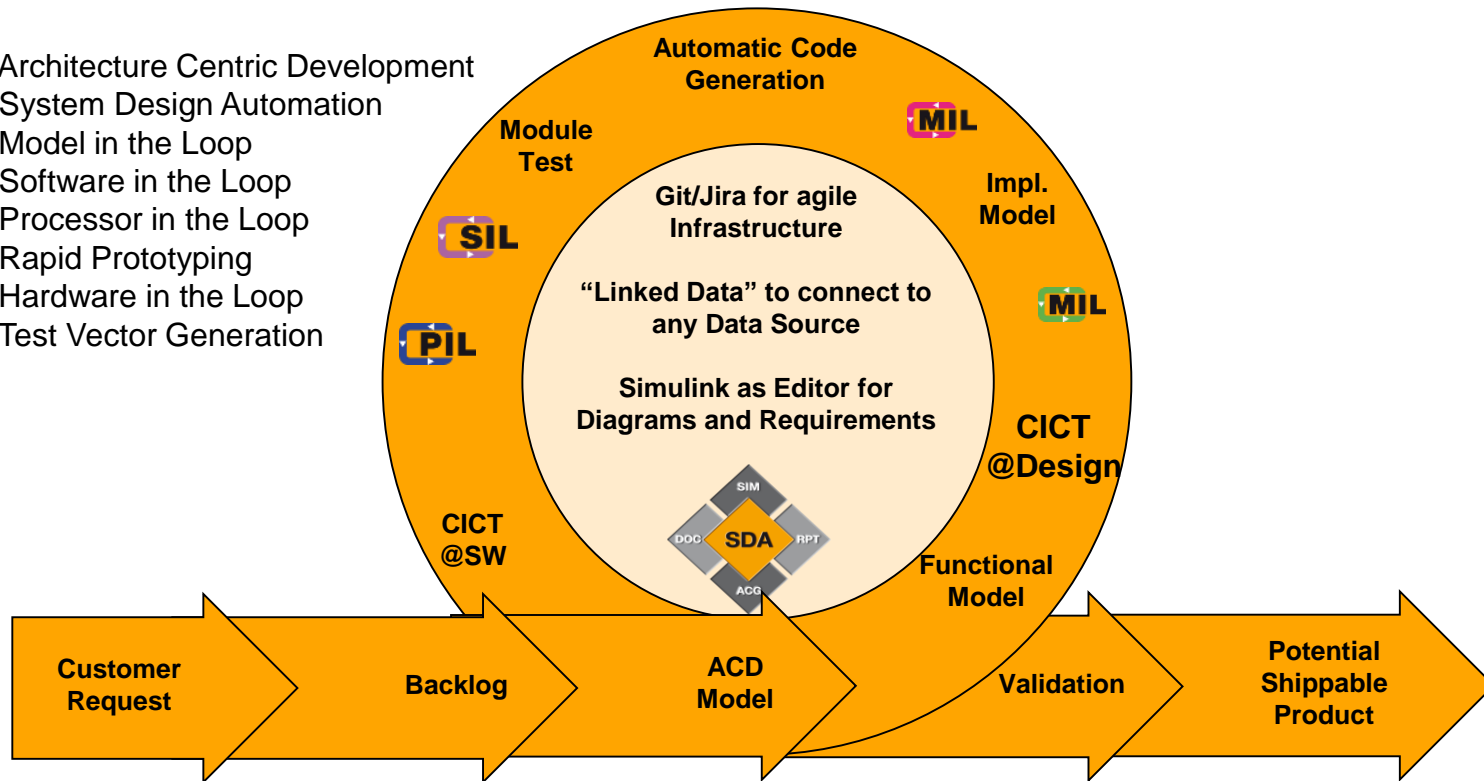
Matlab Simulink

SDA

… connecting element for the entire product description

!

Agile Model Based Design Process
Use Matlab Simulink Environment …

ACD : Architecture Centric Development
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MIL : Model in the Loop
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Automatic Code
Generation

Module
Test

MIL

Impl.
Model

SIL

Git/Jira for agile
Infrastructure

"Linked Data" to connect to
any Data Source

MIL

PIL

Simulink as Editor for
Diagrams and Requirements

SIM

DOC **SDA** RPT

ACG

CICT
@Design

CICT
@SW

Functional
Model

Customer
Request

Backlog

ACD
Model

Validation

Potential
Shippable
Product

… to integrate ACD, MBD and agile development

!

Continental

Conclusion
Feature Extensions And Tool Improvements Needed…

› Seamless tool chain for Model Based Design established

› Future task:

  › Extend area of application to Systems Engineering and architecture

  › Introduce concept of Architecture Centric Development

  › Integrate agile methods for Model Based Design

› For these tasks we need extended and modern features towards

  › System architecture

  › Decentralized CM systems

  › Integration with Continuous Integration (CI) and Test (CT)

… to efficiently master future challenges   **!**

Thank you
for your attention!