PHOENIX INTEGRATION

2018 International Users' Conference

April 17 – 19, 2018

Annapolis, Maryland | USA

The Parametric Digital Engineering Journey

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PTC

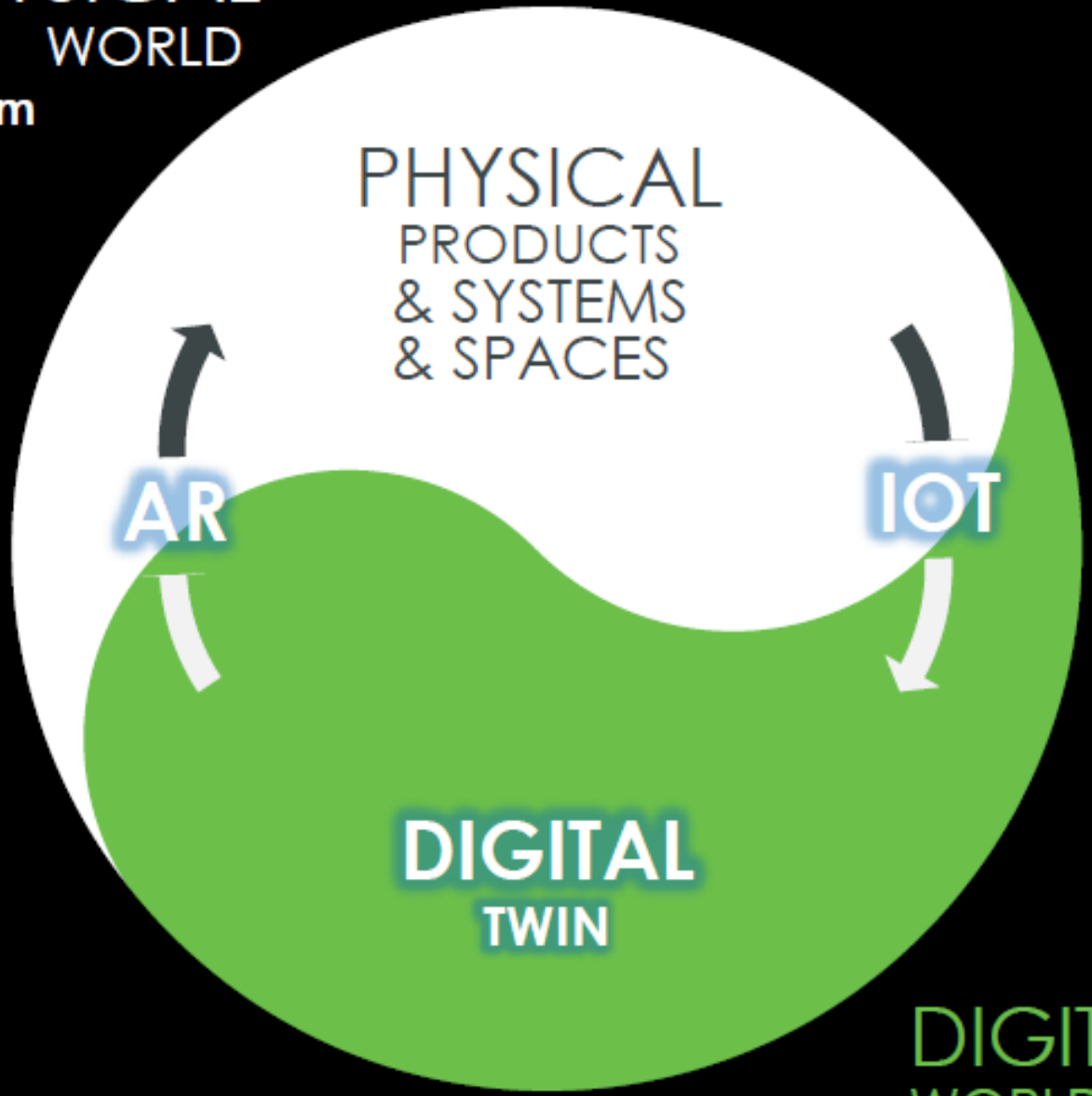
ptc

PHYSICAL WORLD

Industrial Innovation Platform

>$100M Revenue
> 50% Bookings Growth FY16
1,200 End Customers
250 OEMs/Resellers
Ecosystem of SI's, partners

IoT & ANALYTICS | thingworx
AUGMENTED REALITY | vuforia
INDUSTRIAL CONNECTIVITY | kepware

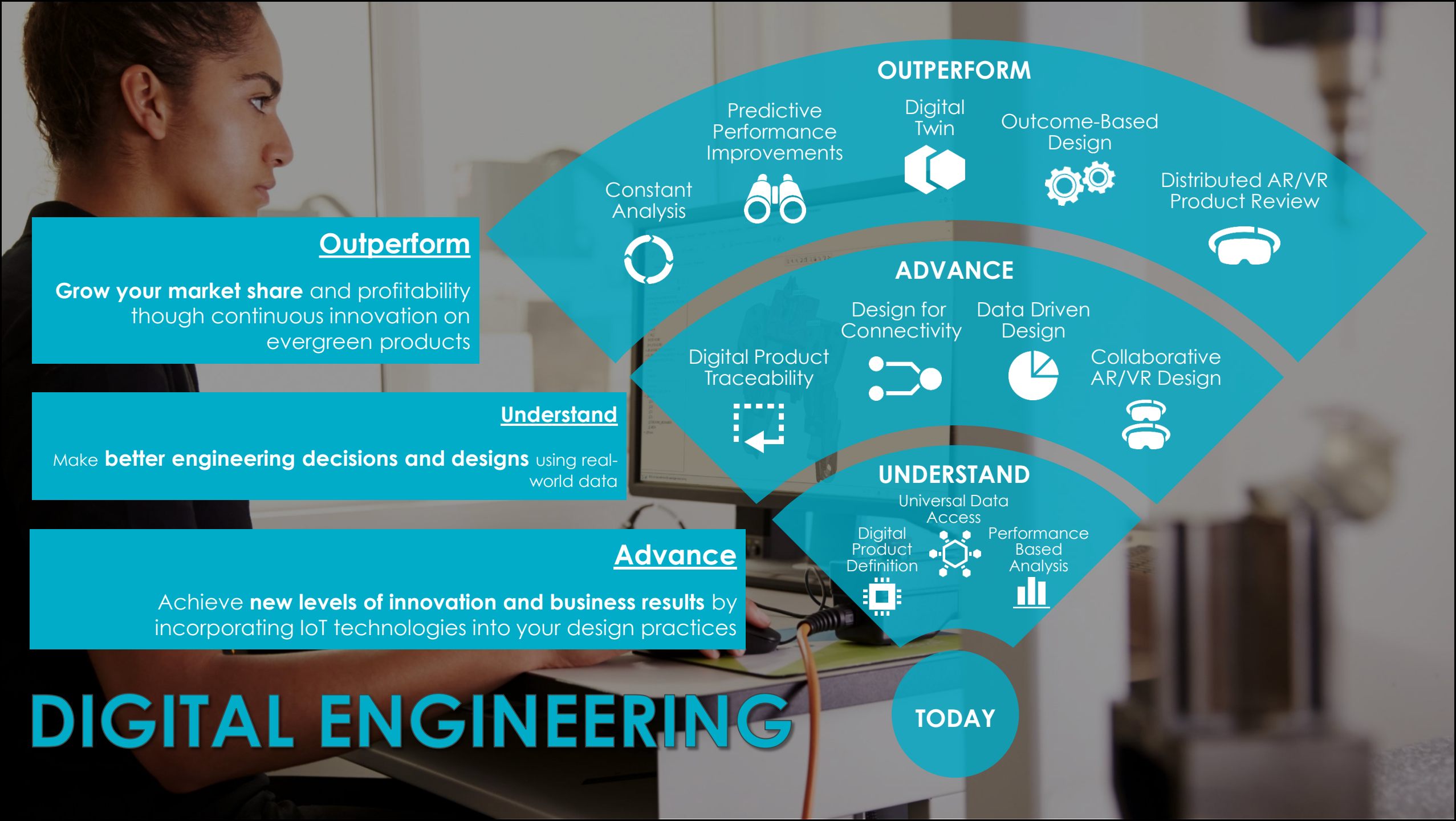


DIGITAL WORLD

PLM Solutions

>$1B Revenue
10% Bookings Growth FY16
28,000 End Customers
70% Direct Sales
30% VARs (~400)
Ecosystem of SI's, partners

CAD | creo
PLM | windchill
ALM | integrity
SLM | servigistics



Outperform

Grow your market share and profitability though continuous innovation on evergreen products

Understand

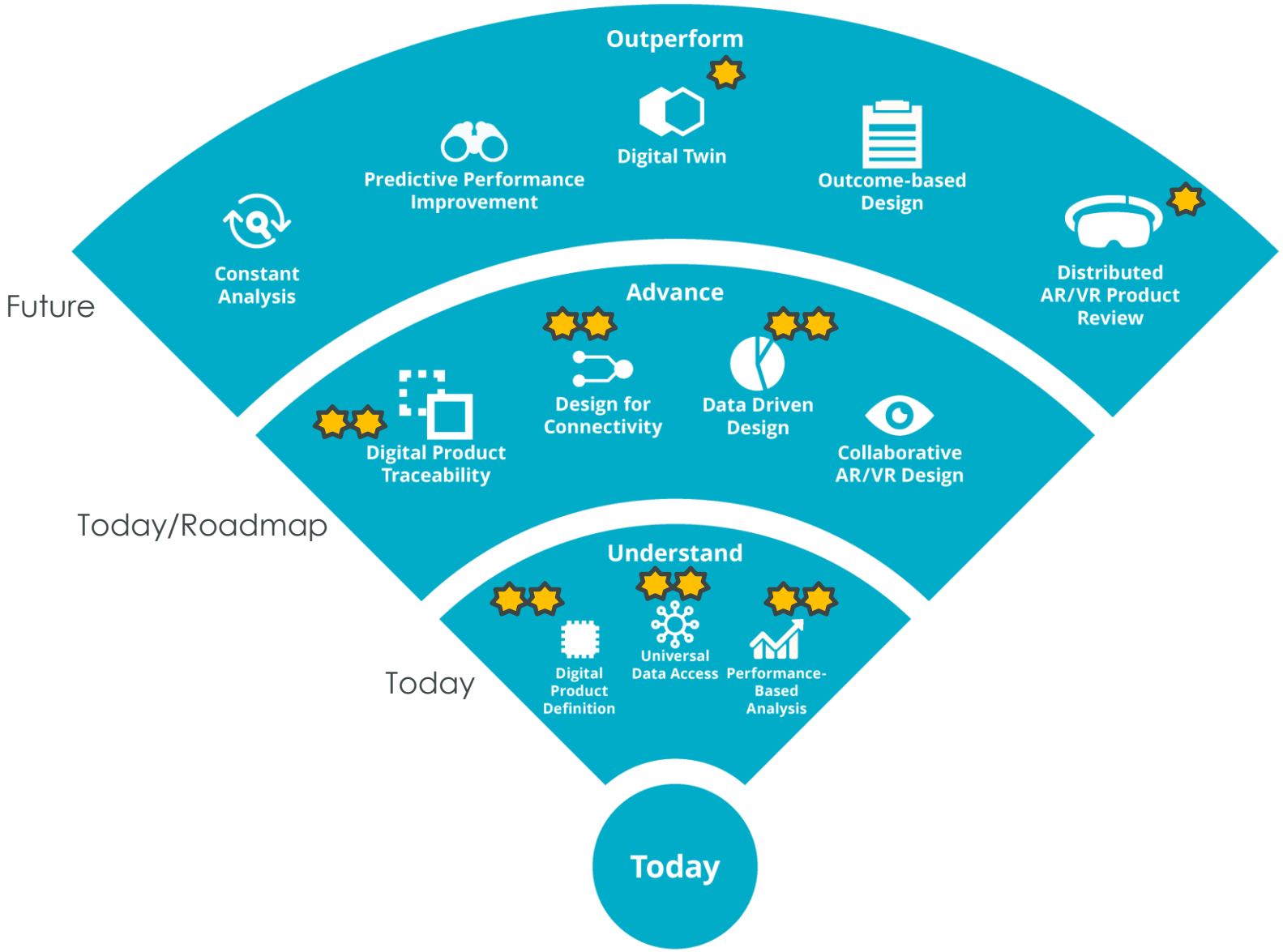
Make **better engineering decisions and designs** using real-world data

Advance

Achieve **new levels of innovation and business results** by incorporating IoT technologies into your design practices

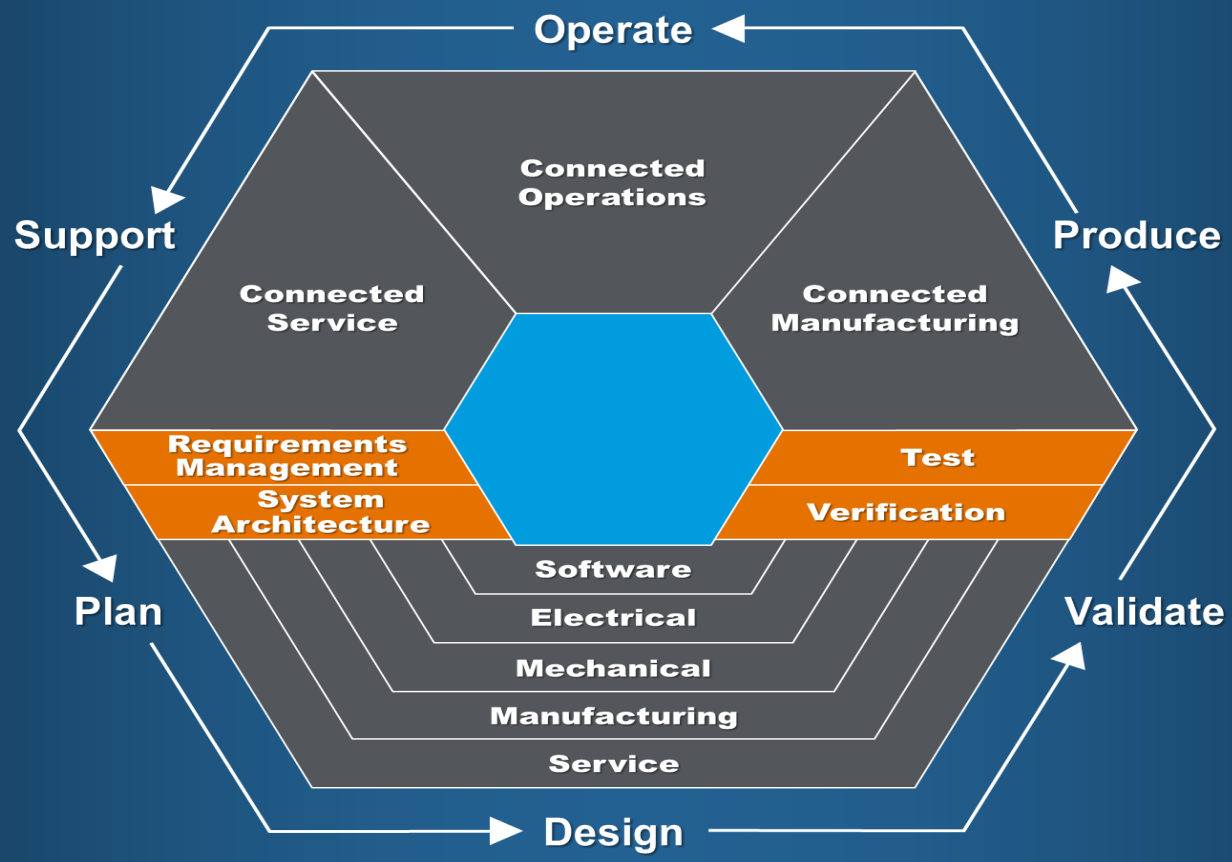
DIGITAL ENGINEERING

MBSE PLAYS A KEY ROLE IN THE DIGITAL ENGINEERING JOURNEY

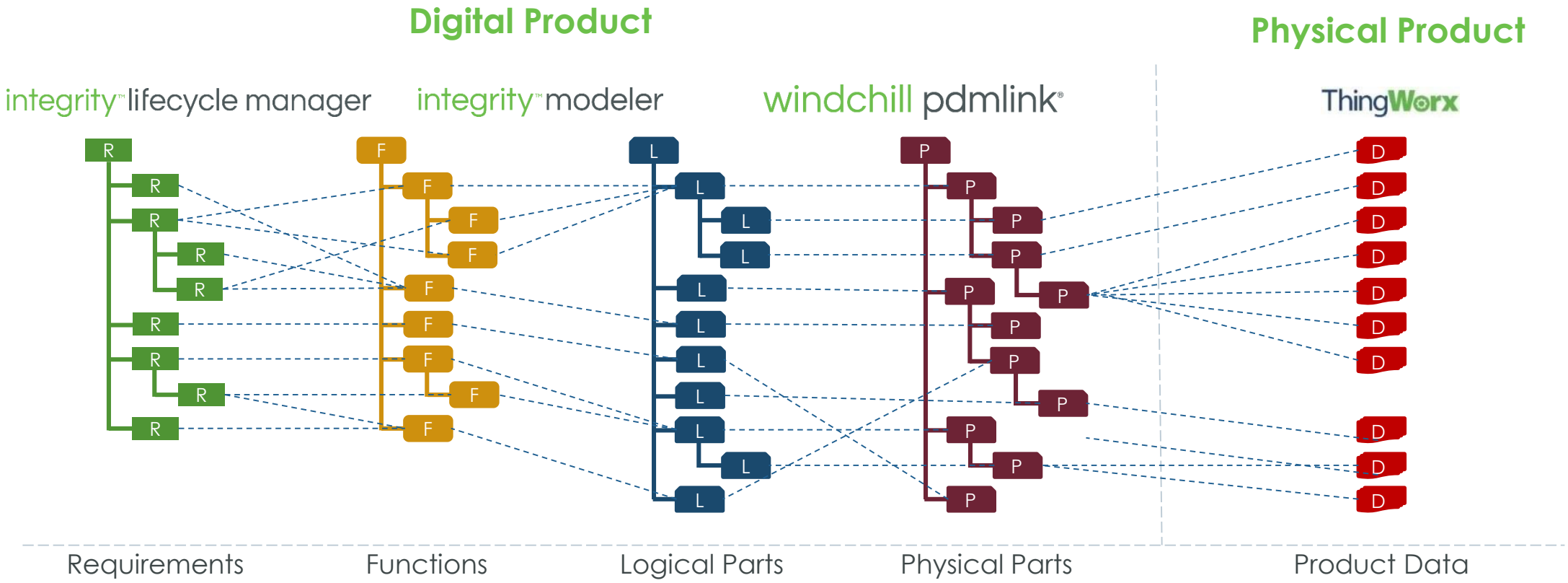


CLOSED LOOP SYSTEMS ENGINEERING

A **holistic**, **multi-disciplinary** and collaborative approach to designing and maintaining **complex** systems throughout the systems lifecycle.



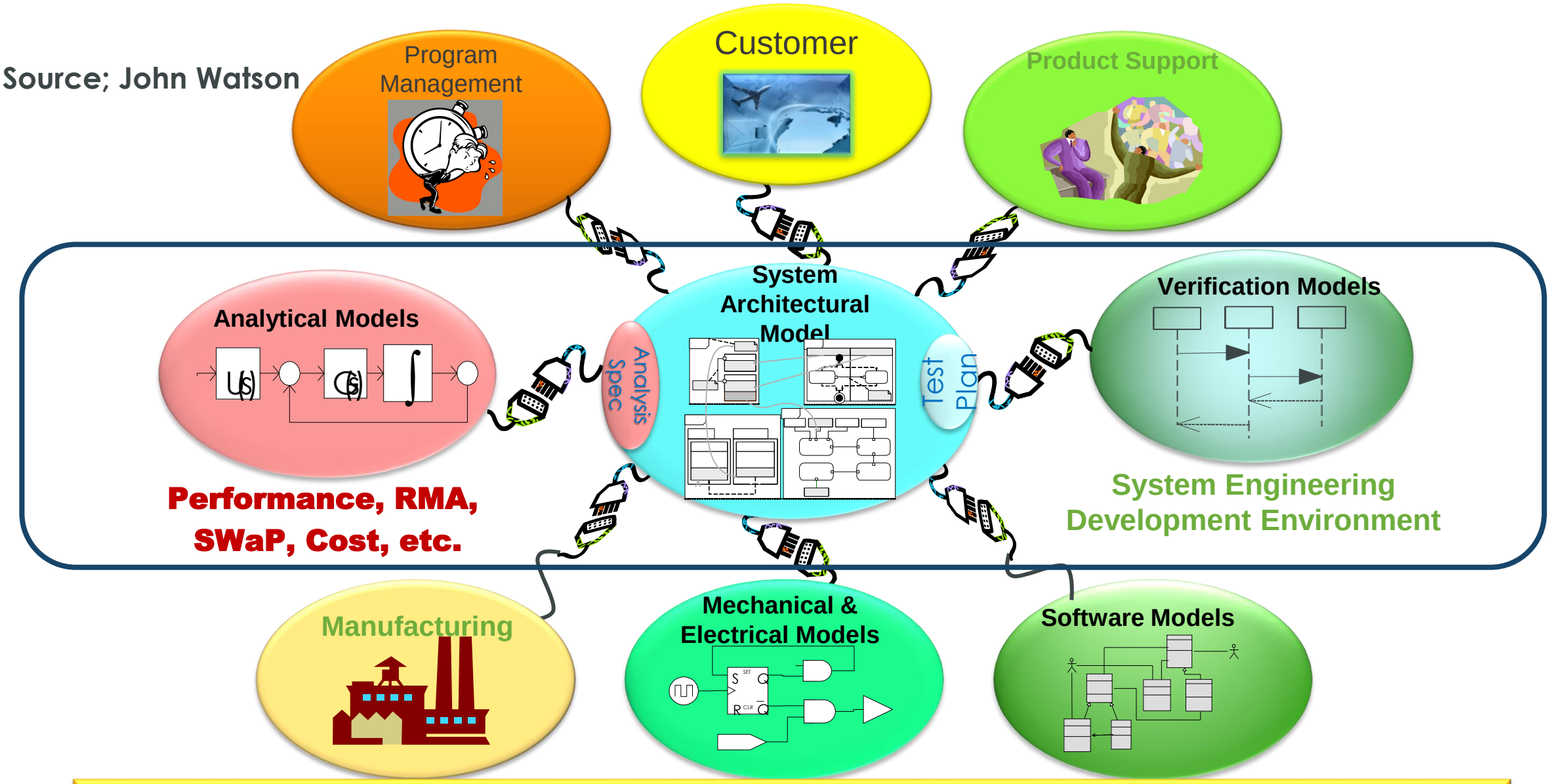
DIGITAL PRODUCT TRACEABILITY



Requirements…..'satisfied by' System Functions…..'allocated to' Logical Parts…
…'implemented by' Physical Parts…..'sending & receiving' real world data

EVOLVING MBSE USE CASES

Source; John Watson



To measure MBSE effectiveness we need to understand the context of how it is used

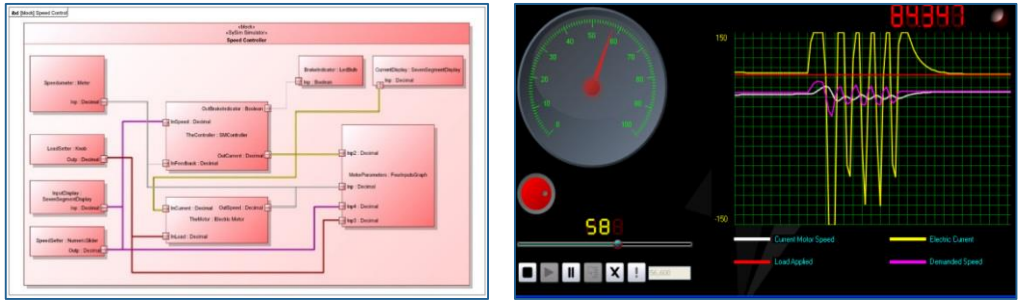
DATA DRIVEN ANALYSIS AND DESIGN

Solution Overview

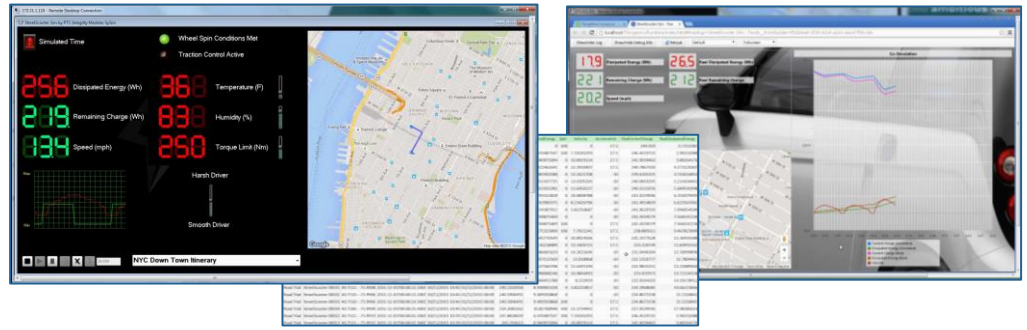
1. Early Functional Simulation with Stakeholders and ThingWorx Mashups/Apps–in-the-Loop
2. Early functional simulation of dummy Edge Devices before physical prototype, to test ThingWorx Apps
3. Re-simulation with prototype IoT product data-in-the-loop
4. Re-simulation with real IoT product data-in-the-loop

Value

1. Ensure that future products better meet the needs of customers
2. Improve quality by correcting design flaws based on actual usage & data
3. Target design efforts to reduce product and development costs



Integrity Modeler SySim
System model (design prototype) functional simulation reduces dependency on physical prototypes and finds problems earlier



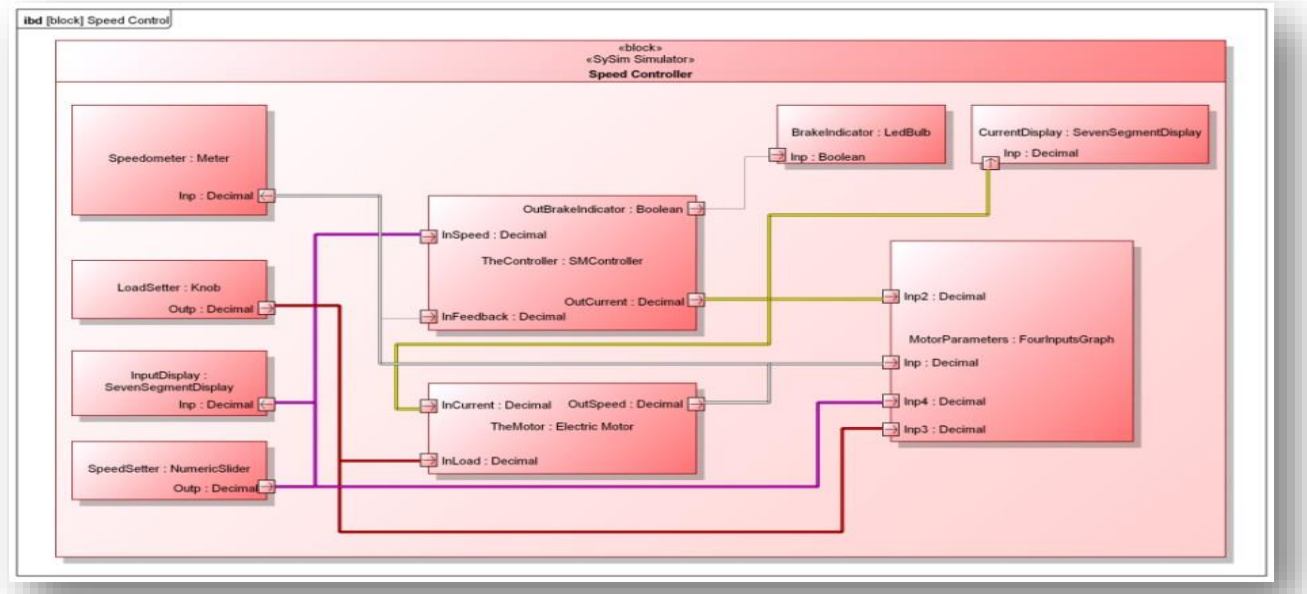
Integrity Modeler SySim & ThingWorx
System model simulation with ThingWorx apps-in-the-loop and real-world data-in-the-loop to improve models & products

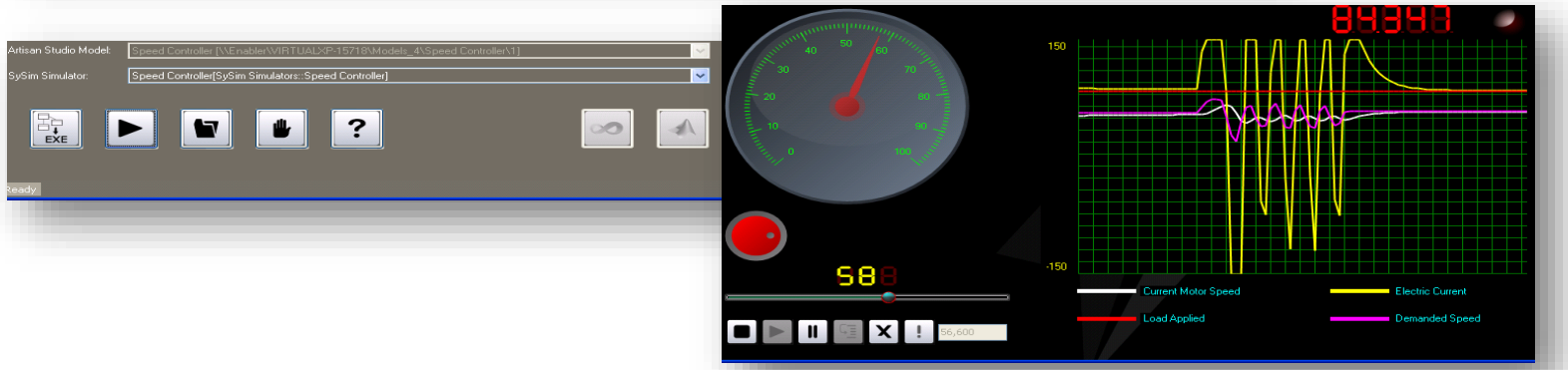
PERFORMANCE BASED ANALYSIS

VALIDATE COMPLEX BEHAVIOR EARLY

- Stakeholder in-the-loop
- Visually simulate systems model functionality
- Record simulation results for analysis
- Co-simulate with 3rd-party simulators (e.g. MATLAB Simulink™)

integrity™ modeler sysim





DATA DRIVEN DESIGN

SYSTEM SIMULATION WITH IOT DATA IN-THE-LOOP

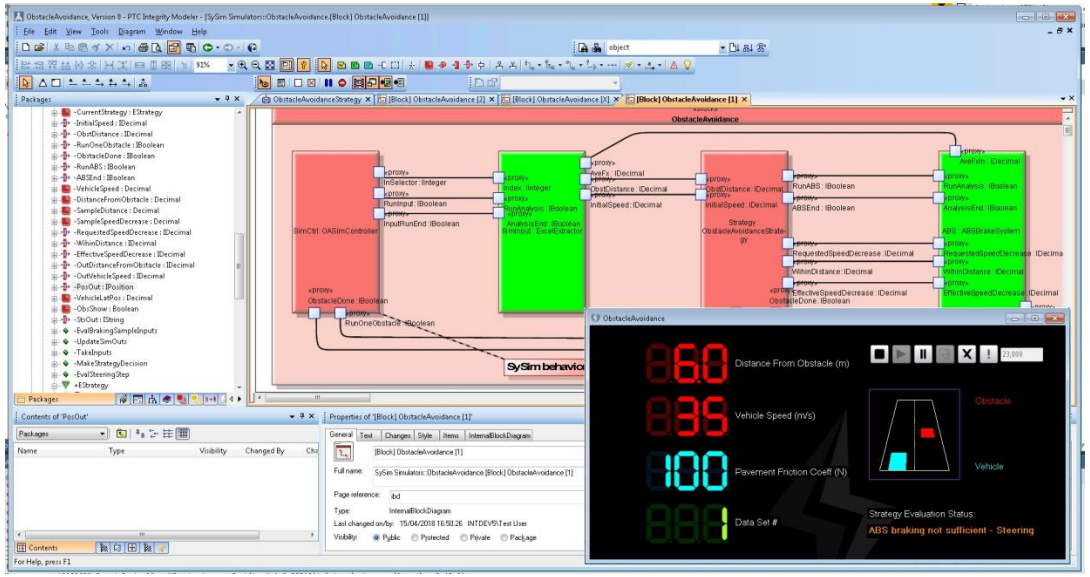
- System simulation with ThingWorx in-the-loop
- IoT data refining simulation & improving designs
- Closed-loop system level IoT modeling

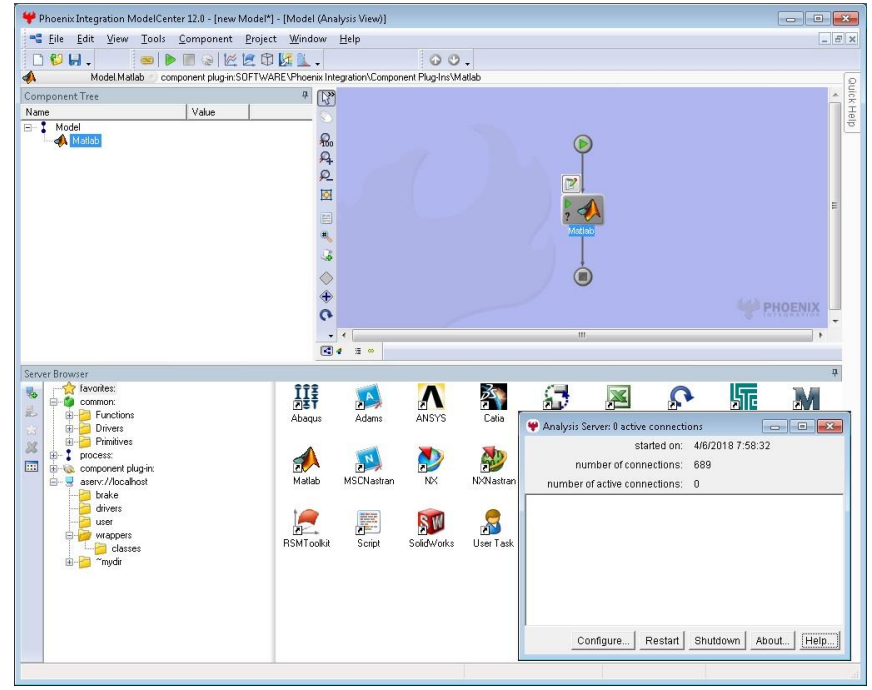
integrity™ modeler sysim

PTC and PHOENIX INTEGRATION

Integration between

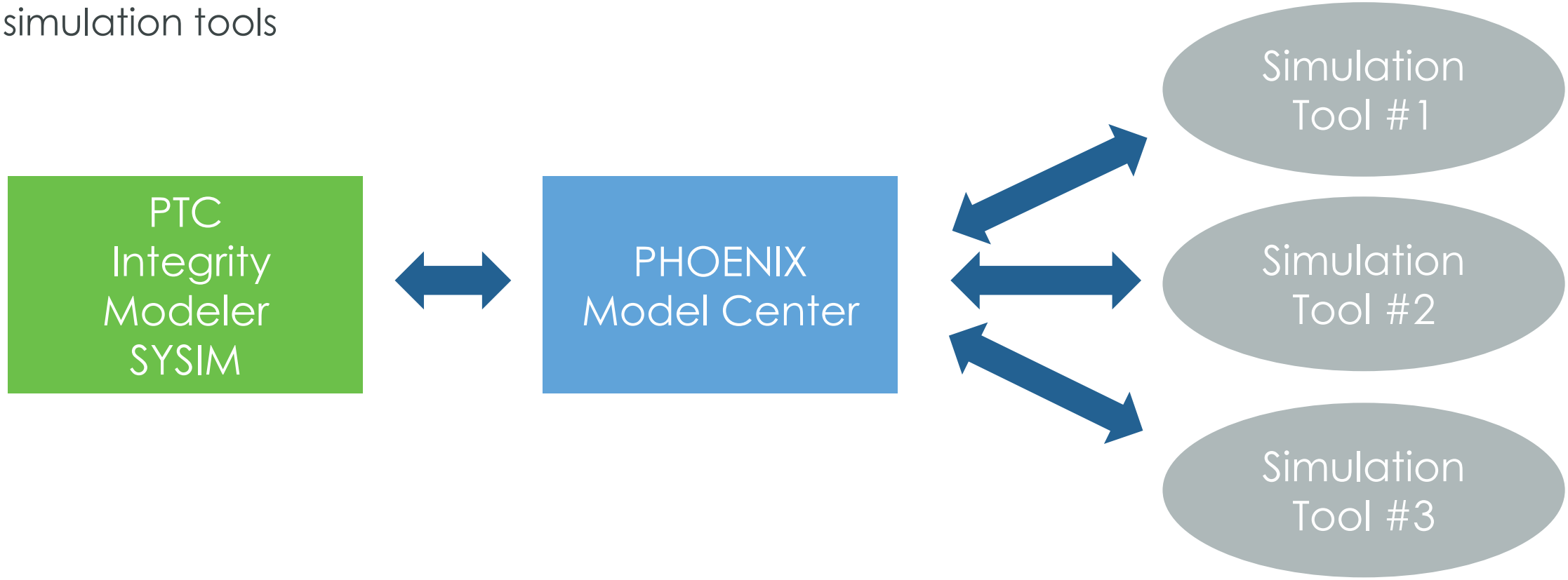
PTC INTEGRITY MODELER SYSIM and PHOENIX MODEL CENTER





PHOENIX INTEGRATION and PTC

- PTC Integrity Modeler enables modeling complex systems using MBSE and SysML
- PTC Integrity Modeler SySim enables execution of SysML models
- PHOENIX Model Center enables integrating with a plethora of simulation tools

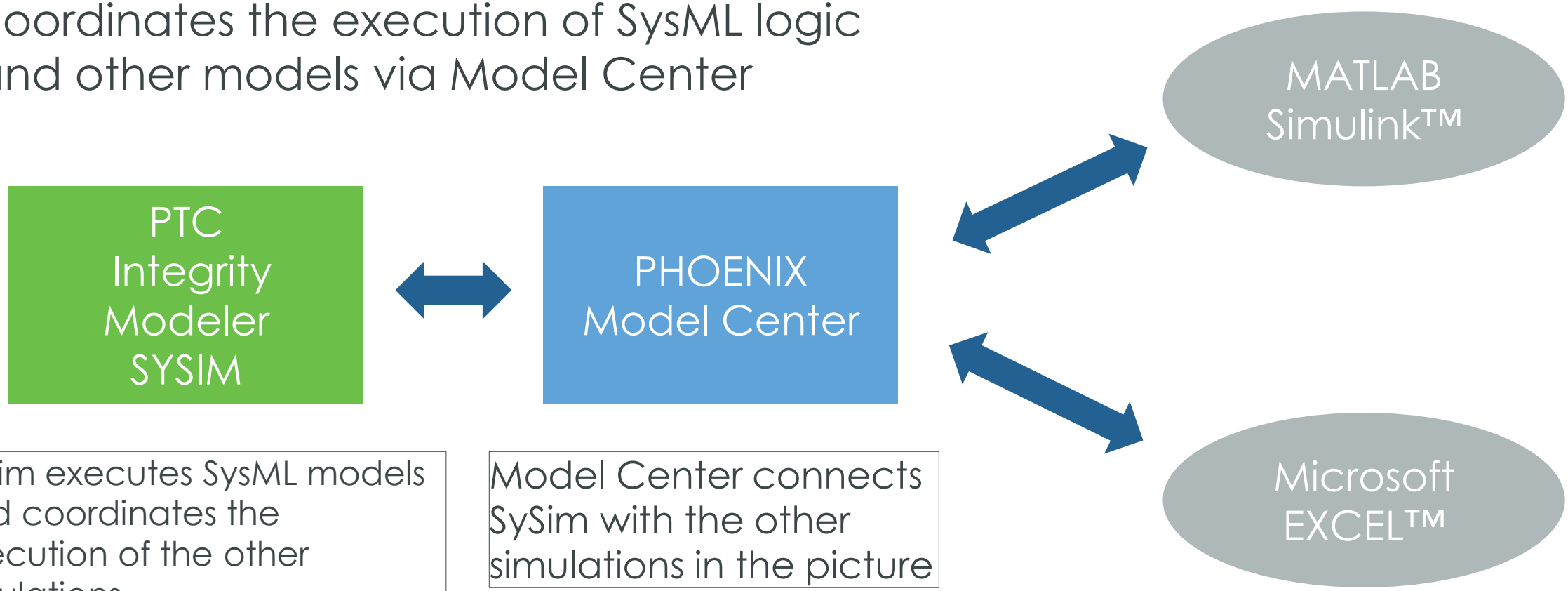


PHOENIX INTEGRATION and PTC

- Problem statement:
  - Self driving vehicle
  - Analyze the combination of braking and steering strategies to avoid an obstacle
  - Simulate the behavior under different road and vehicle conditions

PTC and PHOENIX INTEGRATION

In this example we will see how SySim coordinates the execution of SysML logic and other models via Model Center

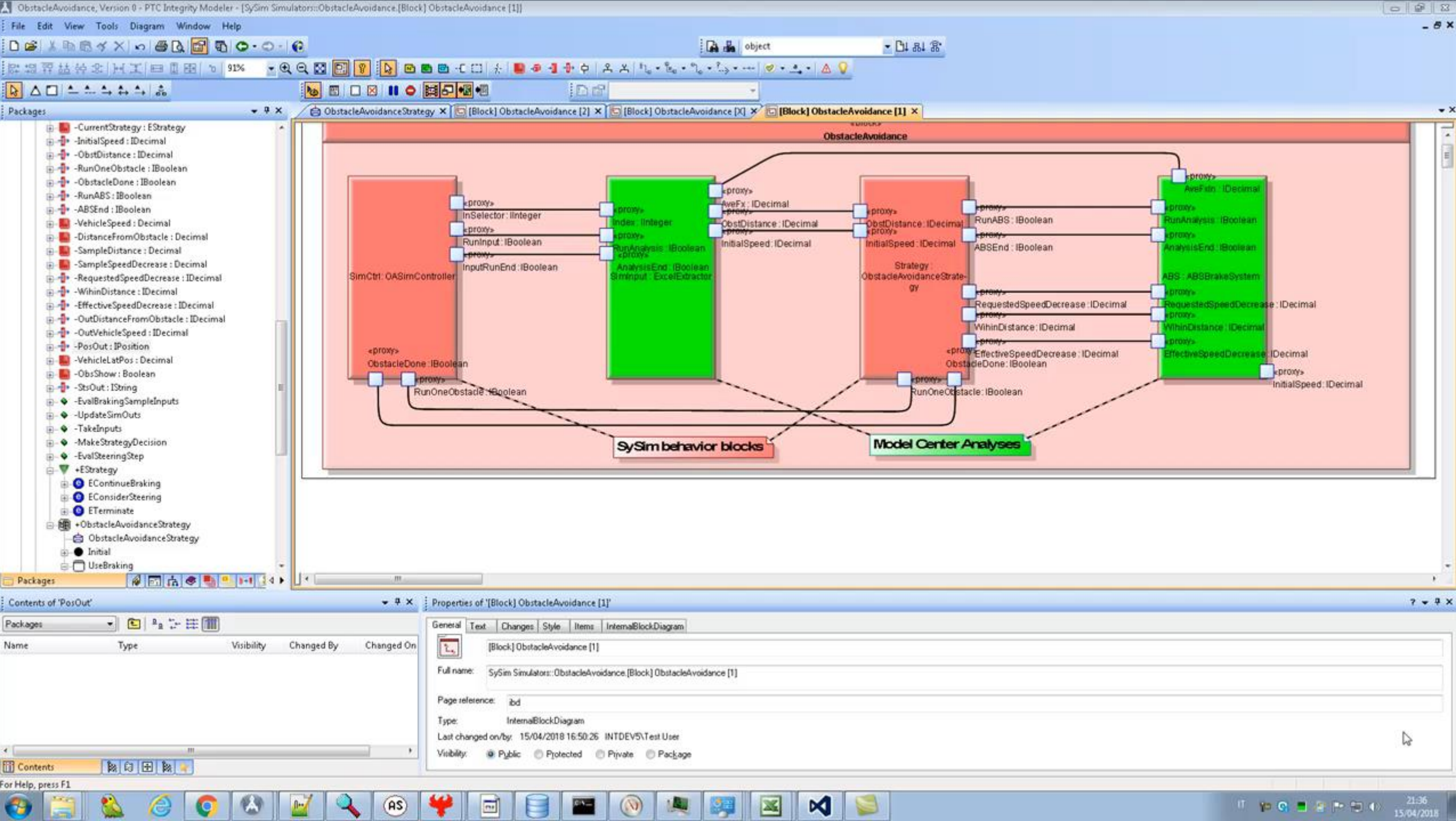


Simulink™ is used to simulate an ABS braking subsystem

SySim executes SysML models and coordinates the execution of the other simulations

Model Center connects SySim with the other simulations in the picture

Excel™ is used to store simulation datasets representing various scenarios


ObstacleAvoidance, Version 0 - PTC Integrity Modeler - [SySim Simulators::ObstacleAvoidance.[Block] ObstacleAvoidance [1]]
File Edit View Tools Diagram Window Help
Packages
-CurrentStrategy : EStrategy
-InitialSpeed : IDecimal
-ObstDistance : IDecimal
-RunOneObstacle : IBoolean
-ObstacleDone : IBoolean
-RunABS : IBoolean
-ABSEnd : IBoolean
-VehicleSpeed : Decimal
-DistanceFromObstacle : Decimal
-SampleDistance : Decimal
-SampleSpeedDecrease : Decimal
-RequestedSpeedDecrease : IDecimal
-WihinDistance : IDecimal
-EffectiveSpeedDecrease : IDecimal
-OutDistanceFromObstacle : IDecimal
-OutVehicleSpeed : IDecimal
-PosOut : IPosition
-VehicleLatPos : Decimal
-ObsShow : Boolean
-StsOut : IString
-EvalBrakingSampleInputs
-UpdateSimOuts
-TakeInputs
-MakeStrategyDecision
-EvalSteeringStep
+EStrategy
EContinueBraking
EConsiderSteering
ETerminate
+ObstacleAvoidanceStrategy
ObstacleAvoidanceStrategy
Initial
UseBraking
ObstacleAvoidanceStrategy
[Block] ObstacleAvoidance [2]
[Block] ObstacleAvoidance [X]
[Block] ObstacleAvoidance [1]
ObstacleAvoidance
SimCtrl: OASimController
«proxy» InSelector : IInteger
«proxy» RunInput : IBoolean
«proxy» InputRunEnd : IBoolean
«proxy» ObstacleDone : IBoolean
«proxy» RunOneObstacle : IBoolean
«proxy» Index : IInteger
«proxy» RunAnalysis : IBoolean
«proxy» AnalysisEnd : IBoolean
SimInput : ExcelExtractor
«proxy» AveFx : IDecimal
«proxy» ObstDistance : IDecimal
«proxy» InitialSpeed : IDecimal
«proxy» ObstDistance : IDecimal
«proxy» InitialSpeed : IDecimal
Strategy : ObstacleAvoidanceStrategy
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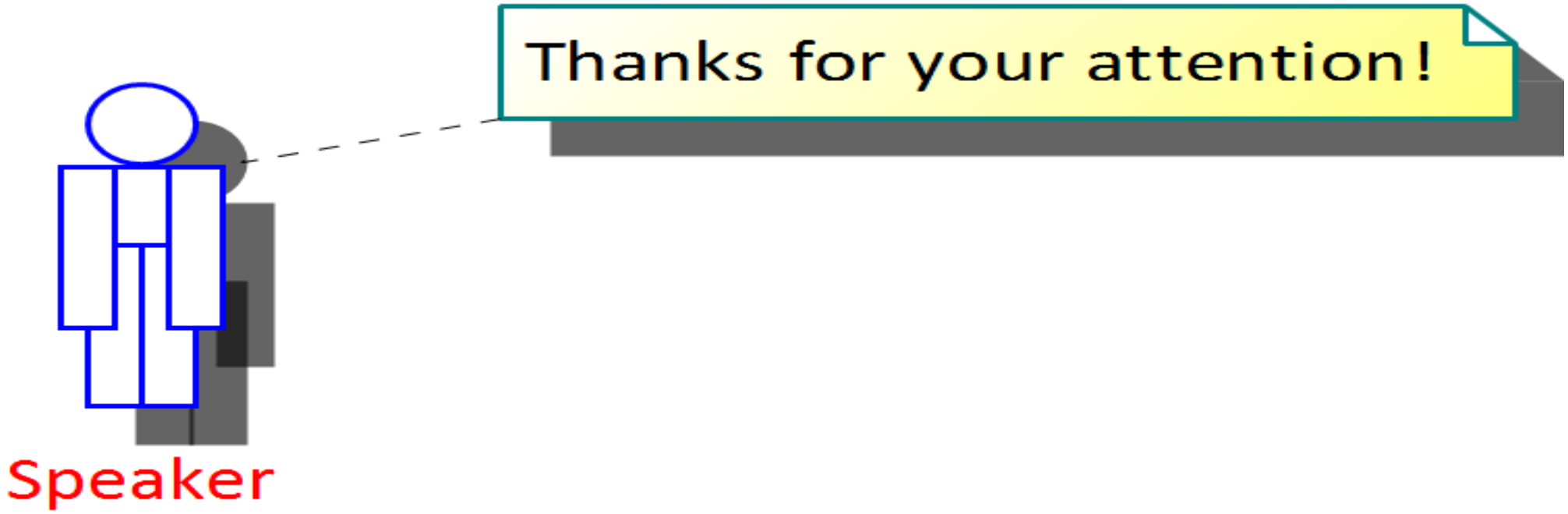
«proxy» ABSEnd : IBoolean
«proxy» RequestedSpeedDecrease : IDecimal
«proxy» WihinDistance : IDecimal
«proxy» EffectiveSpeedDecrease : IDecimal
«proxy» ObstacleDone : IBoolean
«proxy» RunOneObstacle : IBoolean
«proxy» AveFstn : IDecimal
«proxy» RunAnalysis : IBoolean
«proxy» AnalysisEnd : IBoolean
ABS : ABSBrakeSystem
«proxy» RequestedSpeedDecrease : IDecimal
«proxy» WihinDistance : IDecimal
«proxy» EffectiveSpeedDecrease : IDecimal
«proxy» InitialSpeed : IDecimal
SySim behavior blocks
Model Center Analyses
Contents of 'PosOut'
Packages
Name Type Visibility Changed By Changed On
Contents
Properties of '[Block] ObstacleAvoidance [1]'
General Text Changes Style Items InternalBlockDiagram
[Block] ObstacleAvoidance [1]
Full name: SySim Simulators::ObstacleAvoidance.[Block] ObstacleAvoidance [1]
Page reference: ibd
Type: InternalBlockDiagram
Last changed on/by: 15/04/2018 16:50:26 INTDEV5\Test User
Visibility: Public Protected Private Package
For Help, press F1

Summary

- Seamlessly integrate MBSE / SysML with a large base of COTS simulation tools
  - Combining PTC Integrity Modeler and Phoenix Integration Model Center
  - Includes support for external custom simulation executables
  - Select the best environment for each simulation need
  - Behavior can be specified via SysML, via external simulation tools, or any combination of both
- PTC Integrity Modeler SySim effectively coordinates the external simulations via Model Center
  - Each simulation of an external tool is represented by a SysML block
  - Block Ports are automatically connected with Model Center variables
  - Zero coding – SySim natively interfaces with Model Center Analysis Server APIs

QUESTIONS AND ANSWERS



THE DIGITAL ENGINEERING JOURNEY

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