Introduction to ESI Group

Christopher St John – COO ESI Group

Rungis, 12 02 2020

get it right®

Contents

ESI Group: Publically Listed since 2000 (ISIN FR0004110310)
Founded in 1973 on the promise of High Performance Computing

We enable companies to build Virtual Prototypes of their products

Sept 2011

IC.IDO – The Visual Decision Company

Real Time immersive virtual reality

Sept 2012

Open Source Fluid Dynamics Software

OpenFOAM

Oct 2013

MODELICA

CyDesign

New 0D/1D Technology

Mar 2015

Virtual simulation of automated driver assistance (ADAS)

CIVITEC

April 2015

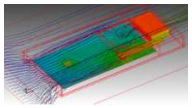
PICVIZ LABS

Renamed **INENDI**

Visual Analysis of Big Data

May 2015

Disruptive solution dedicated to the electronics cooling market



PRESTO

Ciespace

Technology to accelerate CAE delivery in the Cloud

Jan 2016

ITI

Realistic simulation of mechatronic and multi-domain systems

Feb 2016

Big data visual analytics and machine-learning specialist

Mineset

Feb 2017

Scilab

Open Source Modeling Software

get it right®

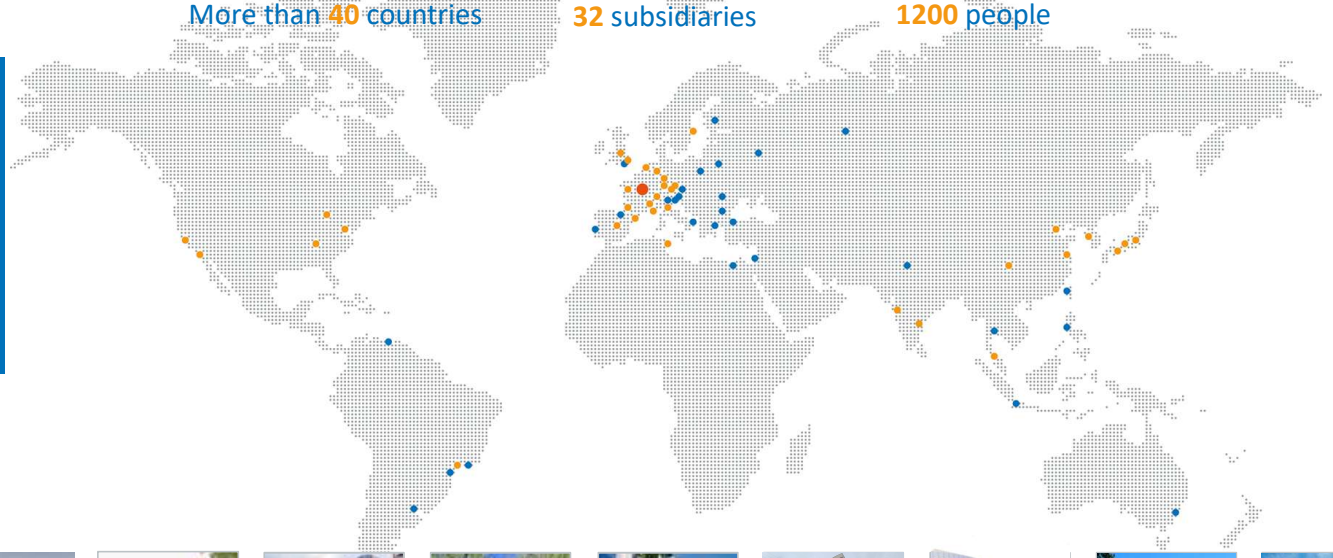
ESI Group – a global company and partner to our customers

Revenues
FY18
140€m

More than 40 countries

32 subsidiaries

1200 people



SAN JOSE, CA
USA

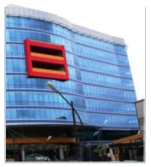
DETROIT, MI
USA

SÃO PAULO
BRAZIL

PARIS
FRANCE

FRANKFURT
GERMANY

EKATERINBURG
RUSSIA



BANGALORE
INDIA

BEIJING
CHINA

TOKYO
JAPAN

ESI Solutions and Foundation Technology

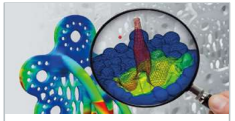
Building computer models that replace physical prototyping and testing

Virtual Manufacturing


Casting


Composites


Sheet Metal Forming


Additive Manufacturing


Machining


Welding & Assembly

Virtual Reality


IC.IDO Immersive Experience

Virtual Performance


Virtual Performance Solution


Virtual Seat Solution


Vibro-Acoustics

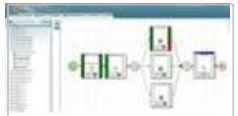
Virtual Environment

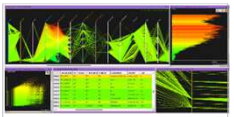

Electronics, CFD & Multiphysics


Open Source CFD

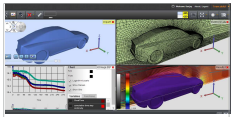

Electromagnetics

Systems, Data Analytics and Cloud


Decision Support Fault Analysis


Big Data Analytics Cybersecurity

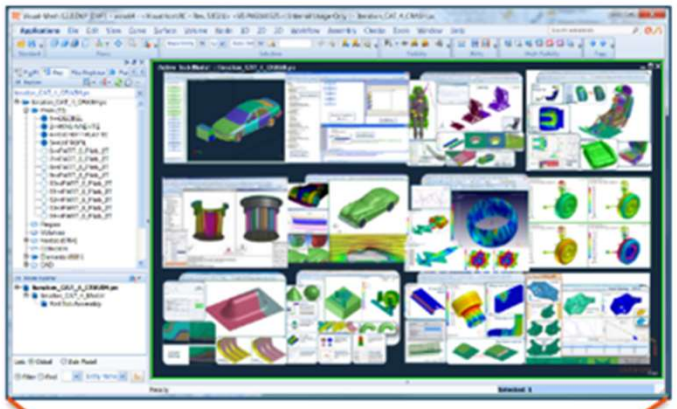

Virtual Systems & Controls

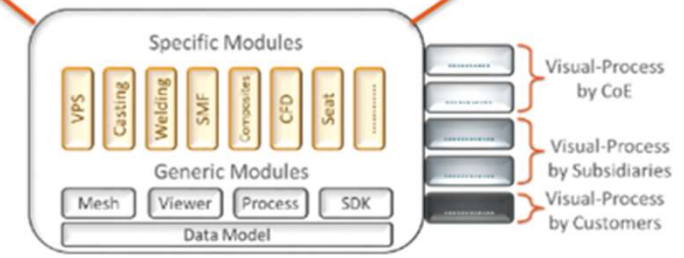

Cloud/SaaS Simulation

VISUAL-ENVIRONMENT

Enabled by an Open CAE Platform Local or Cloud

- Multi-domain **CAE simulation platform**
- **Extendable compute model** across various physics
- **Customizable** at task, process and solution levels
- **Visual-Process: CAE Process automation** (productivity, consistent output)





Open CAE Platform

get it right®

Mission: Enabling the Digital Transformation

From PLM to PPL – shifting the focus to the "Outcome" and service life

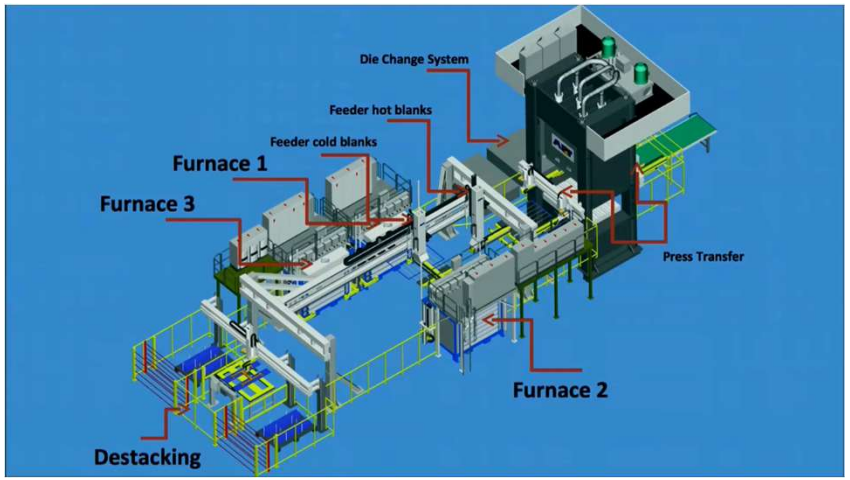
PLM

Product Lifecycle Management

Virtual Prototype

"As built As Tested"

for Pre-Certification



PPL

Product Performance Lifecycle

"As used"
& repaired In real Operation

get it right®

Pre-Certification

Make it right

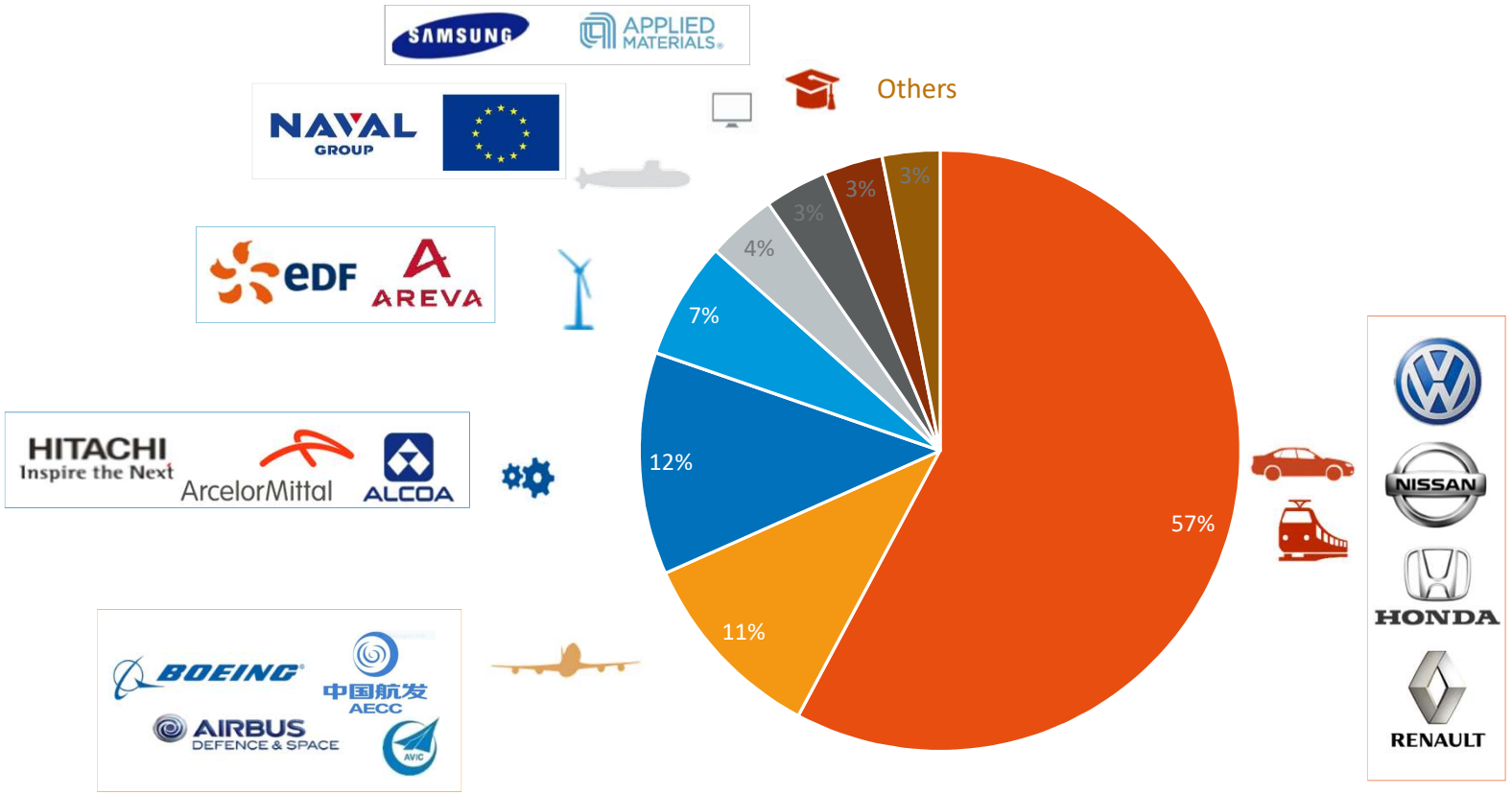
Smart Manufacturing

Assuring the expected Outcome

Experience

Contents

Representative Customers



Pioneers in the Automotive Industry

ZERO REAL TESTS

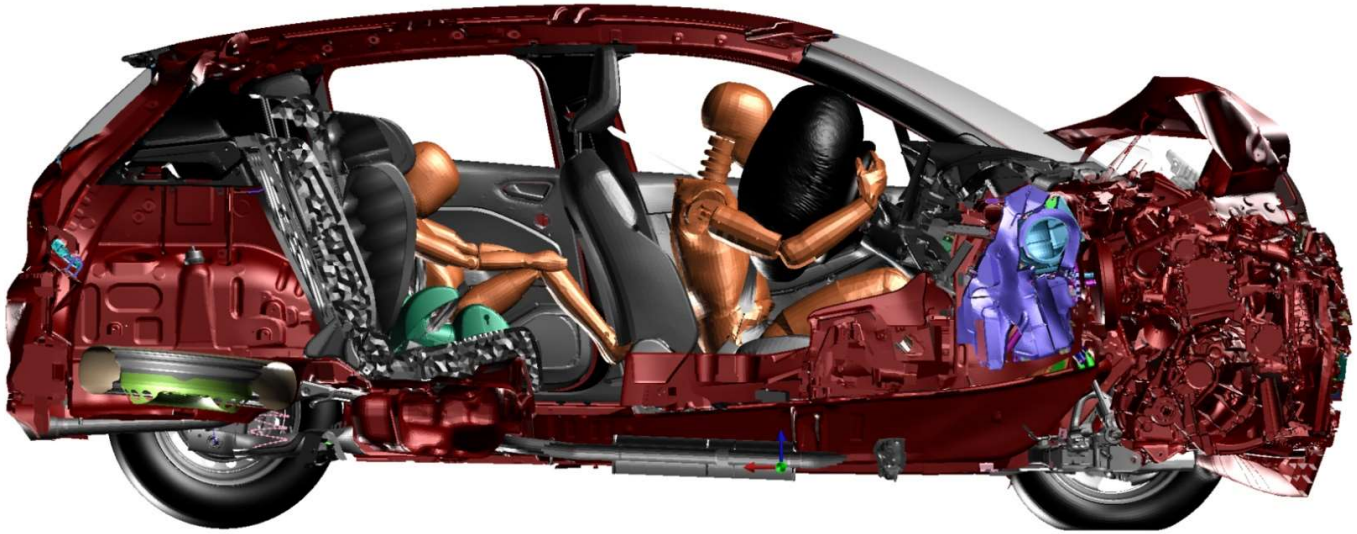
ZERO REAL PROTOTYPES

AUTOMOTIVE

Virtual Prototyping

The Digital Transformation – Major OEMs

Accelerated Development / Eliminated Physical Prototypes



"

We succeeded to develop one of our new vehicles, ***using a single real prototype (first time right).***

"

GROUPE RENAULT

Olivier Colmard
Integrated CAE & PLM,
Engineering VP
Groupe **Renault**

get it right®

The Digital Transformation – Innovative Start-Ups

Disruptive Innovation enabled by Virtual Prototyping

“We were able to validate the performance of our innovative composite vehicle virtually, **before we even manufactured the first real prototype**.”

Gaäl Lavaud
Founder
and CEO
Gazelle Tech

get it right®

The Digital Transformation – Supply Chain

Competitive Tender

FRANKFURT (Reuters) - Daimler has struck a deal to buy lithium ion battery cells from Farasis Energy, a Chinese-American supplier that is building a factory in east Germany to help Mercedes-Benz ramp up electric vehicle production.

Secured without physical delivery

> *"We could not have done that without ESI."*

Dr. Matt Klein

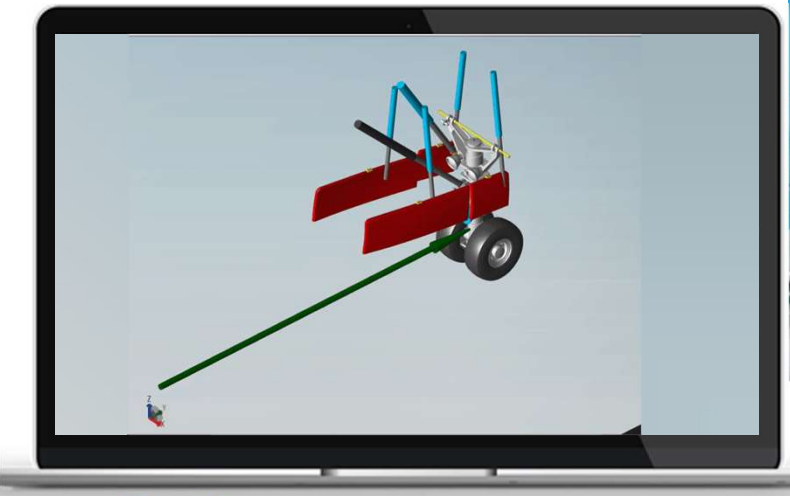
Manager,
Engineering Analysis and Modeling
Farasis Energy

AEROSPACE

Model Order Reduction

Engineering Lifecycle Performance

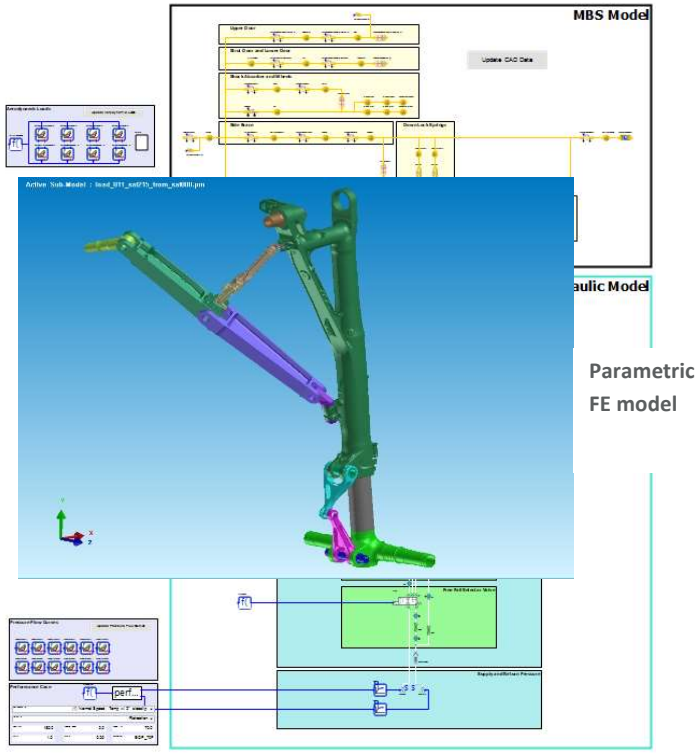
LIEBHERR development and design



Objective: Simulate 100s of aircraft landing scenarios overnight to validate design. Impossible physically.

LIEBHERR Development and Design

ESI Proposal

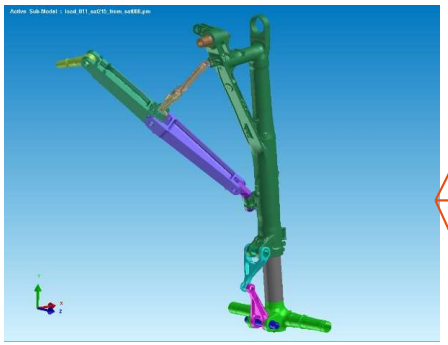


- Replace the complex and not accurate system modeling of landing gear Finite Element Model
- Build a Parametric Finite Element Model using the Model-Order Reduction technics
- Integrate the Parametric Finite Element Model in the complete System Simulation of the landing Gear
- Input to build the Parametric Finite Element Model:
  - 3 Shock Absorber Travel (SAT) positions
  - 3 load cases: Fore/Aft | Lateral | Yawing

LIEBHERR Development and Design

Model-Order Reduction builder

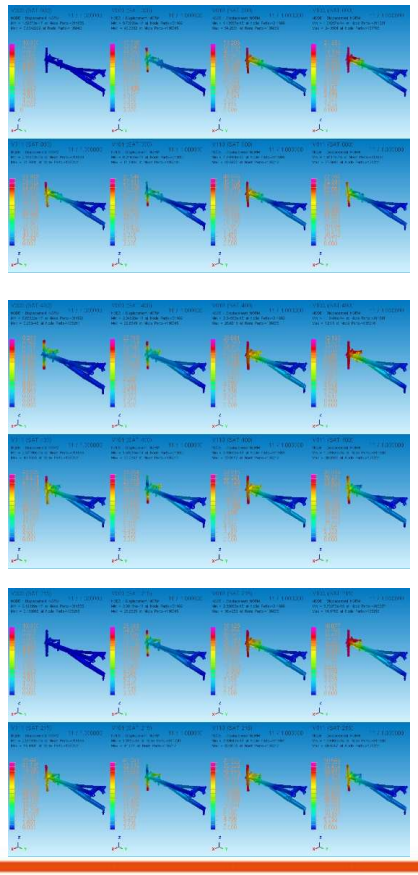
Input FE Model



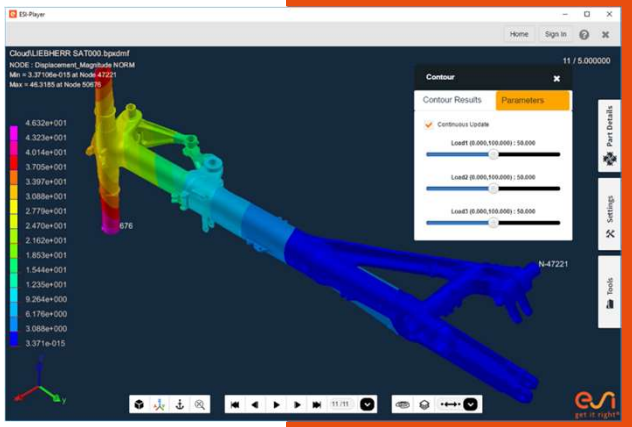
SAT position 1
8 load of Fore/Aft

SAT position 2
8 load of lateral

SAT position 3
8 load of Yawing

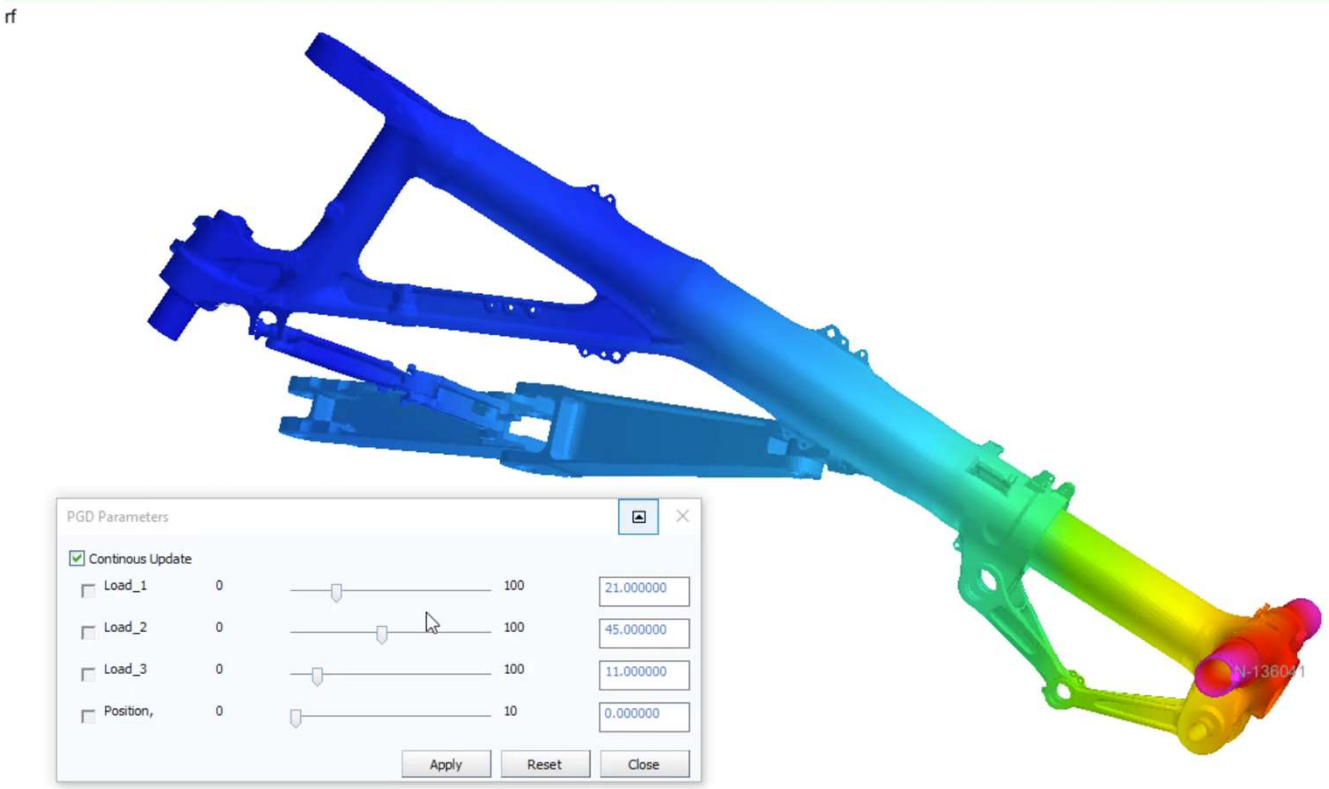


Parametric FE Model



LIEBHERR – Customer Achievement

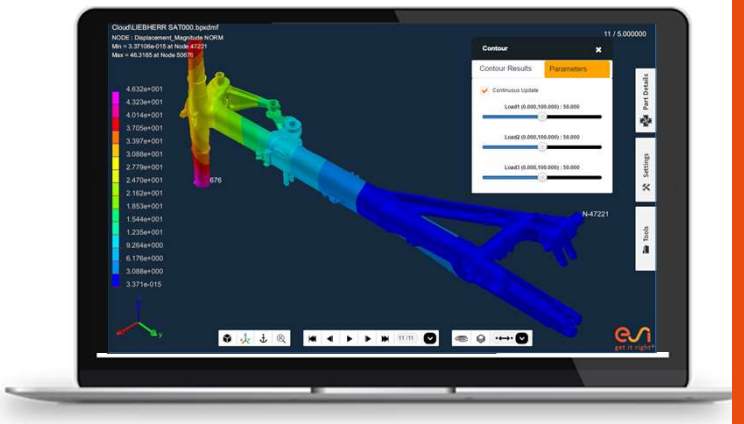
Simulation of 1000 scenario in real time possible



Engineering Lifecycle Performance

LIEBHERR development and design perspectives

Simulate 100s of aircraft landing scenarios overnight to validate design



Improvement Safety

Real Time Adjustment of Virtual and Real Performance

Potential Predictive maintenance to avoid downtime

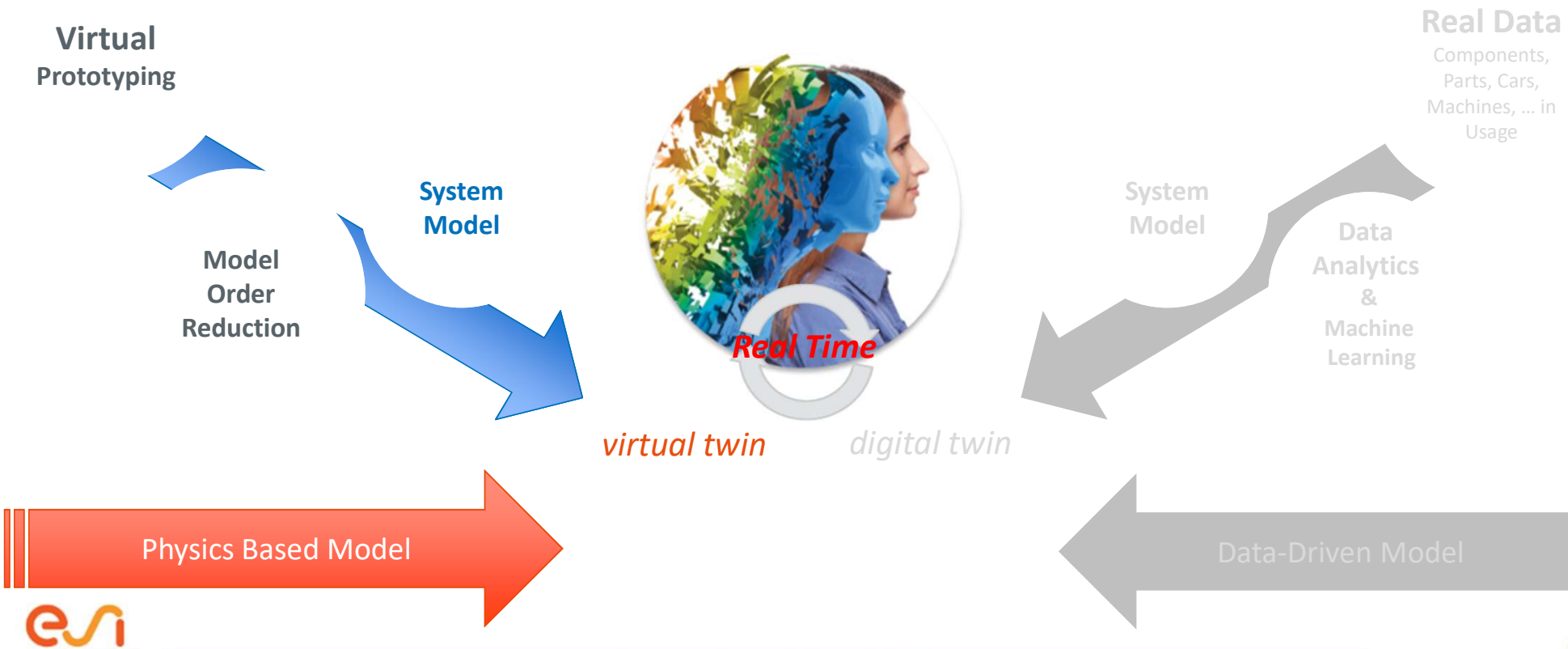
ENERGY

Hybrid Twin™

Hybrid Twin™ - Methodology

Virtual Twin

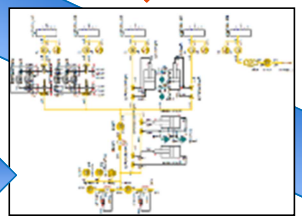
The Hybrid Twin™



Hybrid Twin™ - Methodology

Virtual Twin

- ***Extended Virtual Prototyping*** + System Modelling = Virtual Twin



REAL TIME PROTOTYPING
3D Detailed Virtual CAE-Model + Parametric Solution

ENRICHMENT

SYSTEM MODELLING
1D Virtual Model for the whole System

Virtual Twin

Hybrid Twin™ - Methodology

Digital Twin

The Hybrid Twin™

Virtual
Prototyping

Model
Order
Reduction

System
Model

Real Data
Components,
Parts, Cars,
Machines, … in
Usage

System
Model

Data
Analytics
&
Machine
Learning

virtual twin *digital twin*

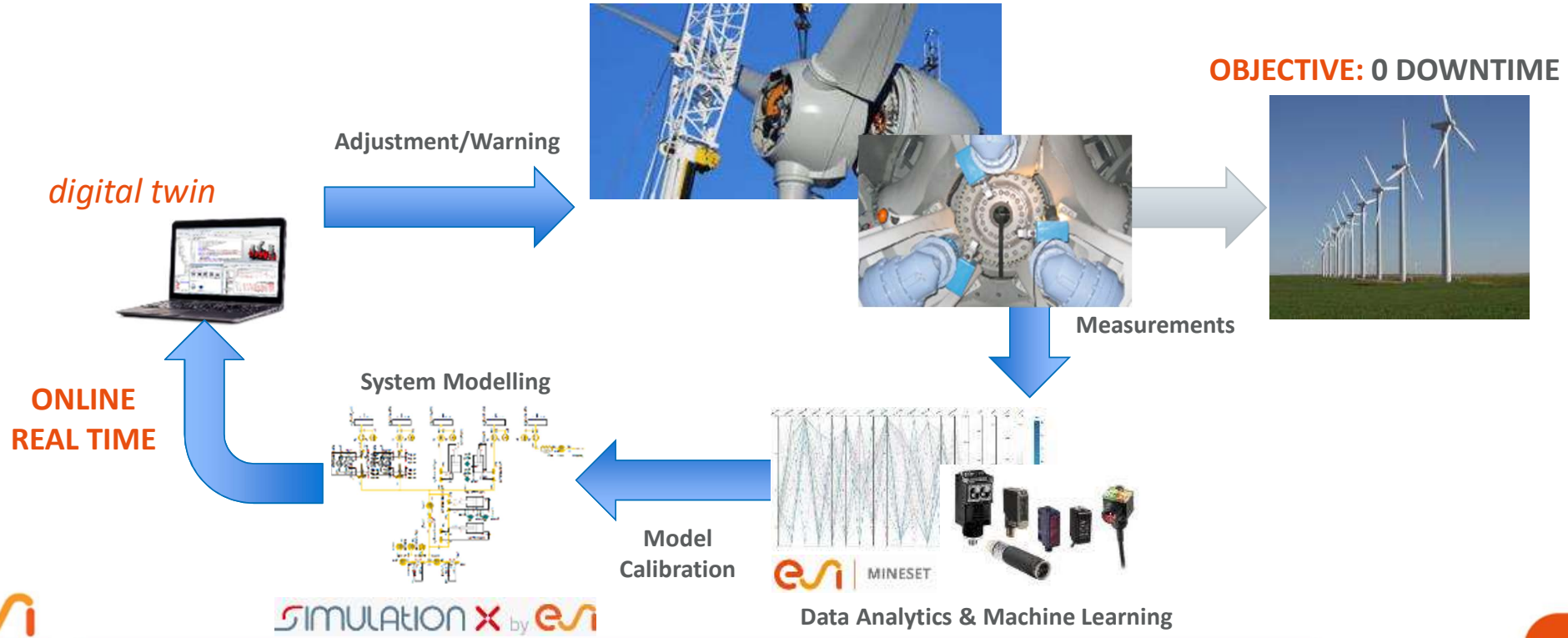
Physics Based Model

Data-Driven Model

Hybrid Twin™ - Methodology

Digital Twin

- "DATA DRIVEN IN SERVICE" Operational Conditions = Digital Twin

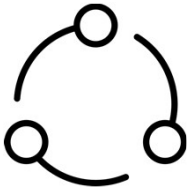


Hybrid Twin™ - Enabling a new Era of Performance

Cutting-edge simulation solutions to predict, in real-time, all products' behaviors

PHYSICS-BASED
VIRTUAL PROTOTYPE

DATA-BASED
DIGITAL TWIN



REAL-TIME
ALGORITHMS

Hybrid Twin™

GATHERING & HARNESSING THE POWER OF DATA AND PREDICTIVE SIMULATION
TO SHAPE THE FUTURE OF INDUSTRIES

Contents

Facing the challenges of Industry 4.0 / Manufacturing 2025

Industrial processes disruption

TOWARDS RATIONAL AND PREDICTIVE INDUSTRIAL PILOTING, SMART MANUFACTURING AND AUTONOMOUS SYSTEMS

ZERO REAL TESTS

END-TO-END VIRTUAL PROTOTYPING

ZERO REAL PROTOTYPES

PRODUCT IN SERVICE HYBRID TWIN™

Closing Comments

- We are in a time of rapid, industrial transformation
  - Powered by the digital transformation
  - Reinforced by multiple national and international initiatives
- ESI has prepared for this transformation for the past 40 years, building a unique capability to build fully realistic virtual prototypes. The objectives:
  - Zero real tests - virtualizing physical testing of parts, subassemblies, ……
  - Zero real prototypes - pre-certification testing before any real product exists
  - Zero down time - anticipating the need for maintenance and support
- Delivering the “Outcome” expected for all Industries
  - Automotive and Ground Transportation
  - Aerospace
  - Power Generation

Thank you!

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