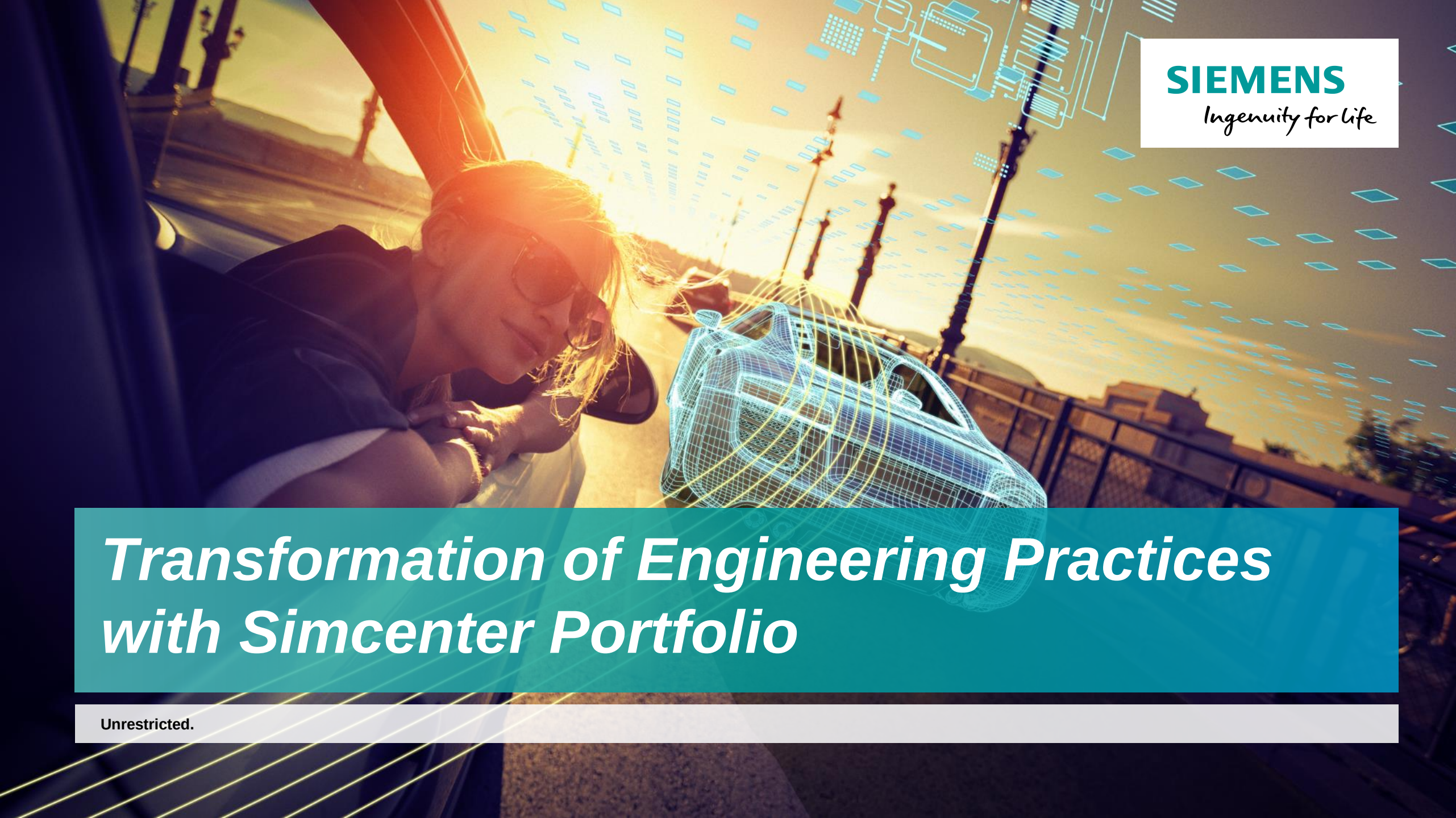

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Transformation of Engineering Practices with Simcenter Portfolio

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Siemens PLM Software

Digital Innovation Platform to Realize the Digital Twin

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PRODUCT DESIGN

MDA - EDA

SOFTWARE DESIGN EMBEDDED - IPS

Simcenter™
SIMULATION AND TEST

CLOUD - IOT

MANUFACTURING EXECUTION

FACTORY AUTOMATION

MANUFACTURING ENGINEERING

COLLABORATION

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Siemens PLM Software

Creating the most holistic Digital Twin available on the market

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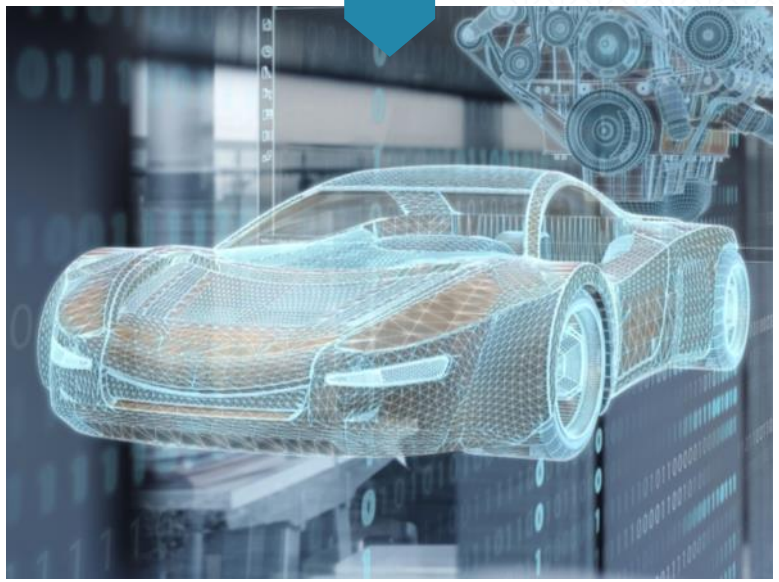
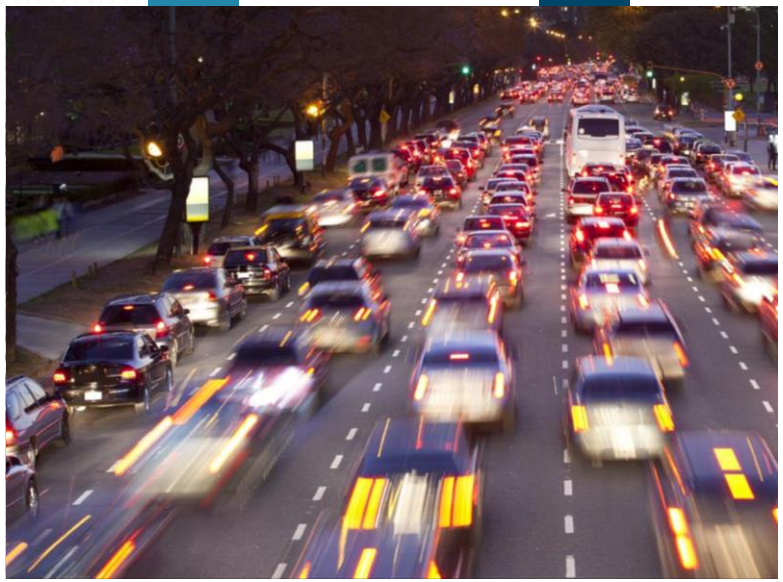
feed back insights to continuously optimize product and production





Digital Twin of the product

Digital Twin of the production

Digital Twin of the usage

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Innovation in Engineering Process and Solutions
Simcenter Portfolio

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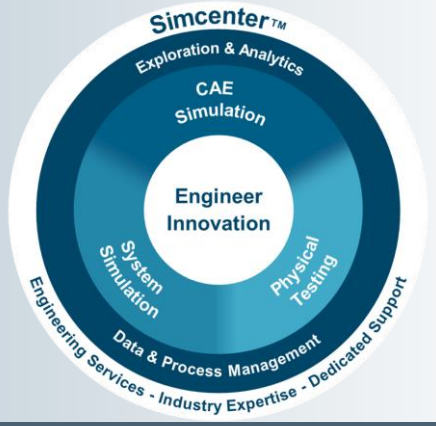
Systems-Driven Product Development

System Mockup

Simcenter

1D

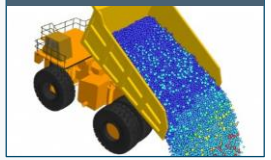
3D



Exploration - Analytics - Reporting

TEST

CFD



Managed in PLM Context - Multi-Domain Traceability, Change and Configuration

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World Class Applications

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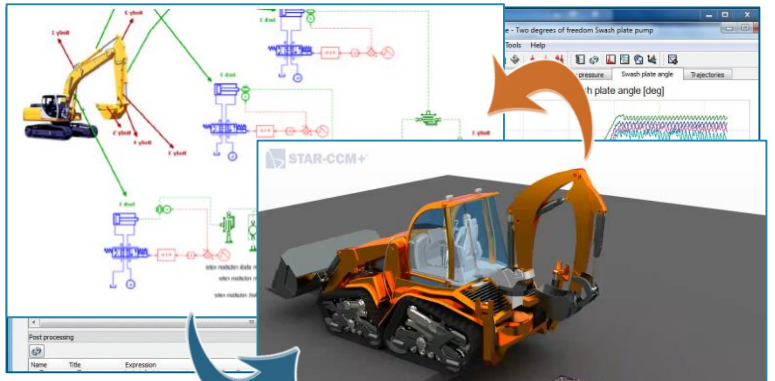
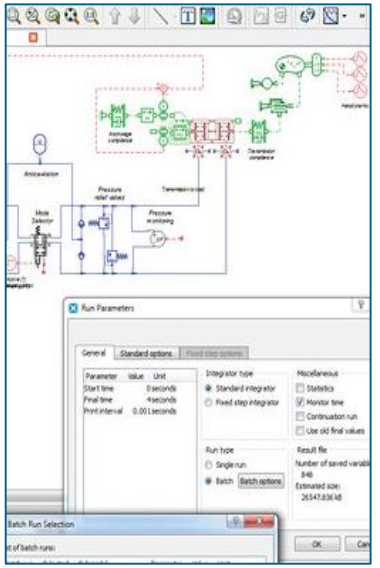
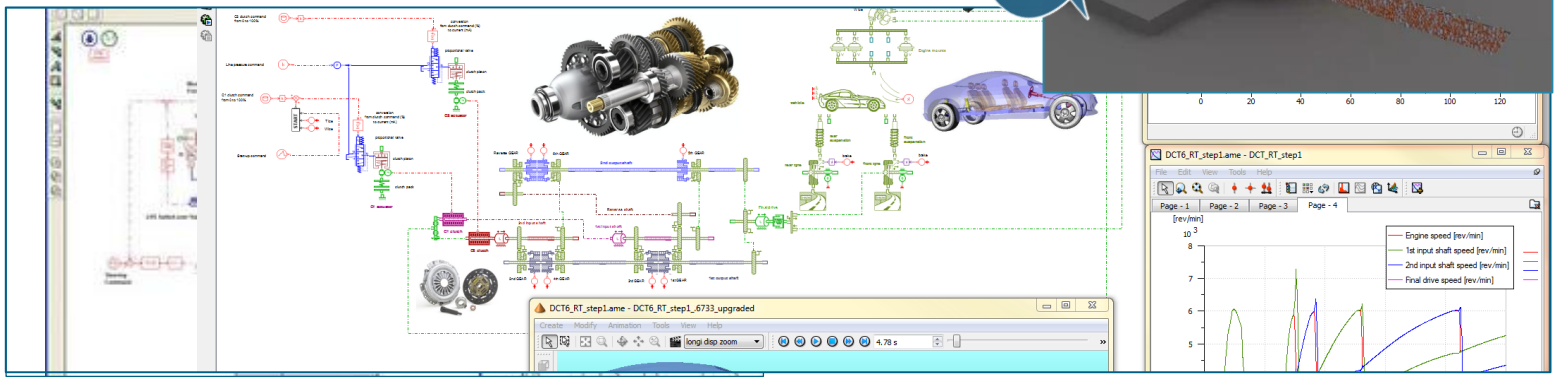
1D Simulation Controls

LMS Imagine.Lab Amesim







LMS Imagine.Lab System Synthesis

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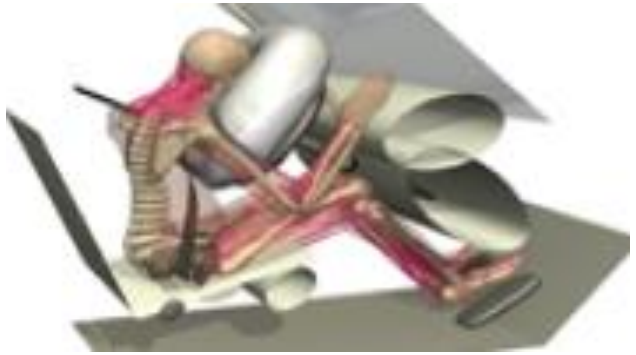
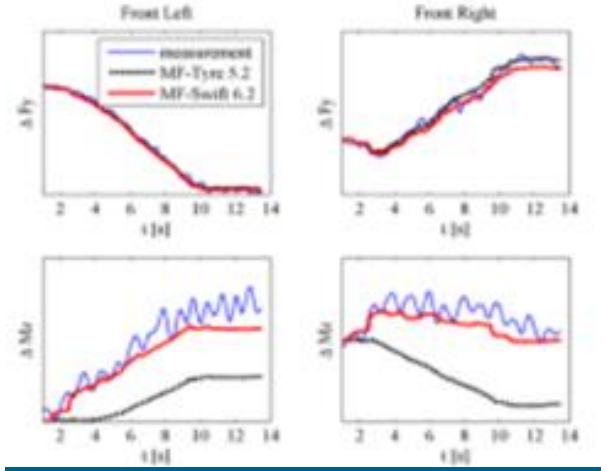
TASS Internaional



Madymo

PreScan



Delft-Tyre

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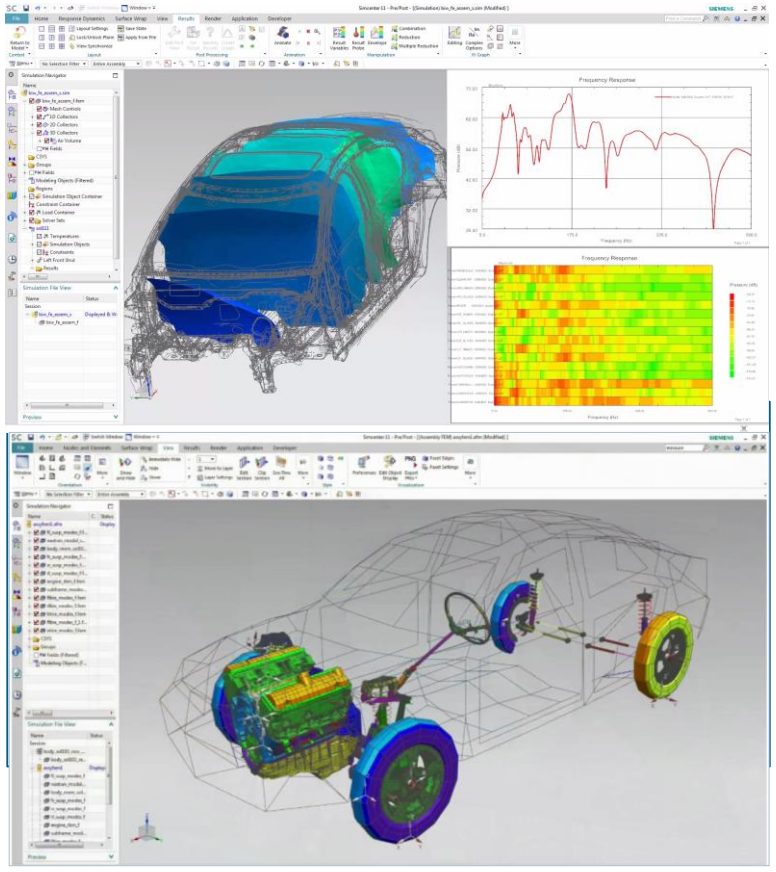
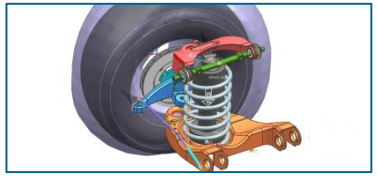
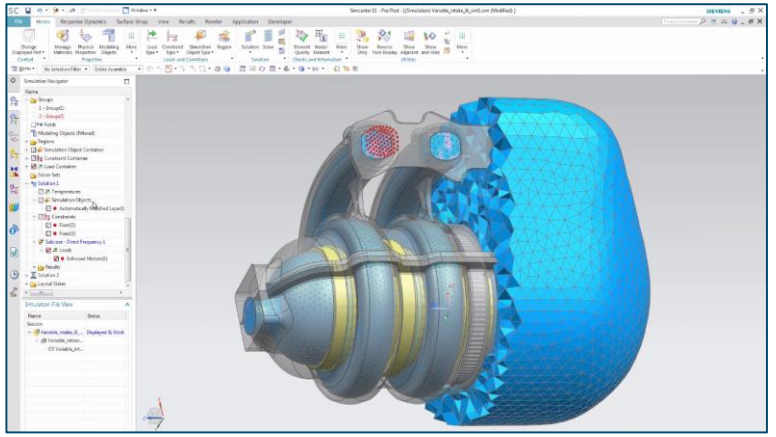
3D Simulation

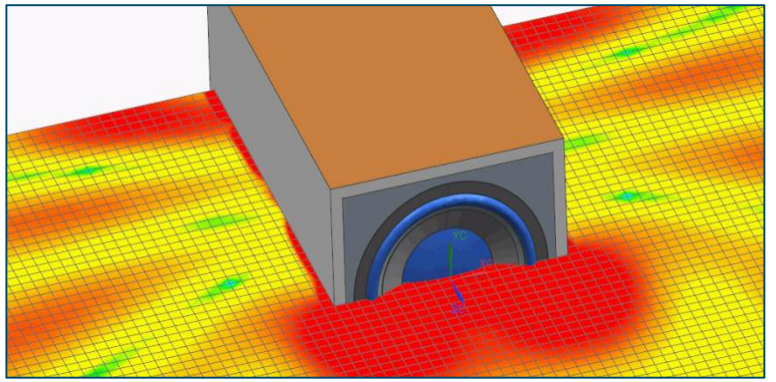


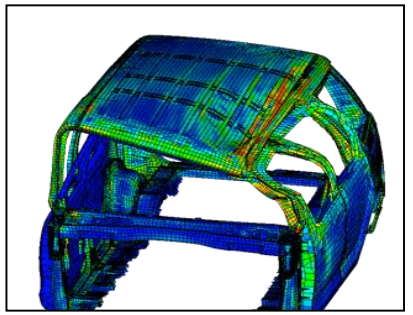
Simcenter 3D

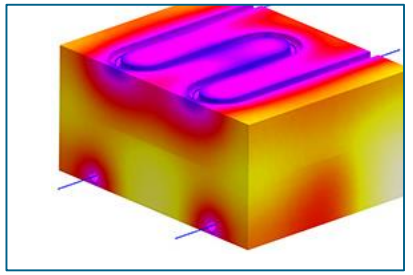
NX Nastran
Multi Physics

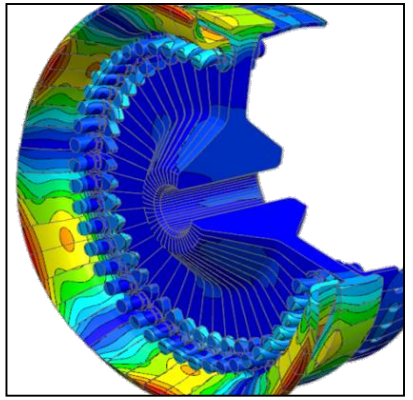












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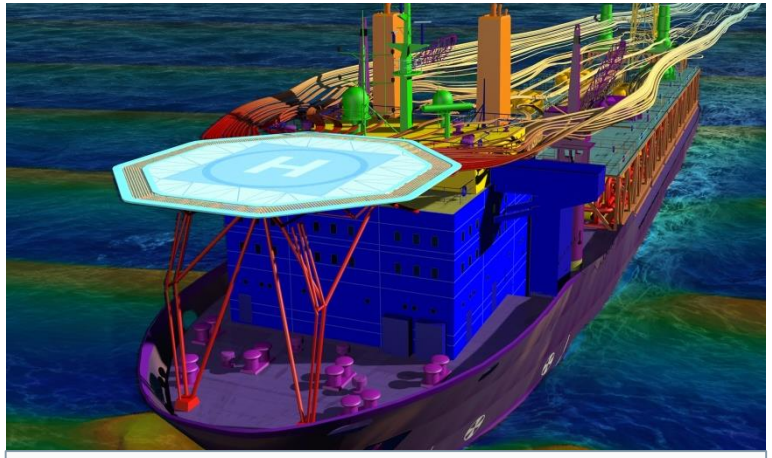
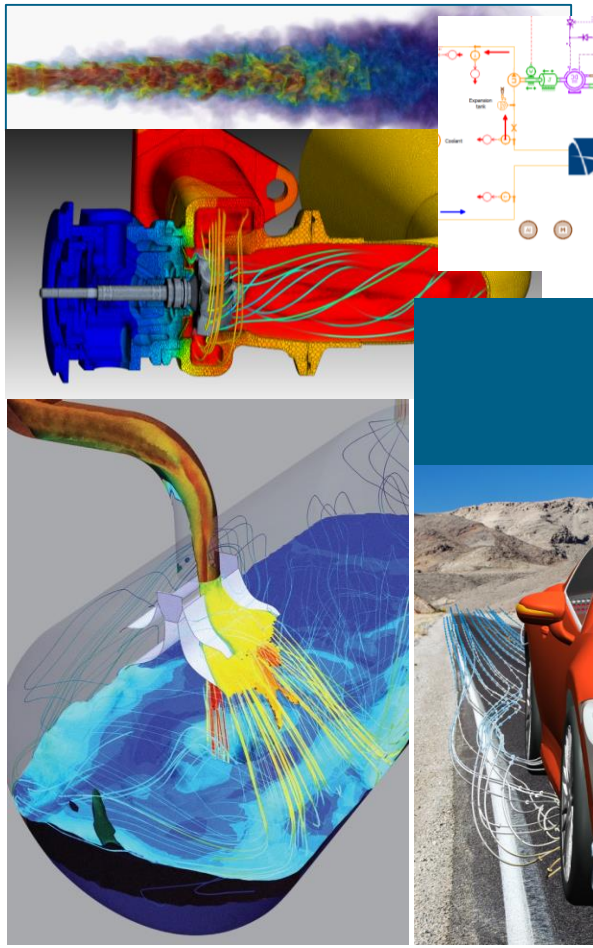
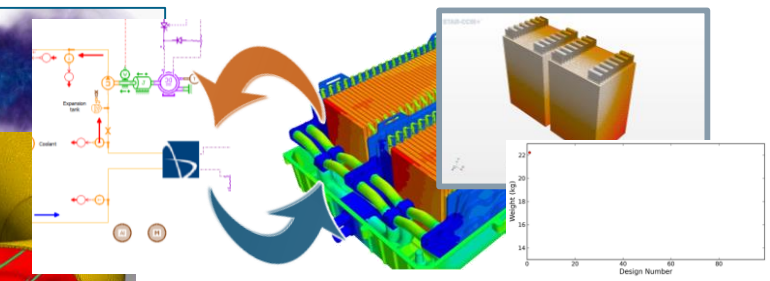
CFD Simulation







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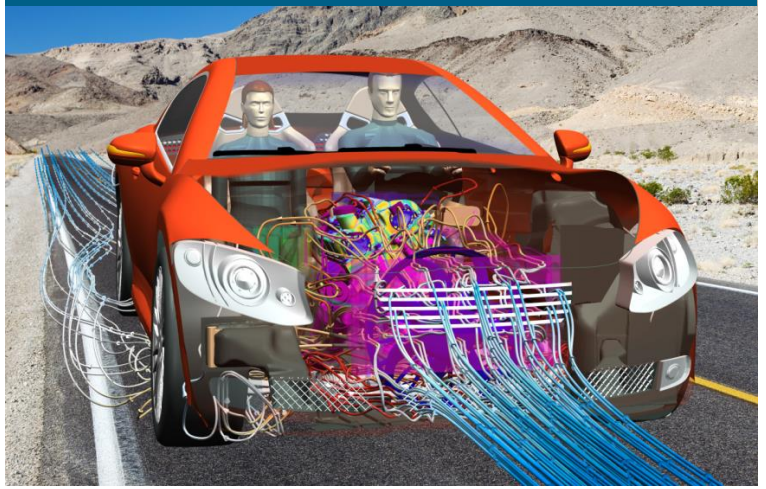

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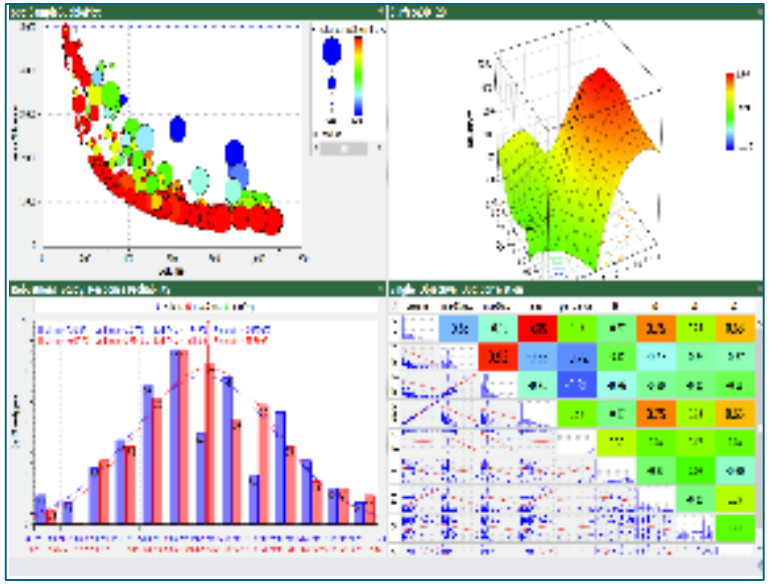
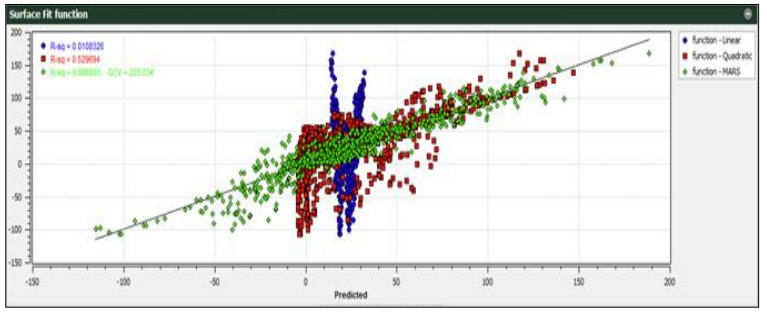
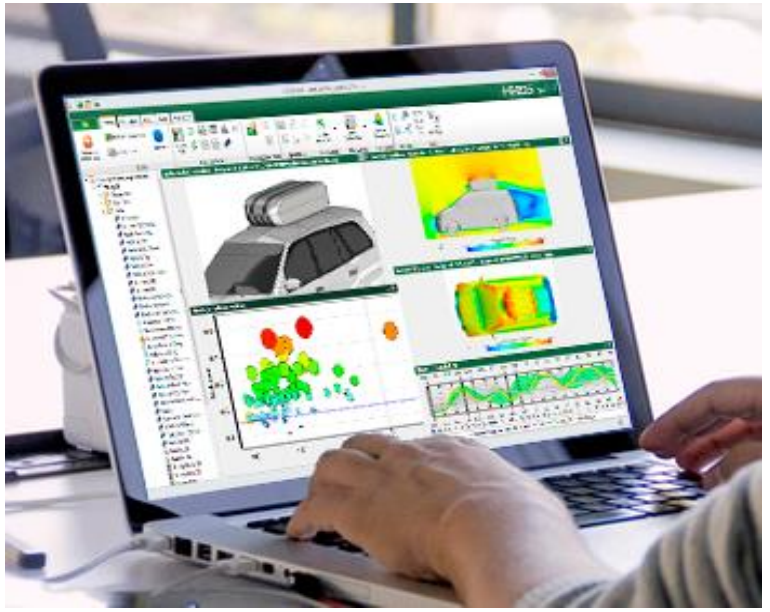
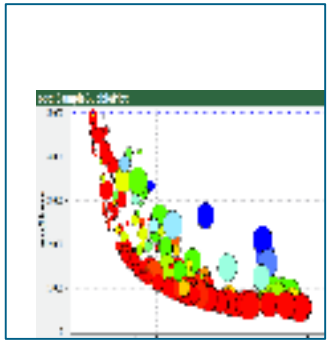
Design Exploration

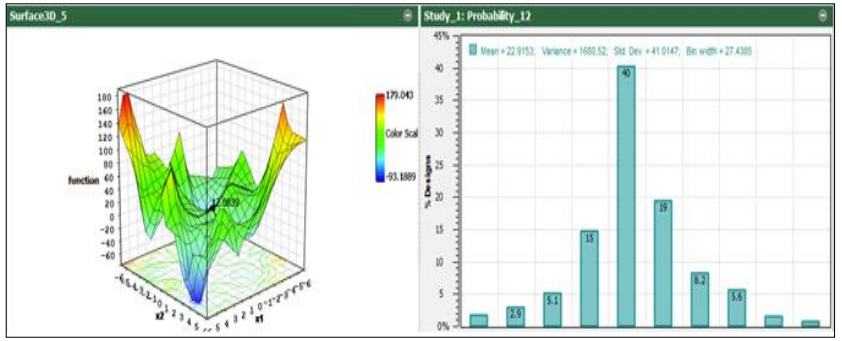


HEEDS









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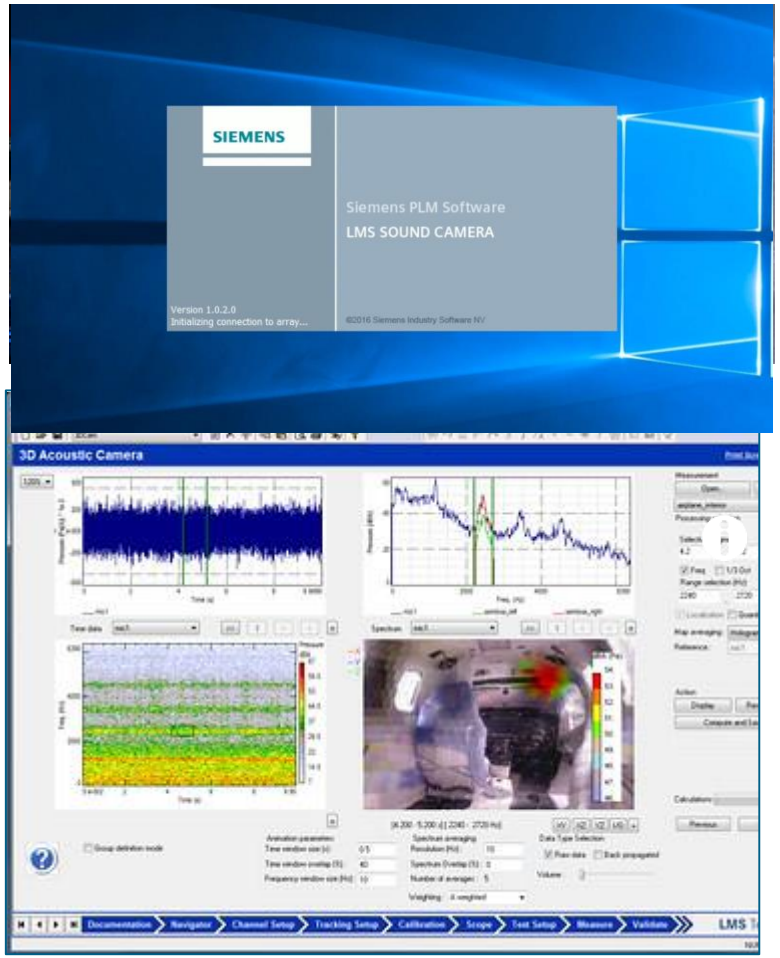
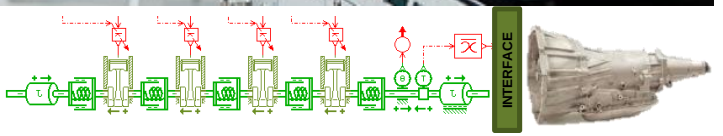
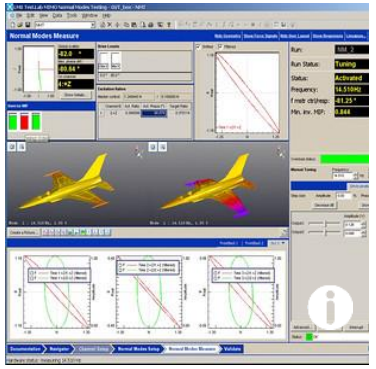
Testing Solutions

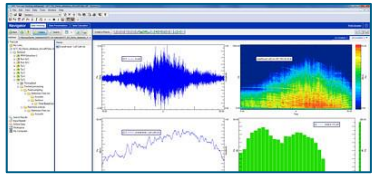


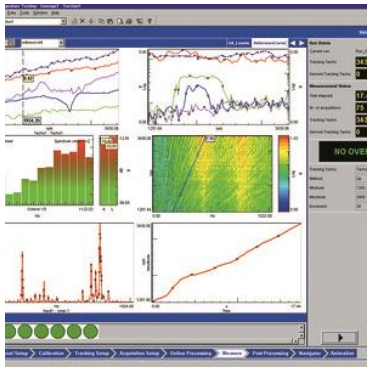
LMS Test.Lab





LMS SCADAS





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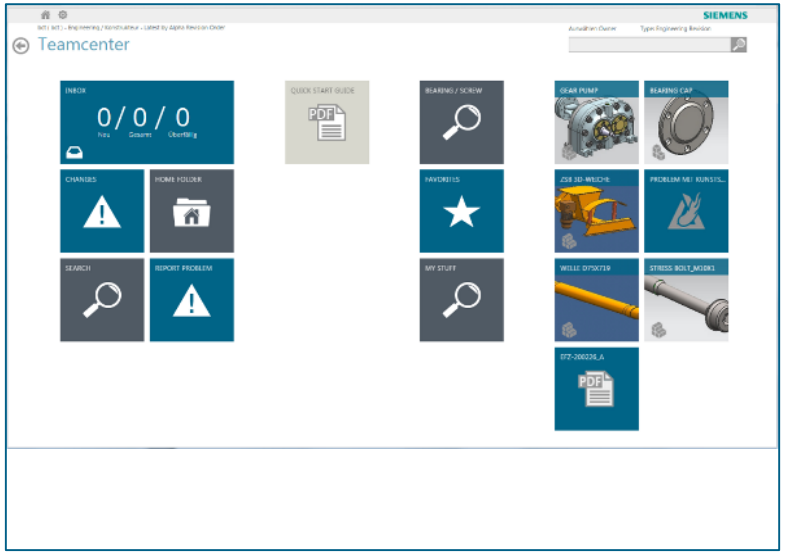
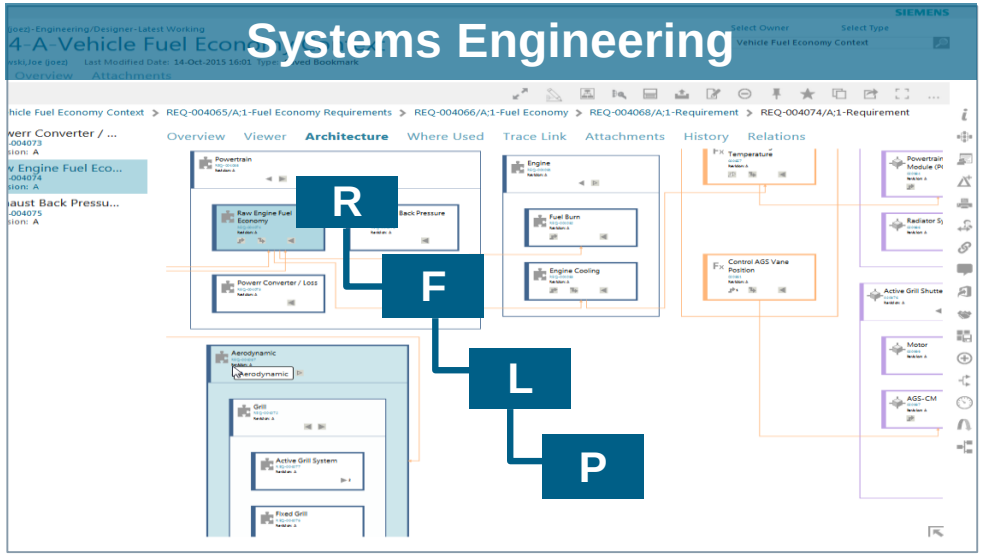
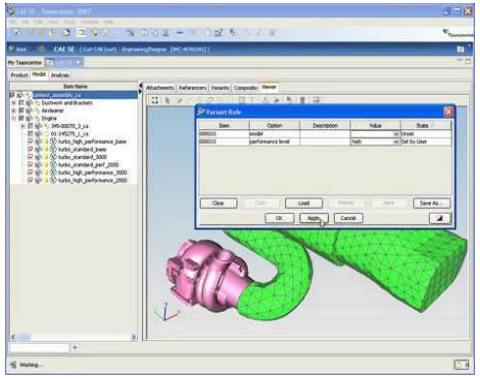
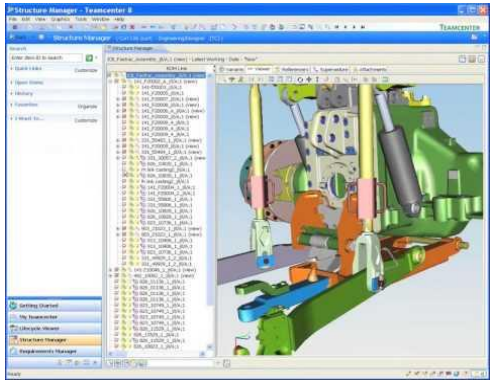
Model & Data Management



Systems Engineering







Teamcenter

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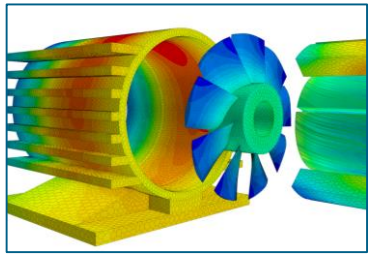
Engineering Services



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Simcenter Solutions
Responding to New Challenges

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Simcenter Solutions
Responding to New Challenges

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Next Generation Design

Re-imagining design for greater business value

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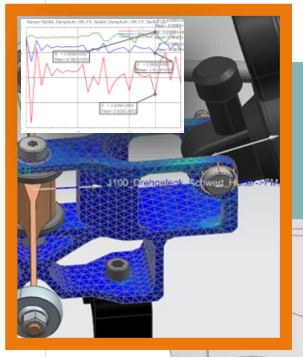
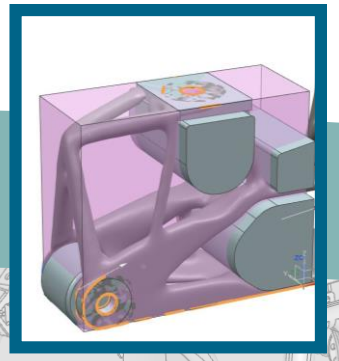
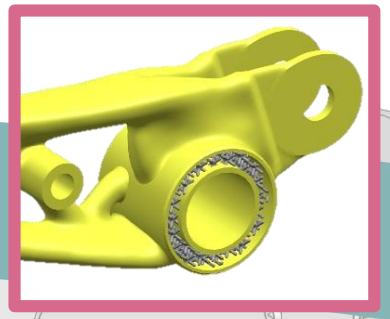
Requirements



Generative Design

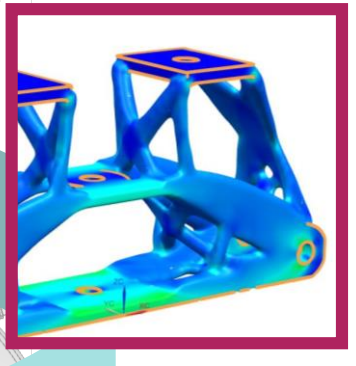


Light weighting

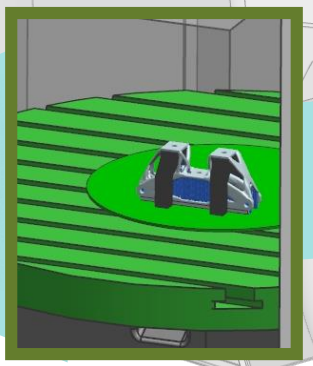


Modeling

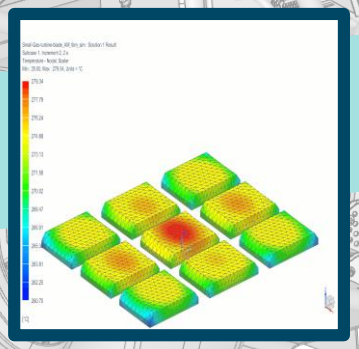
Performance Validation



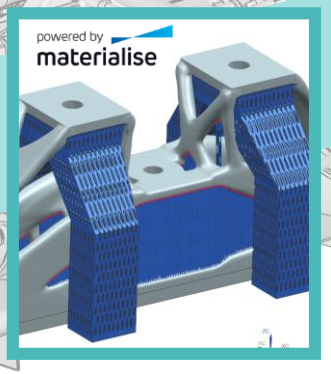
Final Part



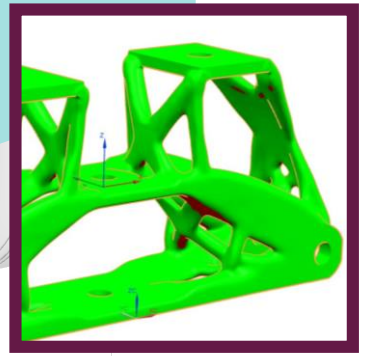
Part Finishing & Quality



Process Simulation



Pre-Processing & 3D Printing



Manufacturing Validation

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Generative Design

Smart, automated design exploration and optimization

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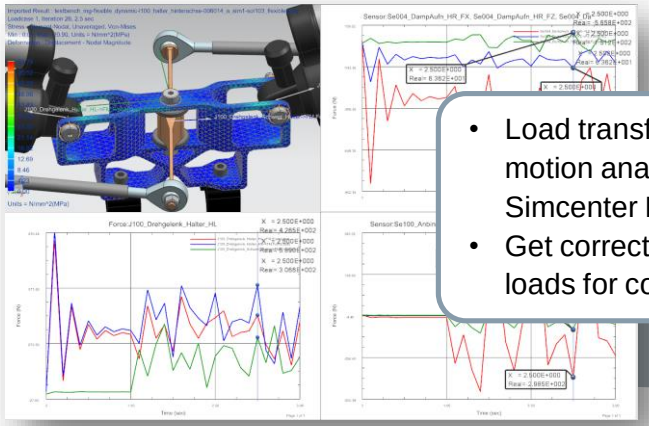
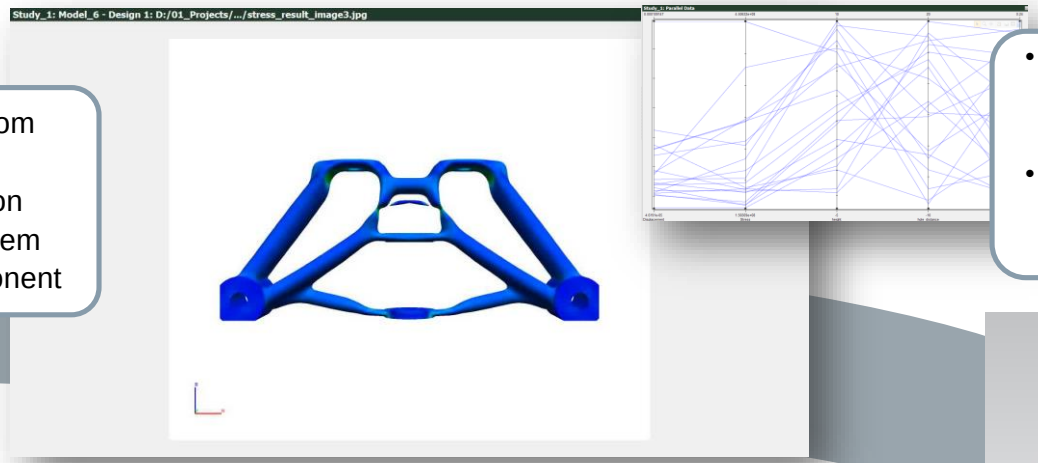
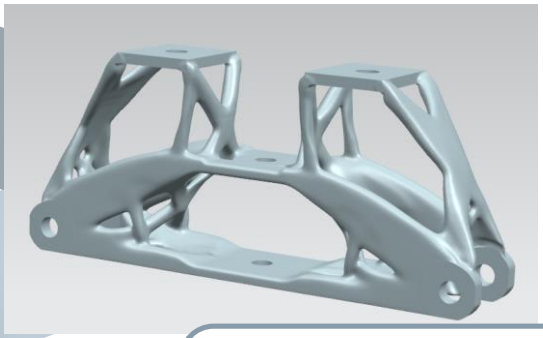


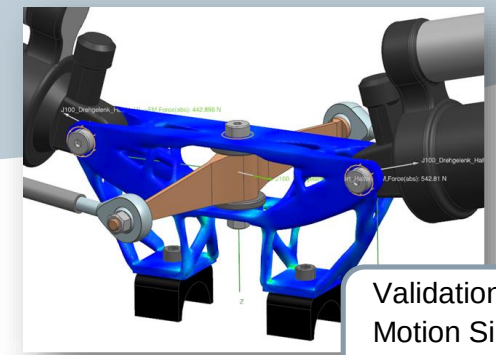
- Load transfer from motion analysis Simcenter Motion
- Get correct system loads for component



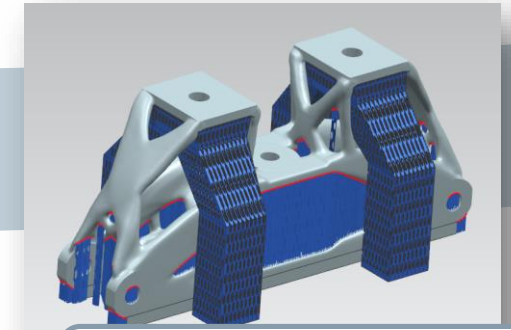
- Generative Design to find minimum weight design and mounting positions.
- Coupling Simcenter HEEDS and Topology Optimization



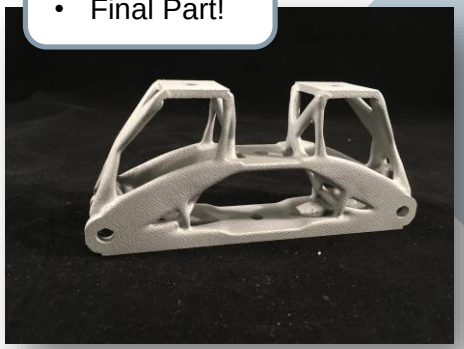
- Generate geometry using NX Realize Shape subdivision modeling and Convergent Modeling™



Validation in Simcenter Motion Simulation - Flexible Body



- Generate Supports and prepare Additive Manufacturing process



- Final Part!

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Hackrod and Siemens Partner to Enable Unprecedented Automotive Design and Production

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Hackrod Siemens PLM Software partnership will accelerate engineering design and manufacturing within the automotive space

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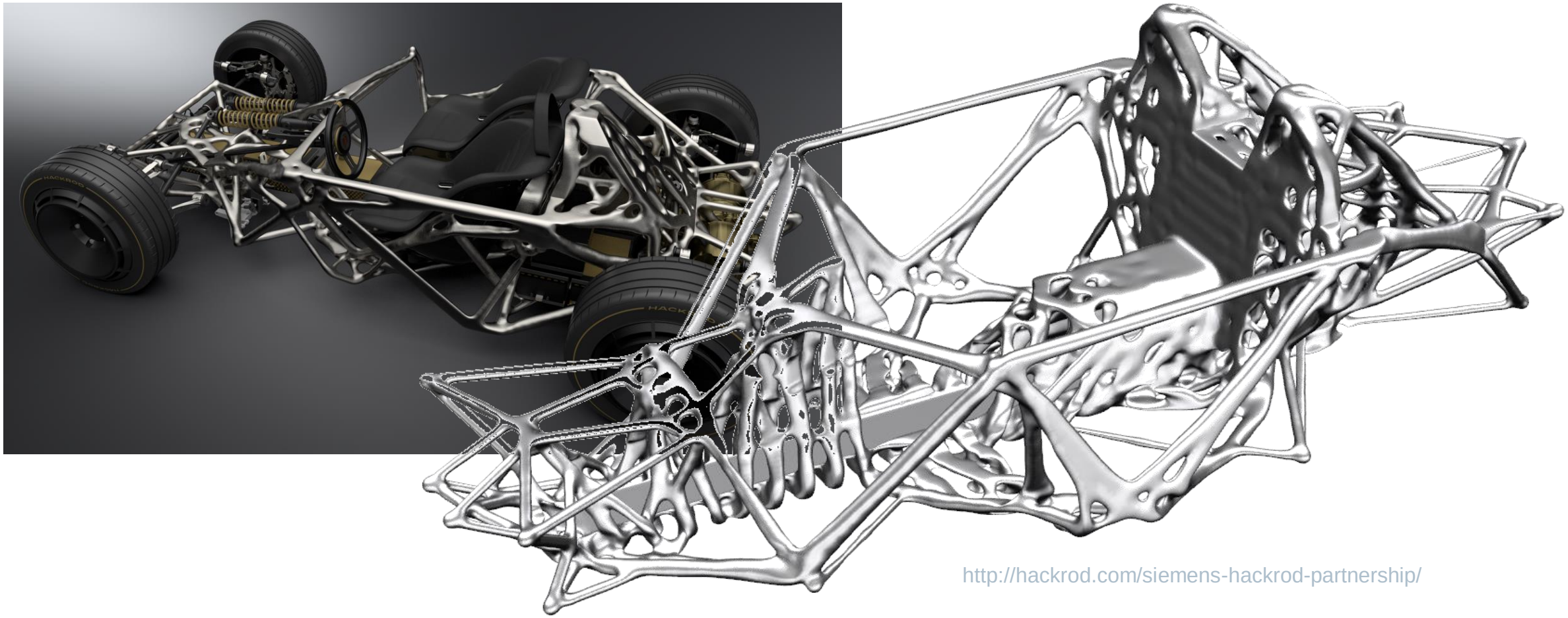
Hackrod, Inc.
Mar 21, 2018, 15:35 ET



http://hackrod.com/siemens-hackrod-partnership/

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Simcenter Solutions
Responding to New Challenges

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Autonomous Vehicles

Dealing with multi-layered system interactions

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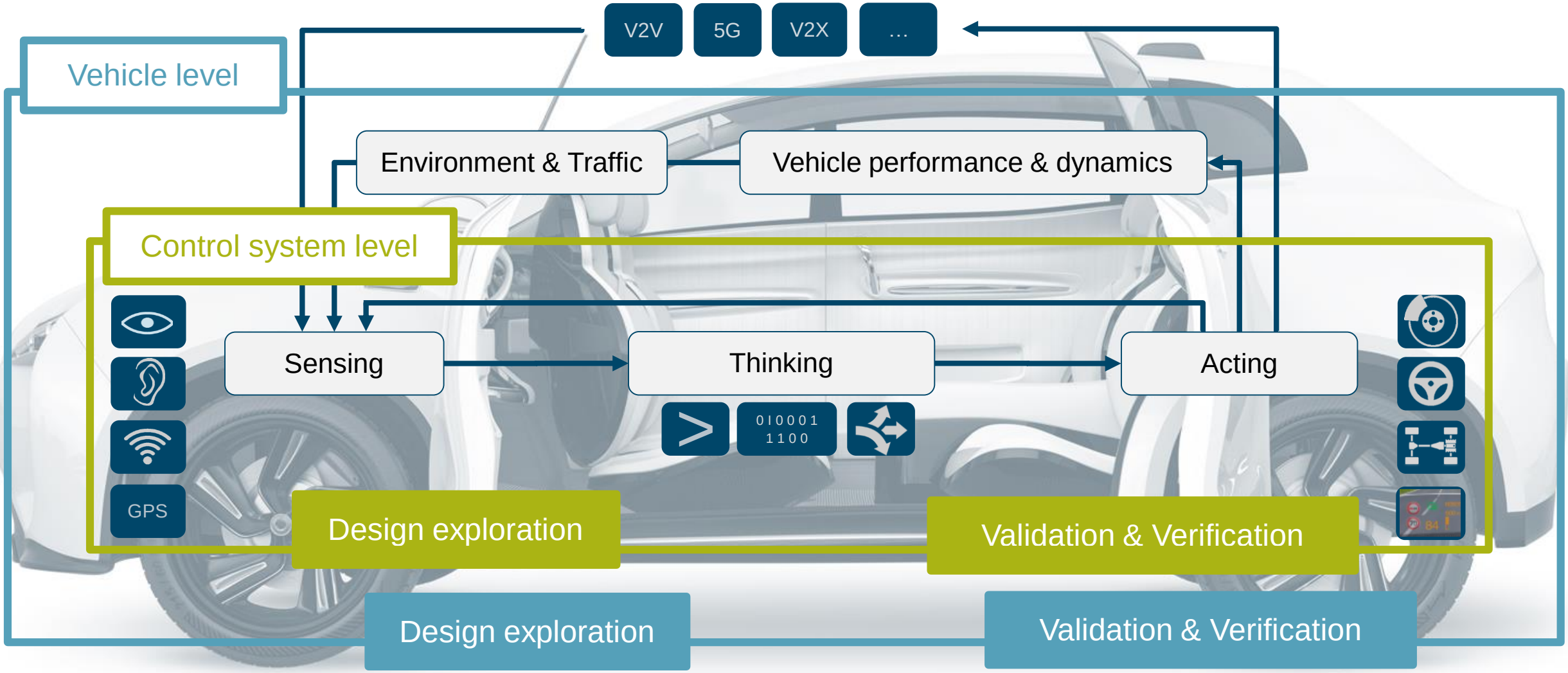

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Addressing engineering challenges for autonomous driving

FROM ADAS TO AUTONOMOUS DRIVING…

“+25% CAGR (through 2030) for Sensors”

Roland Berger , on “Autonomous Driving”, 2014

“14.2 billion miles of testing is needed”

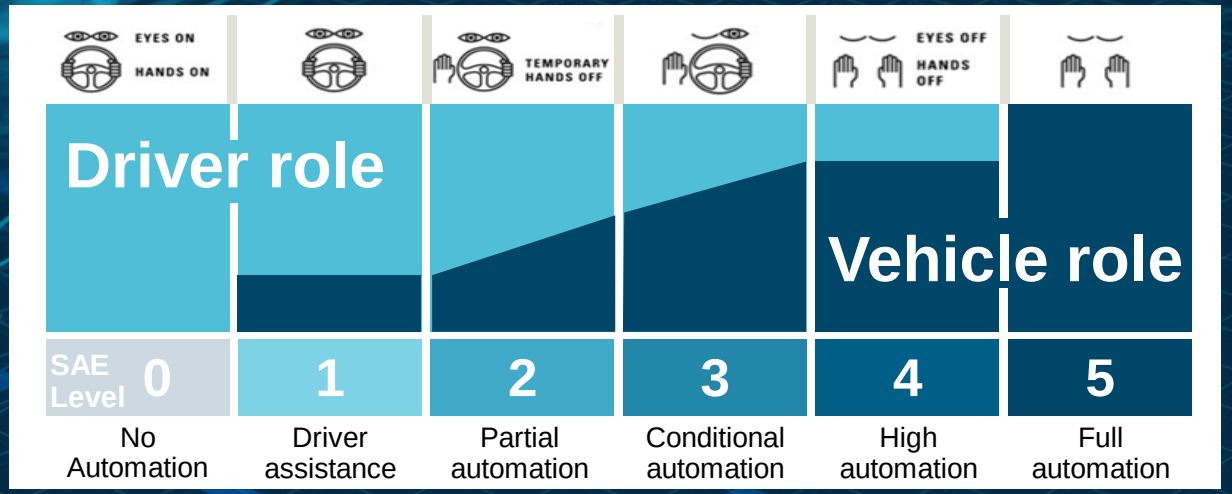
Akio Toyoda, CEO of Toyota
Paris Auto Show 2016

“Design validation will be a major – if not the largest – cost component”

Roland Berger
“Autonomous Driving” 2014

“While hardware innovations will deliver - software will remain a critical bottleneck”

McKinsey
“When will the robots hit the road?”



Simcenter - Sensor Models
Camera, Radar, LIDAR, Ultrasound, Infrared, V2X, GPS

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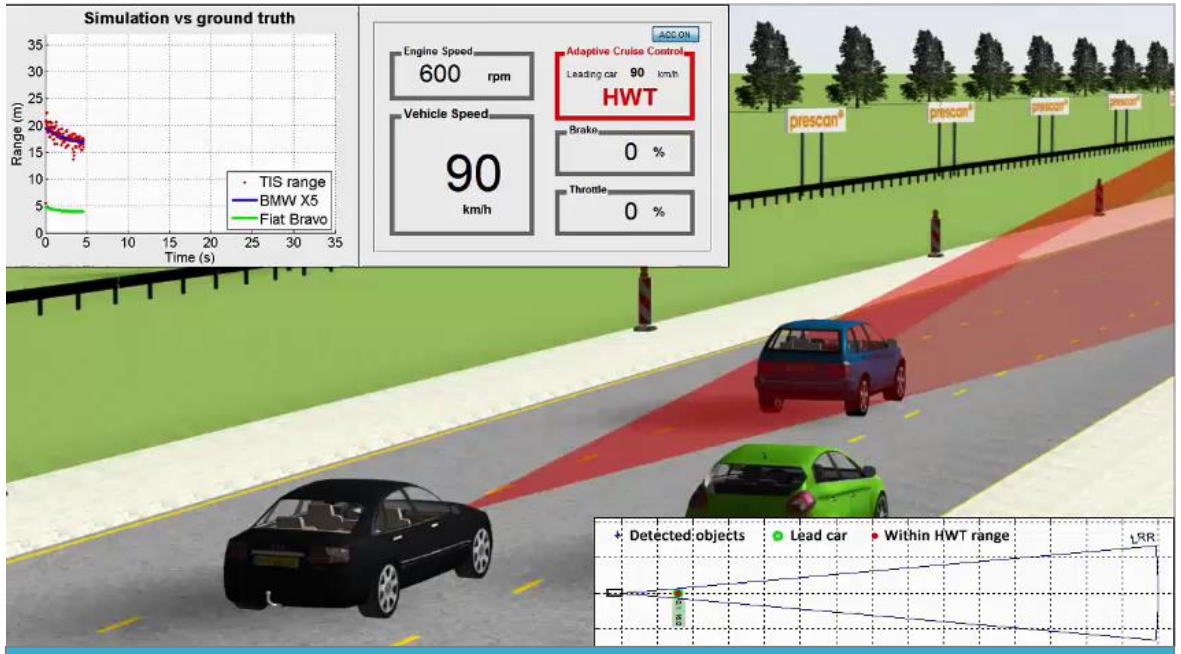
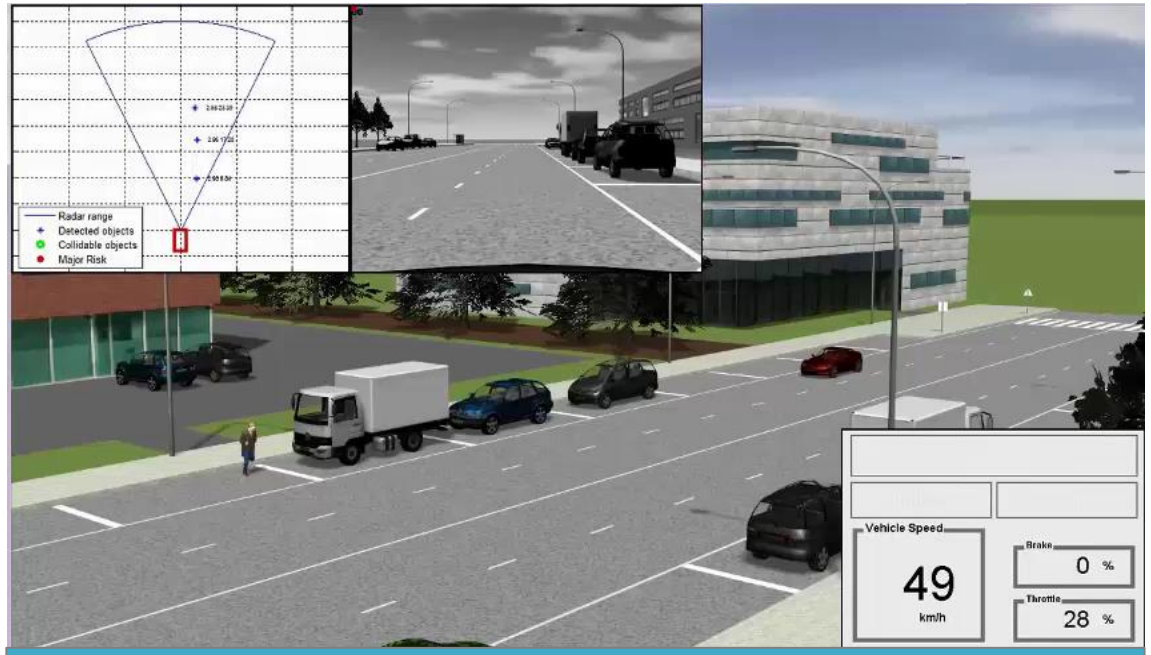


Adaptive Cruise Control



Pedestrian AEB
based on radar-camera fusion

Complete sensor models library:
Camera, Radar, LIDAR, Ultrasound, Infrared, V2X, GPS

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Simcenter - Sensor Models
Varying fidelity level sensor modelling

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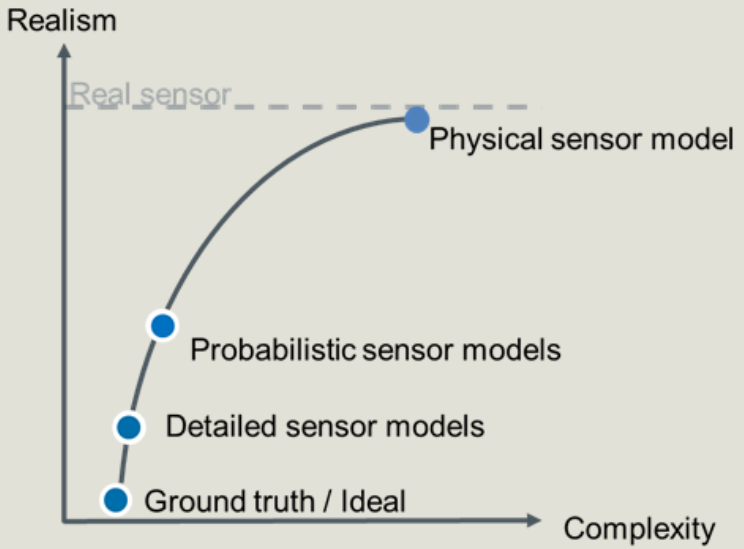
Balancing accuracy and computation time of sensor simulations



PreScan Image Segmentation Sensor (ISS)

PreScan Physics Based Camera (PBC)

Example: during night-time driving

Example: during tunnel entrance/exit

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Mentor DRS360 – Simcenter PreScan

Automating Multi-Sensor Image Classification Based on AI

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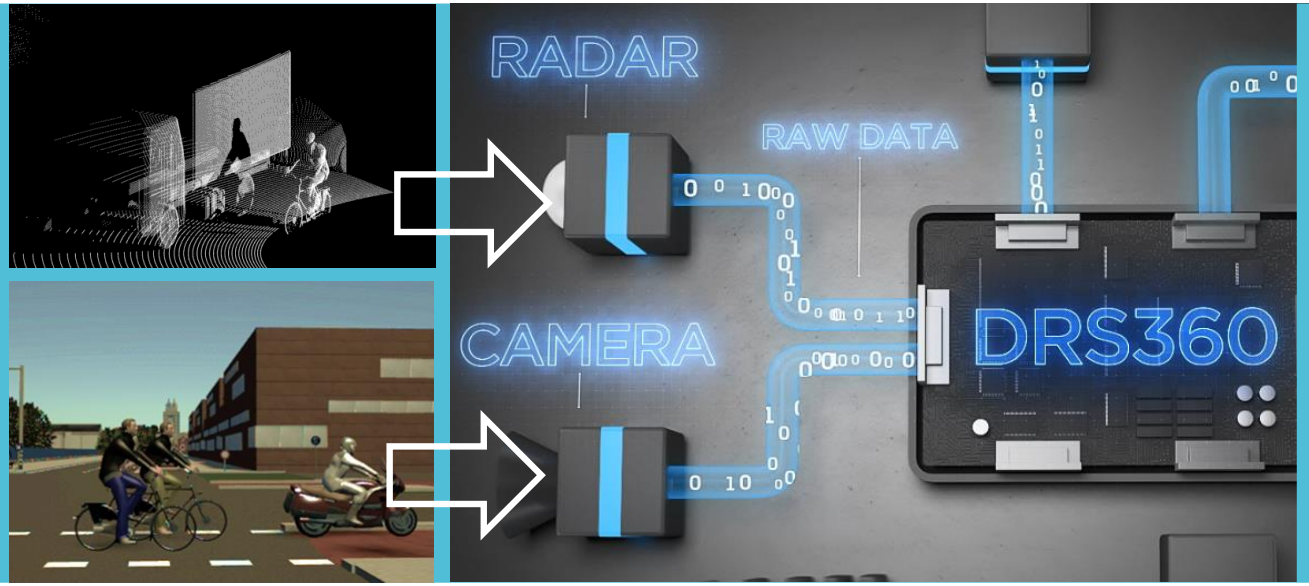
Simcenter PreScan

Virtual Sensor Image Generation (LiDAR, Camera)



PreScan - Virtual Sensor Image Generation to Limit Physical Testing

DRS360 – Machine Learning Automates Classification Based on Fusion of Multi-sensor Data (LiDAR, Camera …)

Demonstrated at "The Global Stage of Innovation", CES 2018, Las Vegas

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Simcenter
Adding braking and suspension fidelity to ADAS controls validation

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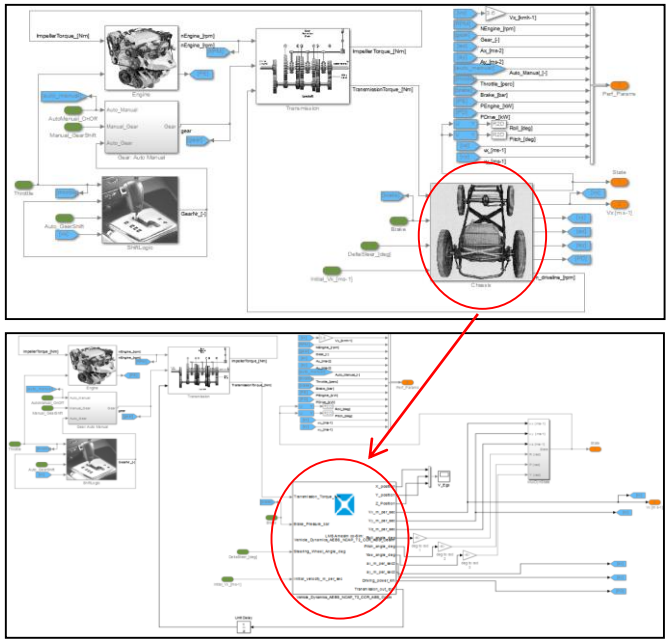
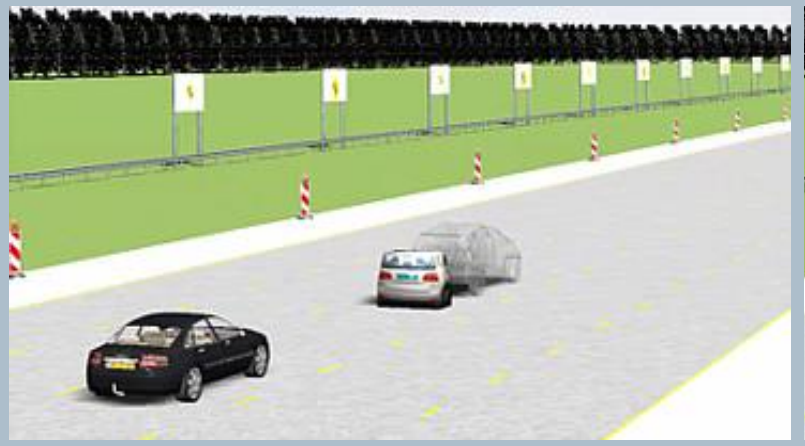


- Replacing basic chassis models by high fidelity Amesim suspension and braking system models
- Results are drastically impacted

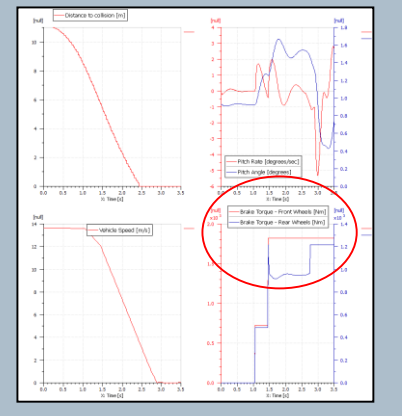
Standard vehicle model



Amesim detailed chassis models

No collision | Collision

- AMESim plots show rear wheel slip and hence the ABS limits braking torque on the rear wheels
- Redesign of the controls solve the safety critical issue



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Simcenter
Coupling with Active Human™ for Integrated Safety

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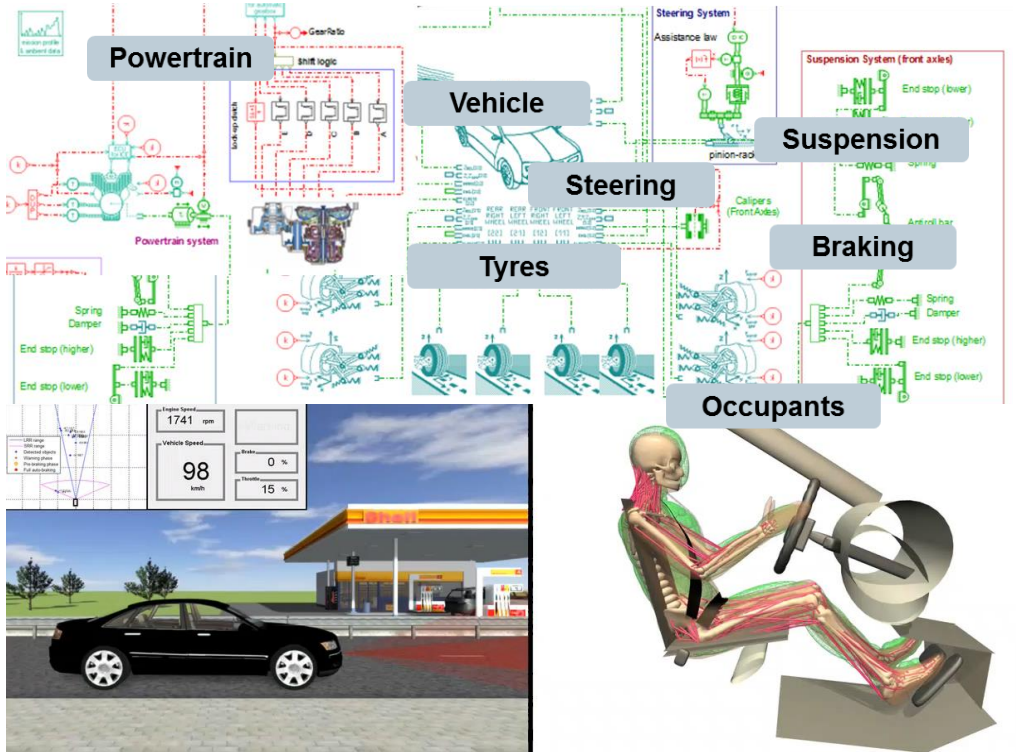

Autonomous controls simulation combined with occupant and vehicle dynamics modelling

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Simcenter - Validation and Verification

Real-Time Models – HIL Testing – Vehicle in the Loop Testing

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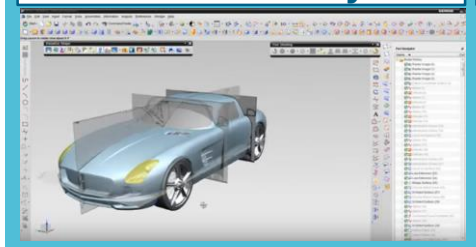
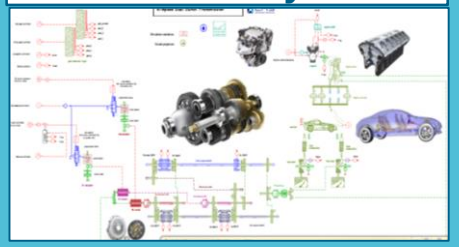
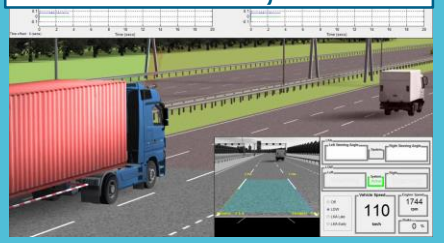
3D Multi-Body



1D Multi-Physics



Environment, Traffic



Real-Time "Digital Twin"

Bridging between

Virtual and Physical

- Simcenter Prescan
- Simcenter 3D Motion
- Simcenter Amesim

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Simcenter in context of Smart Operation
Covering a wide range of applications

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Addressing New Challenges in Manufacturing

Deploying robotics & virtual commissioning on functioning in cell

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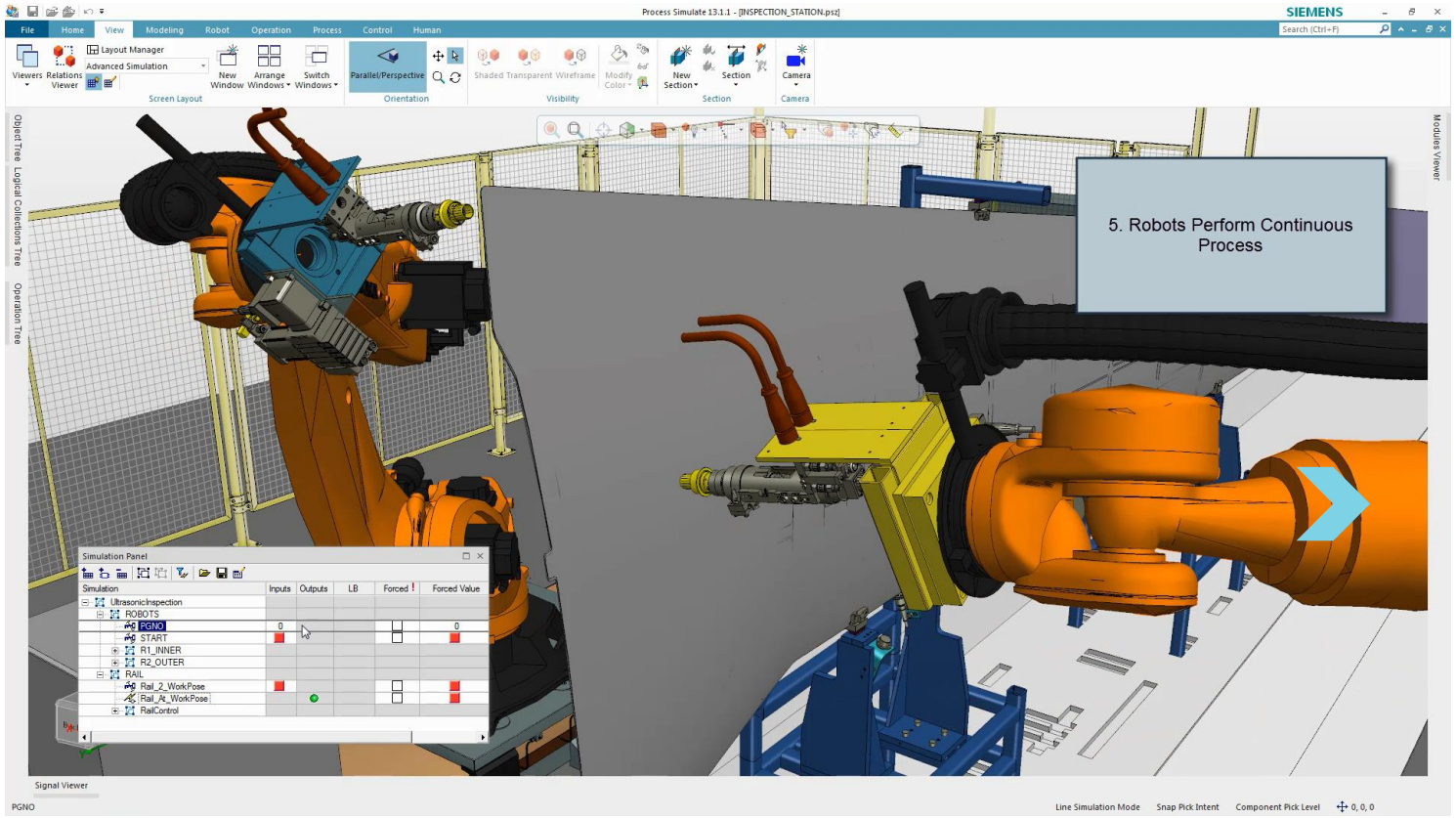

Siemens SIMATIC

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Addressing New Challenges in Manufacturing
Bringing automotive technology to the process and manufacturing Industries

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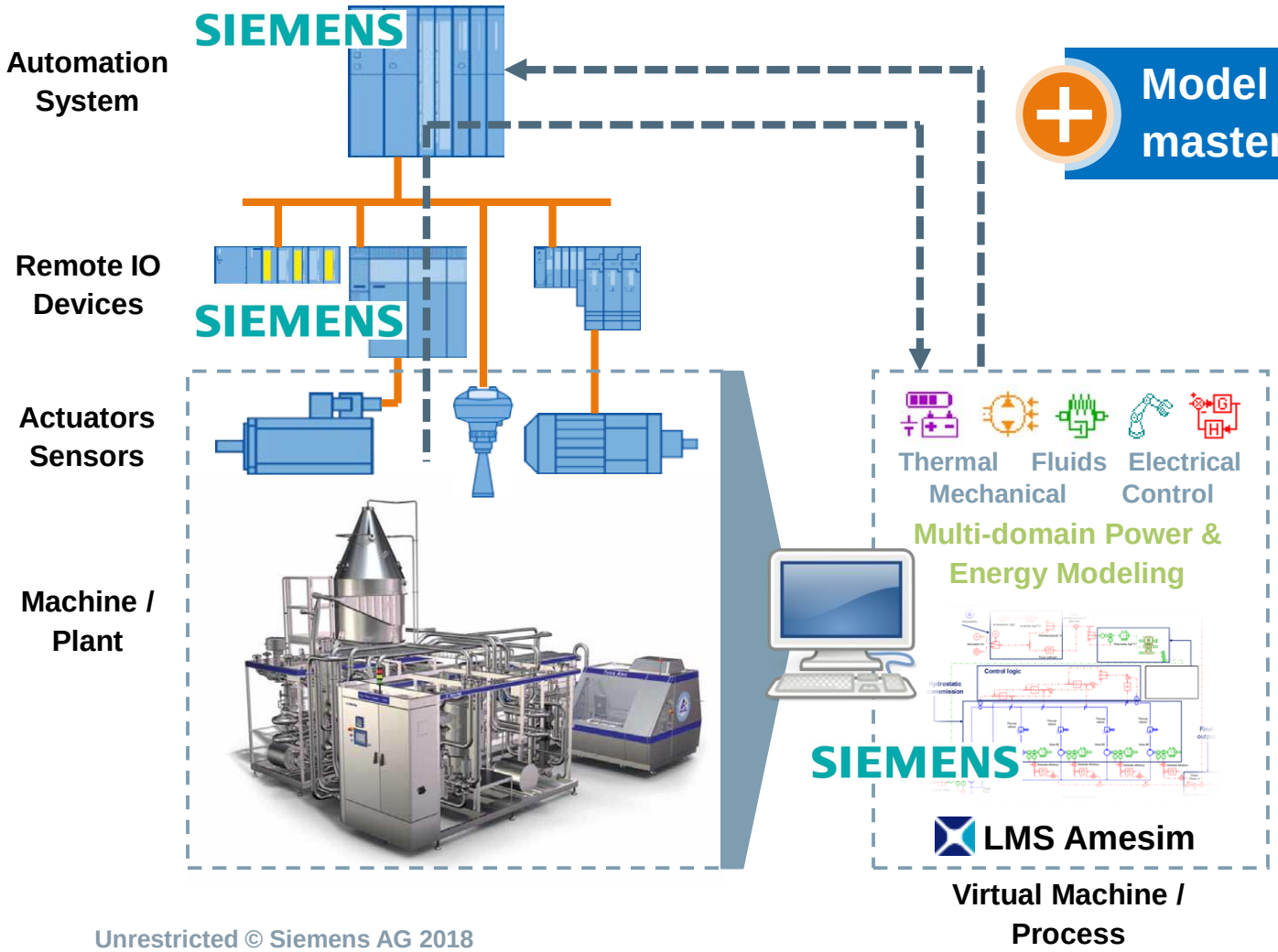

Model of machine/process provides insight to master and optimize in-operation system behavior

- **Meet Desired Production Quality**
- **Improve Productivity & Reduce Downtime**
- **Energy Consumption Mapping for Greener Factory**

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Virtual commissioning of processes

HIL - Example on a oil & gas pumping station

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Objective:

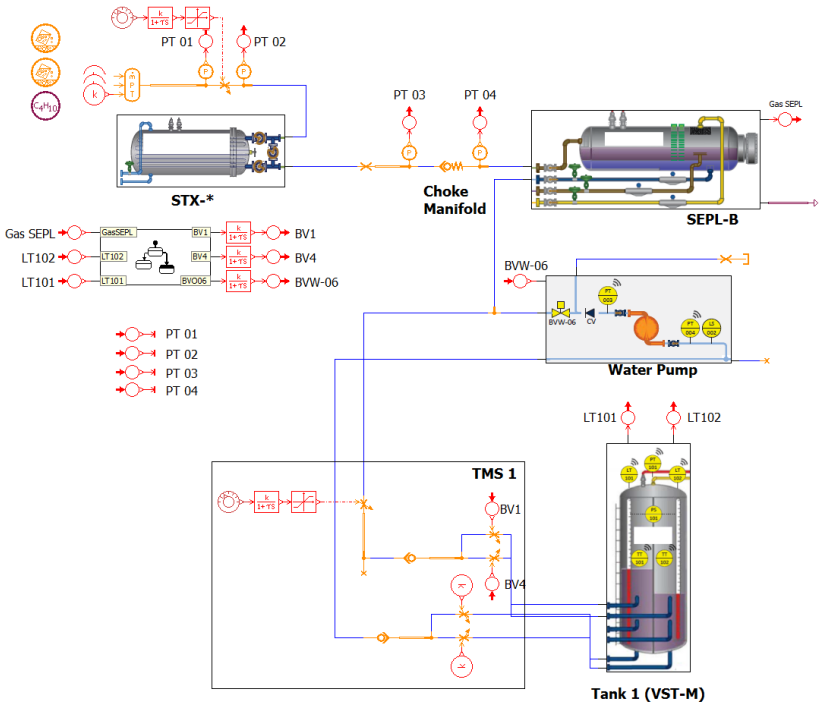
- Virtual validation of automation code of a oil & gas pumping and fluid separation systems

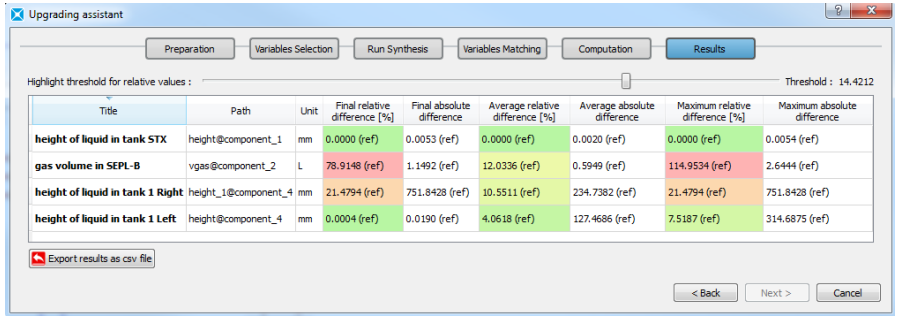
Setup for hardware-in-the-loop simulation:

- Exchange of data between PLC (Siemens SIMATIC S7-1500) and LMS Amesim model
- Connection through OPC UA

Simulation model requirement:

- Ability to precisely estimate flow, pressures, volume of fluid into reservoirs, in function of the fluid properties
- Ability to simulate a mixture of liquid and gas





Title	Path	Unit	Final relative difference [%]	Final absolute difference	Average relative difference [%]	Average absolute difference	Maximum relative difference [%]	Maximum absolute difference
height of liquid in tank STX	height@component_1	mm	0.0000 (ref)	0.0053 (ref)	0.0000 (ref)	0.0020 (ref)	0.0000 (ref)	0.0054 (ref)
gas volume in SEPL-B	vgas@component_2	L	78.9148 (ref)	1.1492 (ref)	12.0336 (ref)	0.5949 (ref)	114.9534 (ref)	2.6444 (ref)
height of liquid in tank 1 Right	height_1@component_4	mm	21.4794 (ref)	751.8428 (ref)	10.5511 (ref)	234.7382 (ref)	21.4794 (ref)	751.8428 (ref)
height of liquid in tank 1 Left	height@component_4	mm	0.0004 (ref)	0.0190 (ref)	4.0618 (ref)	127.4686 (ref)	7.5187 (ref)	314.6875 (ref)

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Virtual commissioning of processes

HIL - Example on a oil & gas pumping station

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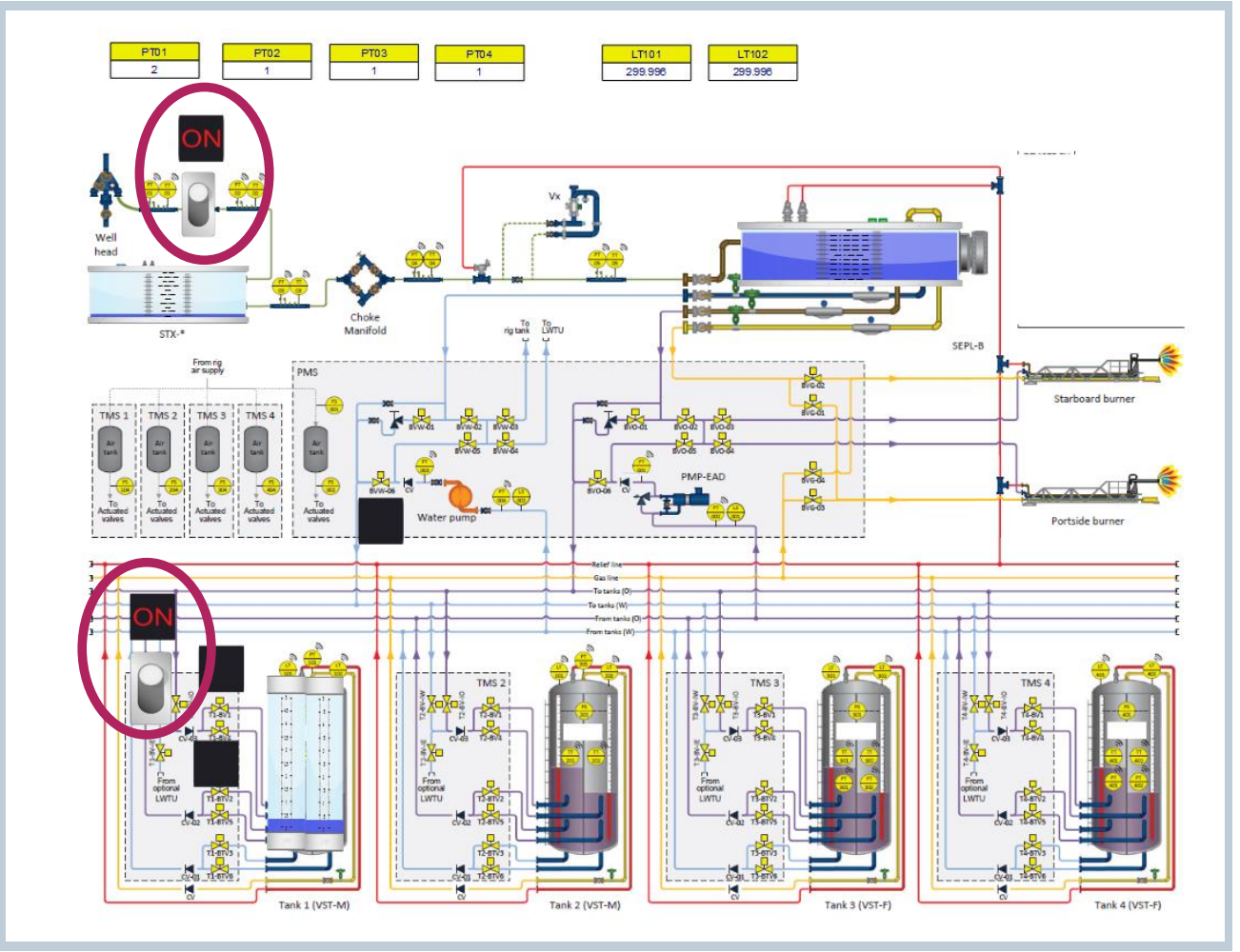
Creation of an interactive GUI:

- Ability to open/close valves, switch on/of pumps and compressors, so as to be able to simulate various working conditions
- Monitor flows, pressures, temperatures and level of fluid in the tanks
- Be able to test failure modes



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Siemens Marine
Monitoring ship energy efficiency

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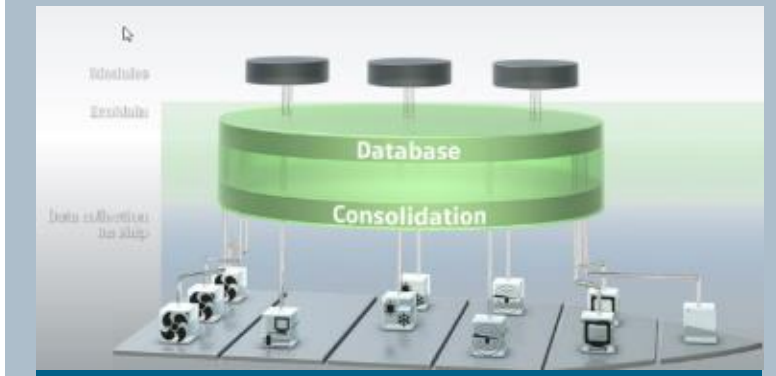
- **Good predictability of the system's behavior under changing ambient conditions**
- **Helped on-board personnel in their decisions and operations in an efficient way**

Optimize a waste heat recovery system



Multi-domain system modeling

Keep system performance under control

- Simulate the real world and achieve better efficiency
- Leverage Engineering Services to deploy a usable solution to control performance

"Simcenter Amesim and Engineering Services enabled us to provide our customers a system which can simulate the real world in a perfect way. We wouldn't have been able to do this with other solutions."

Kay Tigges, Siemens Marine

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The aviation industry is on the verge of a major shift towards electrified propulsion

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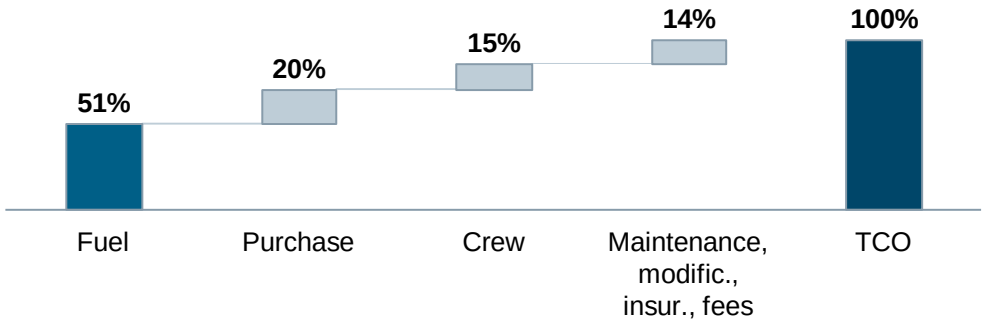
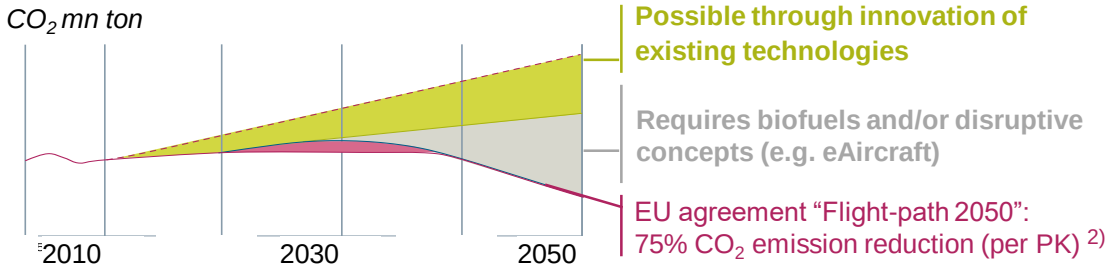
1. Reduction of fuel consumption: main lever to reduce aircraft TCO (example 737-800)



2. Projected emission goals: can only be reached with disruptive concepts [1)]



3. Customer perspective: extension of potential operating hours through noise reduction

Industry: various hybrid electric propulsion roadmap defined for demonstration (TRL's) and product development until 2035, e.g.

2016 – 2020

Hybrid Electric Systems Project
- Hybrid Ground Demonstrator, 10 MW platform
- <2 MW potential platform applications vertical take off and landing (VTOL), door-to-door

2028

Regional Aircraft
100 passengers, 6-8 MW

2035+

Short Range Aircraft
150-200 passengers, 20MW

1) IATA technology roadmap, June 2013

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Hybrid Electric Propulsion Units (EPU) with high power/weight requirements

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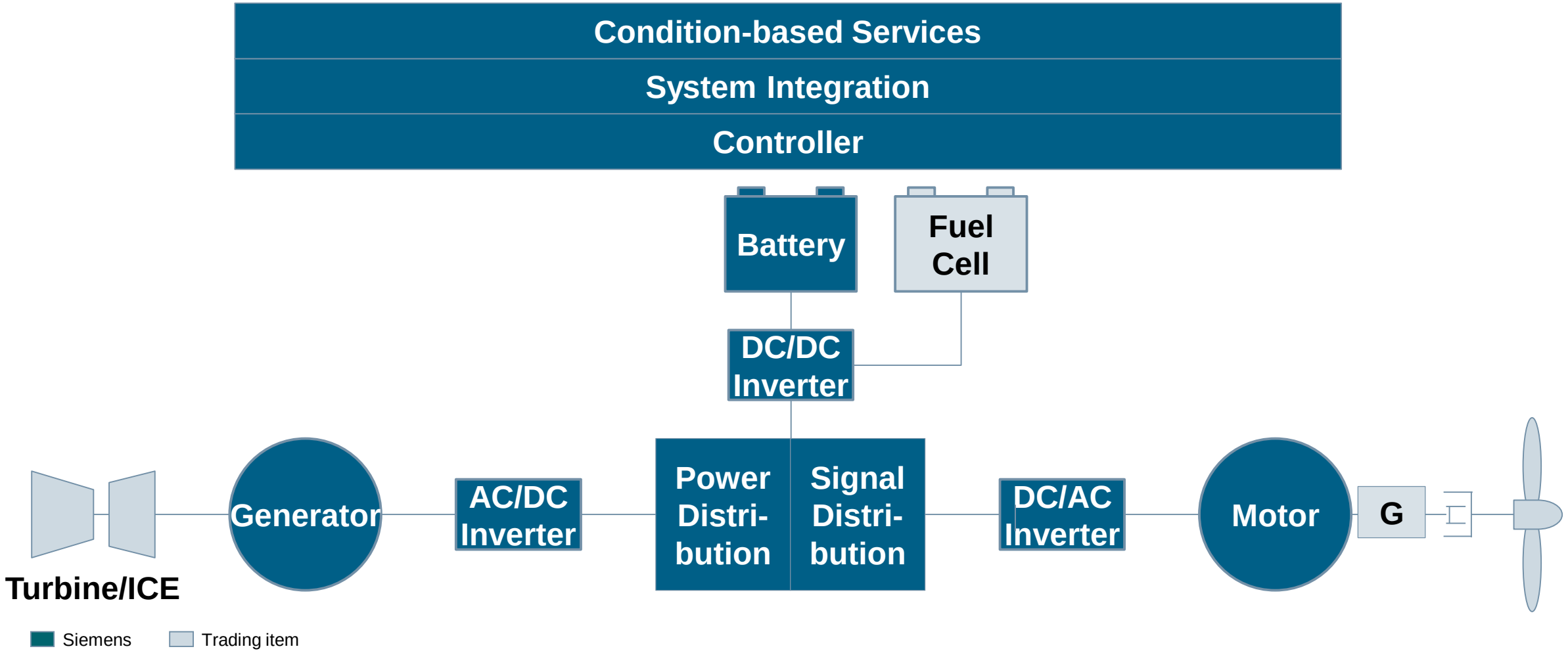

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Siemens eAircraft on a Mission

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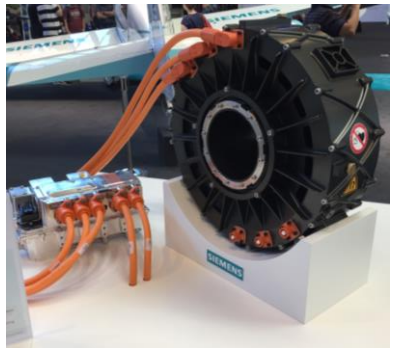
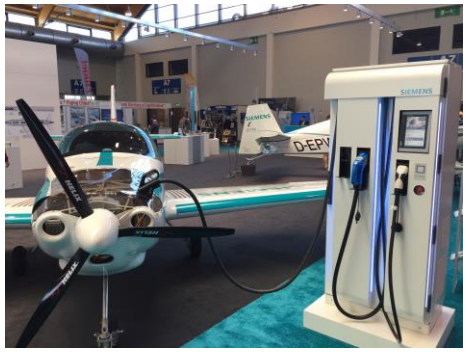


SP260D

Direct Drive Permanent Magnet
MTOP 260 kW @ 2500 RPM
Weight 44kg
Power Density 5.9 kW/kg

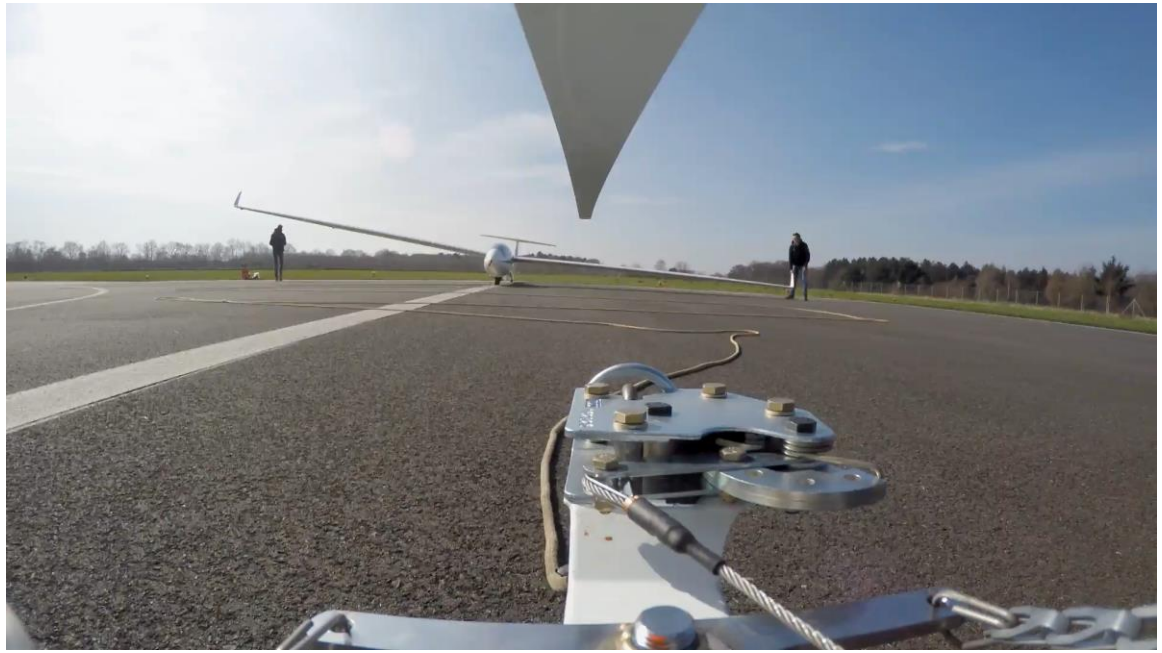
On Extra 330LE Battery Configuration



SP55D & SP70D

On Magnus eFusion
- (exchangeable) Battery config.
- Hybrid Electric (FlyEco Smart eng.)

New 57 kW Inverter SD104 900g
Take-Off & Landing 100% Electric



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Achievements, Record Flights and Opportunities
Fly-Over Noise Reduction Extra 330LE Battery Configuration

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https://www.youtube.com/watch?v=WylLWeDtPy0&index=7&t=0s&list=PLw7lLwXw4H53YUddJ99vzOVFgn-o4f17U

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Airbus, Rolls-Royce & Siemens

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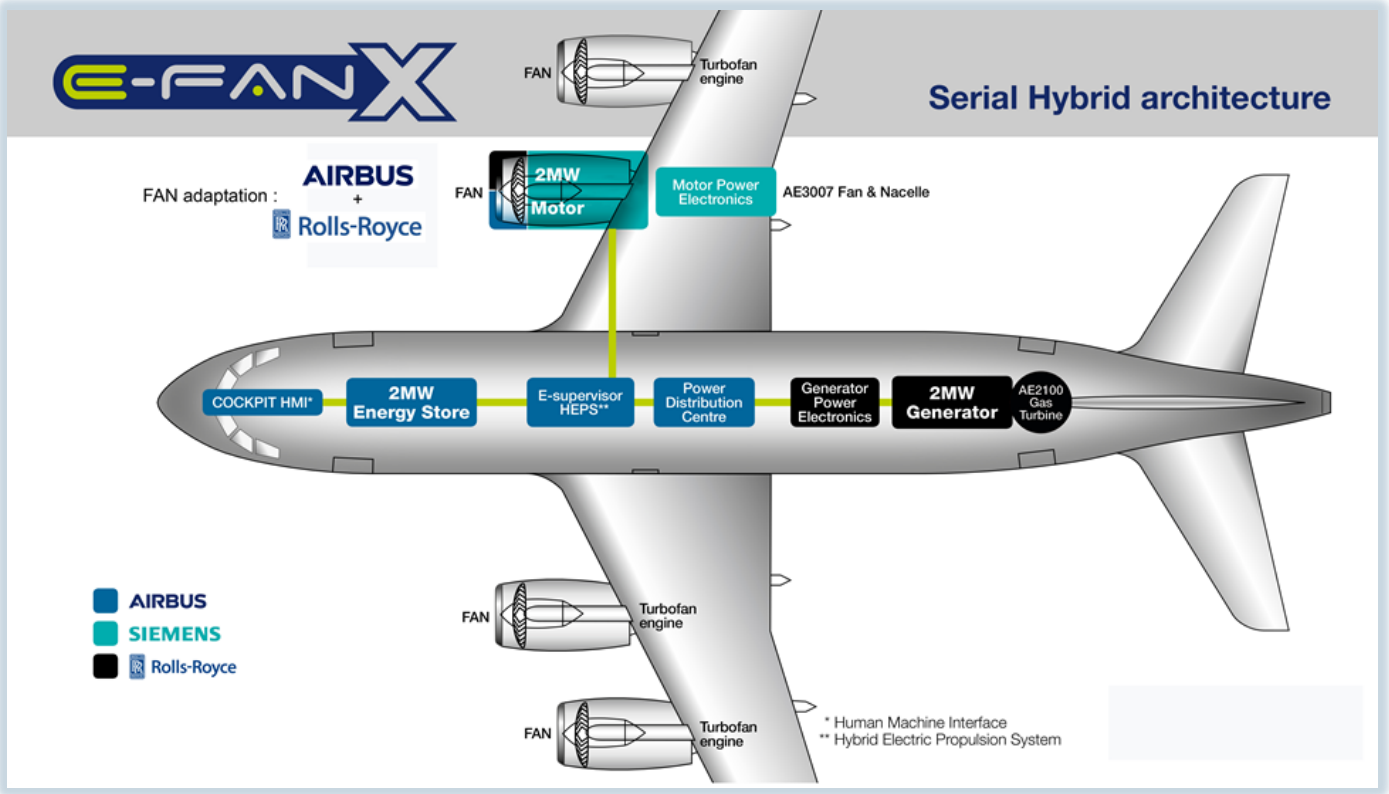
28
November 2017

EN | FR | DE | ES

Commercial Aircraft

Airbus, Rolls-Royce, and Siemens team up for electric future Partnership launches E-Fan X hybrid-electric flight demonstrator



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Source: http://www.airbus.com/newsroom/press-releases

EPUs with Record Power Density are Complex & Highly Integrated Products

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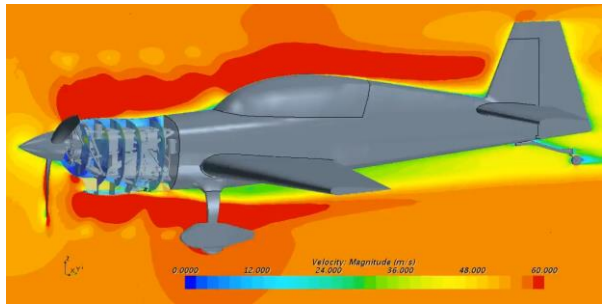


Greener & Cost Effective Aircraft Operations

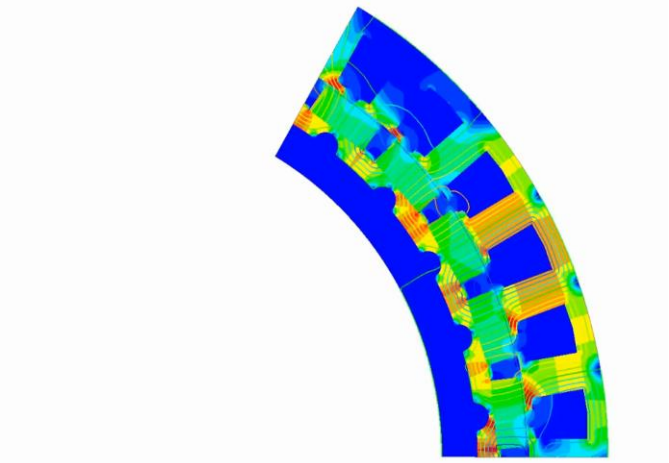
Aircraft | Mission | Environment

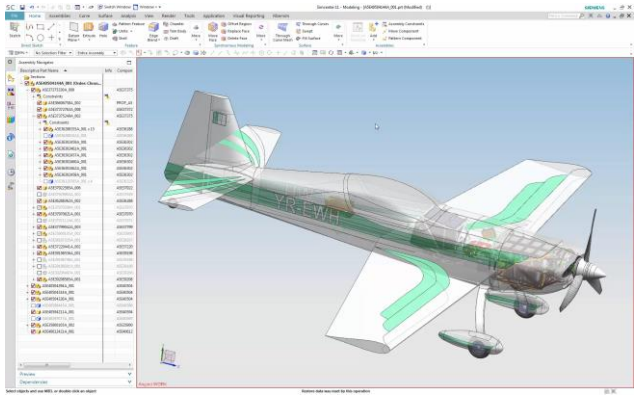
Efficient & Reliable Motor Performance

Electro-Magnetic | Structural

Electrical | Software

Thermal | Systems





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CityAirbus uses Siemens SP200D EPU Direct Drive

Based on SP260 technology : 50% increase in Torque to Mass Ratio

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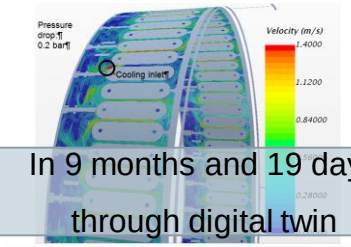
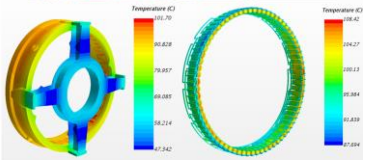
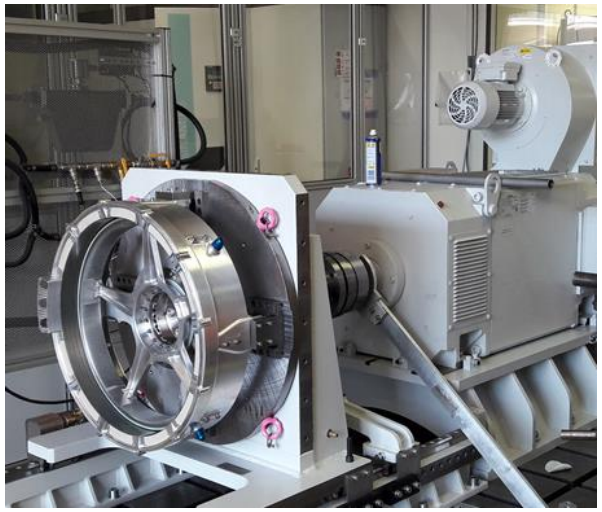


In 9 months and 19 days
through digital twin





	SP260D 2015		SP200D 2017
Continuous Power	260 kW		204 kW
Rotational Speed	2500 RPM non-geared		1300 RPM non-geared
Continuous Torque	**1000 Nm**		**1500 Nm**
Mass	50 kg		49 kg
Torque to Mass Ratio	**20 Nm/kg**	**Increase by 50%**	**30.6 Nm/kg**
Inverter Type	Si		SiC

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Simcenter Portfolio
Engineer Innovation

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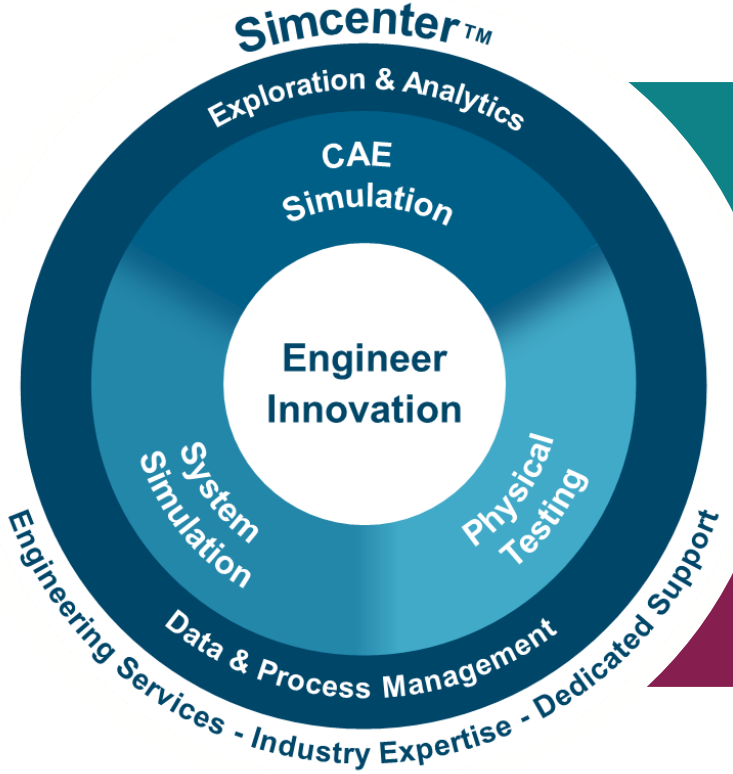

Productivity
Saving engineering time

Realism
Increasing confidence

Continuity
Enabling enterprise collaboration

Exploration
Delivering insight

- Innovative solutions
- Faster to market
- Better products
- Lower development cost
- Increased market agility

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