



MOIRA Industrial Meeting
2nd Industrial Session
20th June 2023

MOIRA industrial meeting 2nd Industrial Session – Agenda

- [9:30-9:45] **Company introduction Siemens Industry Software NV (SISW)**
Bram Cornelis – SISW
- [9:45-10:30] **End-of-Line Testing and Structural Health Monitoring activities at SISW**
Bram Cornelis – SISW
- [10:30-10:45] **Coffee Break**
- [10:45-11:30] **A federated learning approach to a fault diagnosis bearing problem**
Fabrizio De Fabritiis – KU Leuven
- [11:30-12:15] **Dataset shift and its impact on machine learning-based fleet monitoring**
Deepti Kunte – SISW

Siemens Digital Industries Software

Siemens AG

Digital Industries



Smart Infrastructure



Mobility



Siemens Advanta



Portfolio Companies



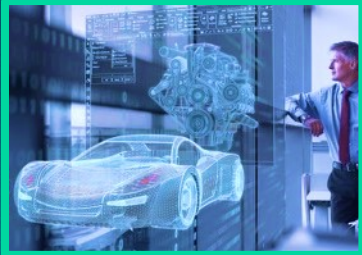
Siemens Healthineers



Software

#1 market position in industrial software

Factory Automation



Motion Control



Process Automation



Customer Services



Leader in digitalization, automation and electrification

The Software Business Units address our customers' needs for software, automation, and services



Software (industrial)

#1 market position

- Comprehensive, integrated portfolio of software, services and an application development platform called Xcelerator



Factory Automation

#1 market position

- Automation products
- Engineering software
- SCADA software
- Systems for production machines
- Industrial Edge



Motion Control

#1 market position

- Drives
- Motors
- Machine tool systems
- Additive manufacturing
- Digitalization and Edge computing for machine tools and drive technology



Process Automation

#3 market position

- Automation systems and software for process industries
- Process instrumentation and analytics
- Industrial communication and identification
- Power supply systems



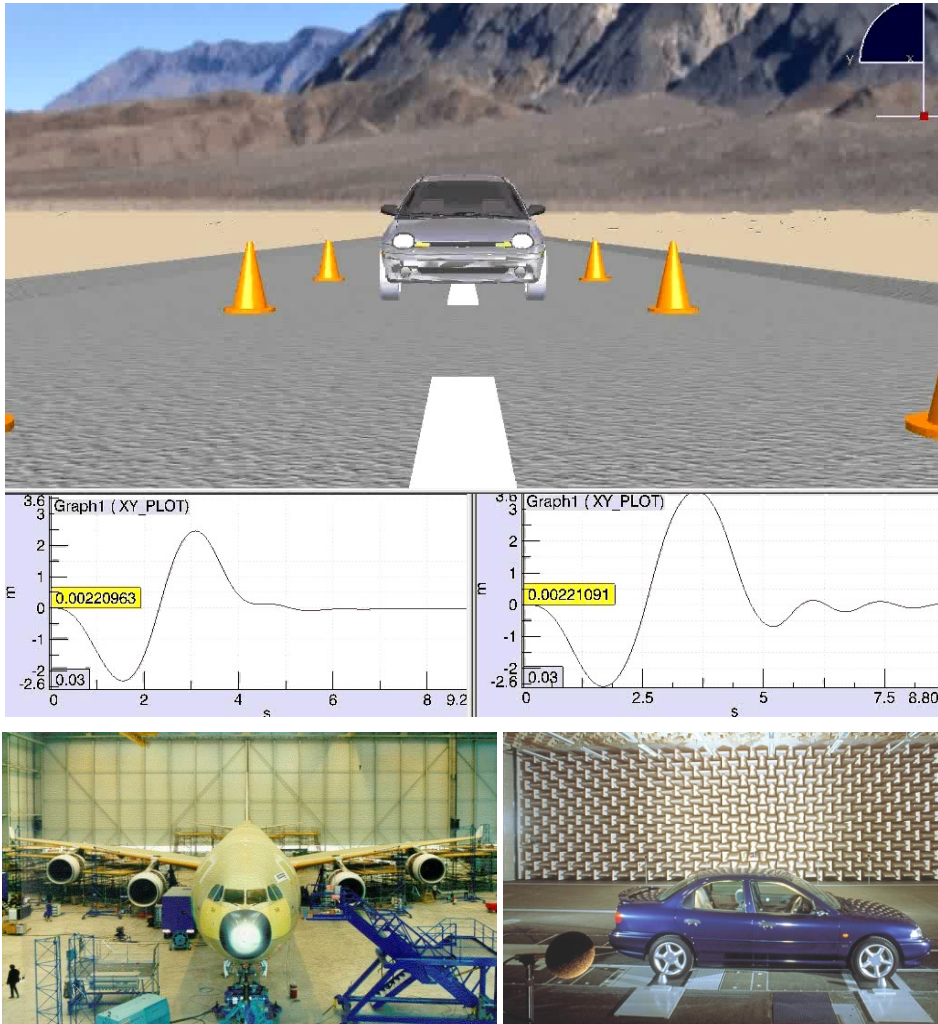
Customer Services

- Lifecycle Services
- Artificial Intelligence Services
- Remote Services
- SITRAIN/E-learning
- Digital Enterprise Services with Consulting, Implementation, and Optimization approach

Solutions for focus industry verticals

1 w/o Bentley - (Adj. EBITA margin as reported 21.7%).

Siemens Industry Software NV – History



- **Spin-off** from KU Leuven, 1980, as **LMS International**
- Partner in engineering innovation in the mechanical and mechatronic industries: **software, systems and services**
- **B2B** company selling to leading **R&D labs of major industries**
- Addressing **critical product performances** and supporting the design of green and safe products
- Committed to innovation: **> 20% of budget in R&D**
- More than **5.000 manufacturing** companies actively use LMS Products and Services (75% auto & aero)
- Acquired by **Siemens in 2013**, LMS now is the HQ of the “**Simulation and Test**” segment of **Siemens Digital Industries Software**
- Belgian Legal Entity: **Siemens Industry Software NV**
- Product brand “**Simcenter**”

Siemens Industry Software NV – History

UGS acquisition establishes software foundation for product development

2007

2008

2009

2010

2011

Acquisition of LMS expands strategy for verification and validation of systems

2012

2013

2014

2015

Siemens establishes leadership in product and process simulation to enable digitalization

2016

2017

2018

2019

2020

2021

Orsi
Innotec

ETM

Active
IBS

Preactor

Camstar

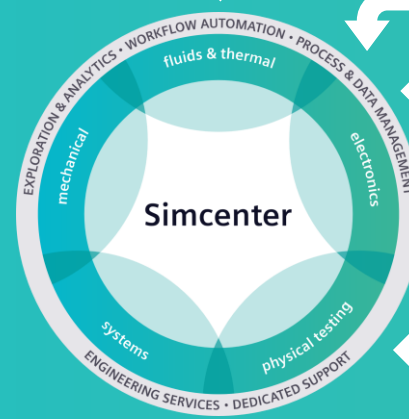
Bentley Systems

Production engineering and execution



KINEO

PERFECT COSTING SOLUTIONS
Software | Knowledge | Services



Mentor
Mechanical Division & Automotive Business

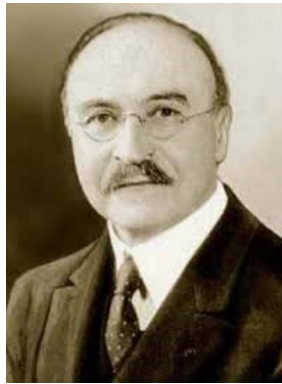
tass international

infolytica corporation

SAAB
MEDAV

Open Innovation Approach SISW

Long track record of hosting students and researchers



- Hosting PhD degree research in an industrial environment
 - “Dual desk” approach (local) and/or extended **missions** (international)
 - **Industrial problem** definition and use cases - **Academic supervision** by a strategic partner university
 - **Multiple schemes** (regional industry doctorate programs, Marie Skłodowska Curie projects, university funded projects)
- Active student internship program
 - ~**50 per year**, dedicated staff support – support for lodging
 - 4 weeks to 6 months, intensively coached
 - Building on long term academic cooperation basis
- **Many researchers or students stay in the company or become ambassadors at customers**

Digital Twin – setting the scene

Origin

Digital Twin: origin in aerospace

- First mentioning by authors **Tuegel, Glaessgen, Vickers and Kobryn**, from NASA, USAF...
- First turned into a concept by **Michael Grieves**
- Introducing the Digital Twin to explain the requirements for “**as manufactured**” and “**as operated**” simulation models, contrary to and complementary with “as designed”
- Enabling the use for **diagnosis** and model-based monitoring.
- Enabling extension to **individualized** Digital Twin
- Enabling mapping the impact of all loads encountered, with emphasis on structural damage and **residual useful life (RUL)**

Reengineering Aircraft Structural Life Prediction Using a Digital Twin

Eric J. Tuegel,¹ Anthony R. Ingraffea,² Thomas G. Eason,¹ and S. Michael Spottswood¹

¹Structural Sciences Center, Air Vehicles Directorate, U.S. Air Force Research Laboratory, Wright-Patterson Air Force Base, Dayton, OH 45433, USA

²School of Civil and Environmental Engineering, Cornell University, Ithaca, NY 14853, USA

The Airframe Digital Twin: Some Challenges to Realization

Eric J. Tuegel¹

U. S. Air Force Research Laboratory, Dayton, OH 45433

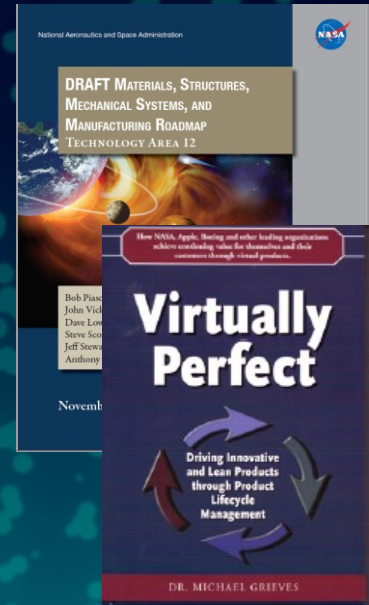
The Digital Twin Paradigm for Future NASA and U.S. Air Force Vehicles

E. H. Glaessgen*

Durability and Damage Tolerance Branch
NASA Langley Research Center, Hampton, Virginia, 23681

D.S. Stargel†

Aerospace, Chemical, and Material Sciences
Air Force Office of Scientific Research, Arlington VA, 22203



Condition-based Maintenance Plus Structural Integrity (CBM+SI) & the Airframe Digital Twin

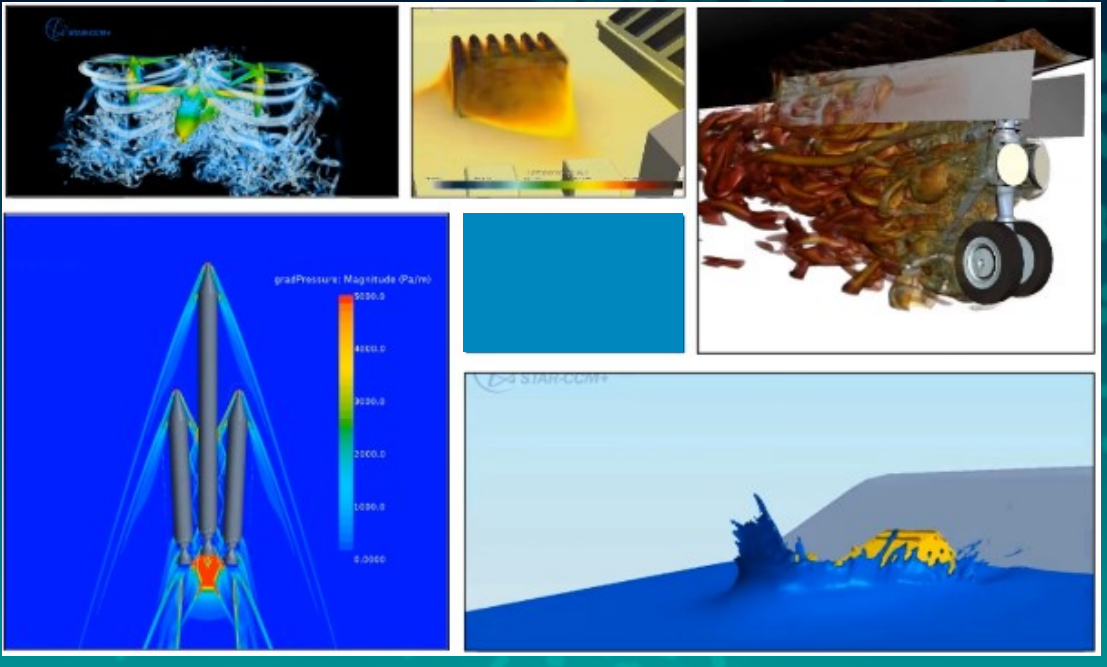
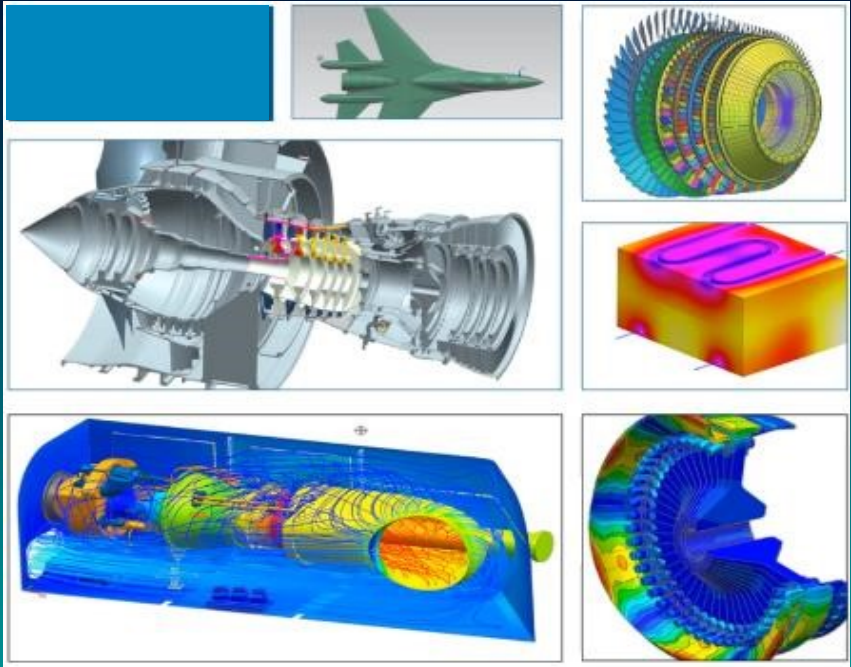
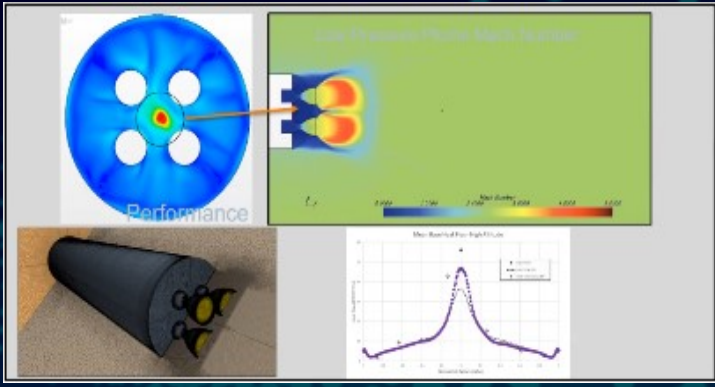
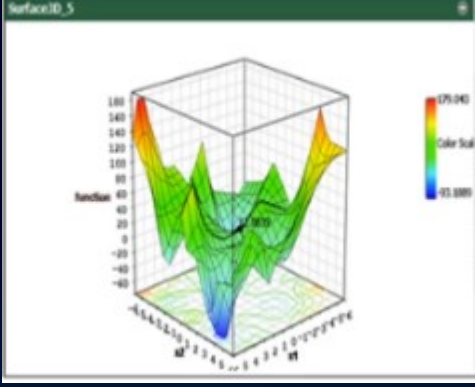
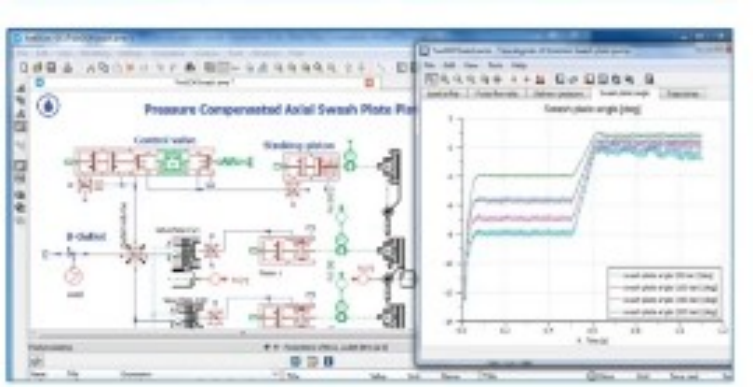
March 2011

Pamela A. Kobryn & Eric J. Tuegel
Structural Mechanics Branch
Air Vehicles Directorate
Air Force Research Laboratory

Example early papers on Digital Twin

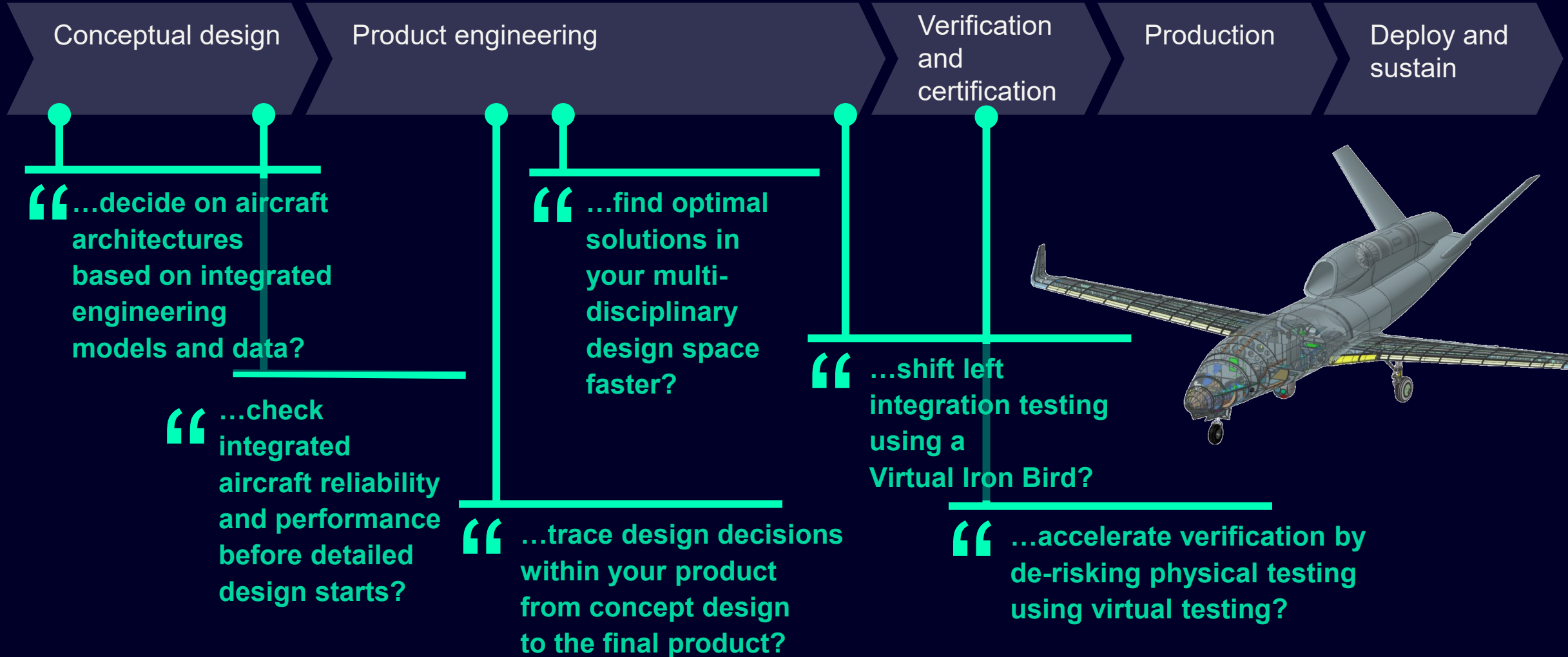
Digital Twin – setting the scene

Enabling model-based design and digital prototyping – multiple aspects

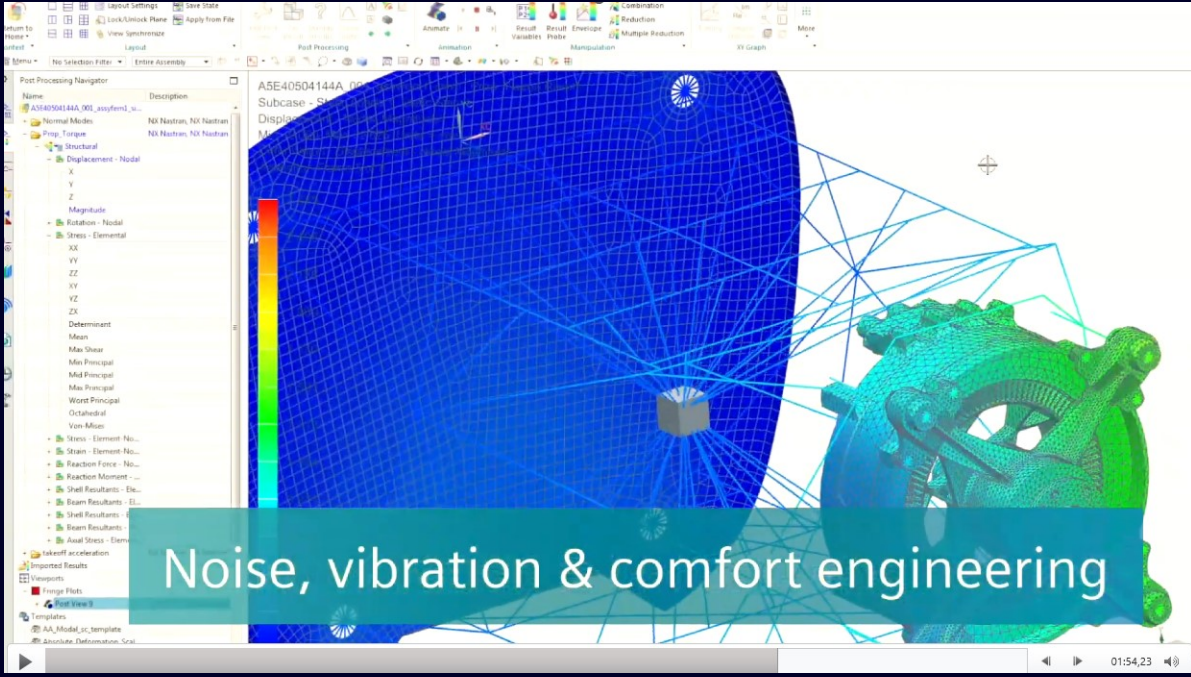
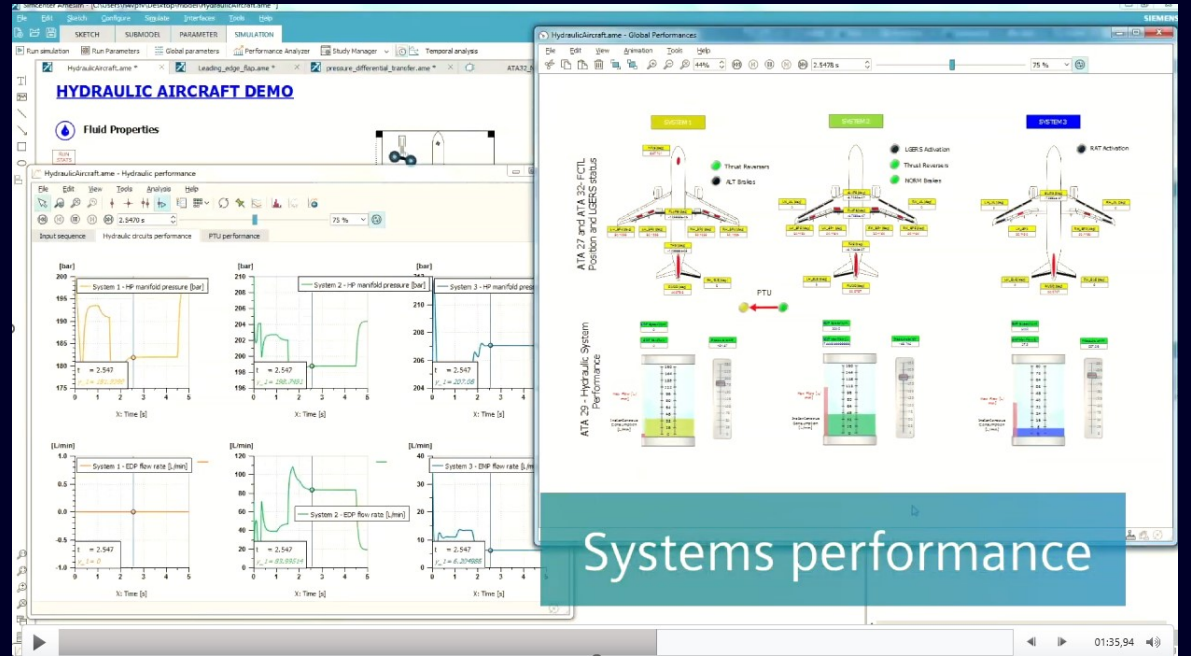
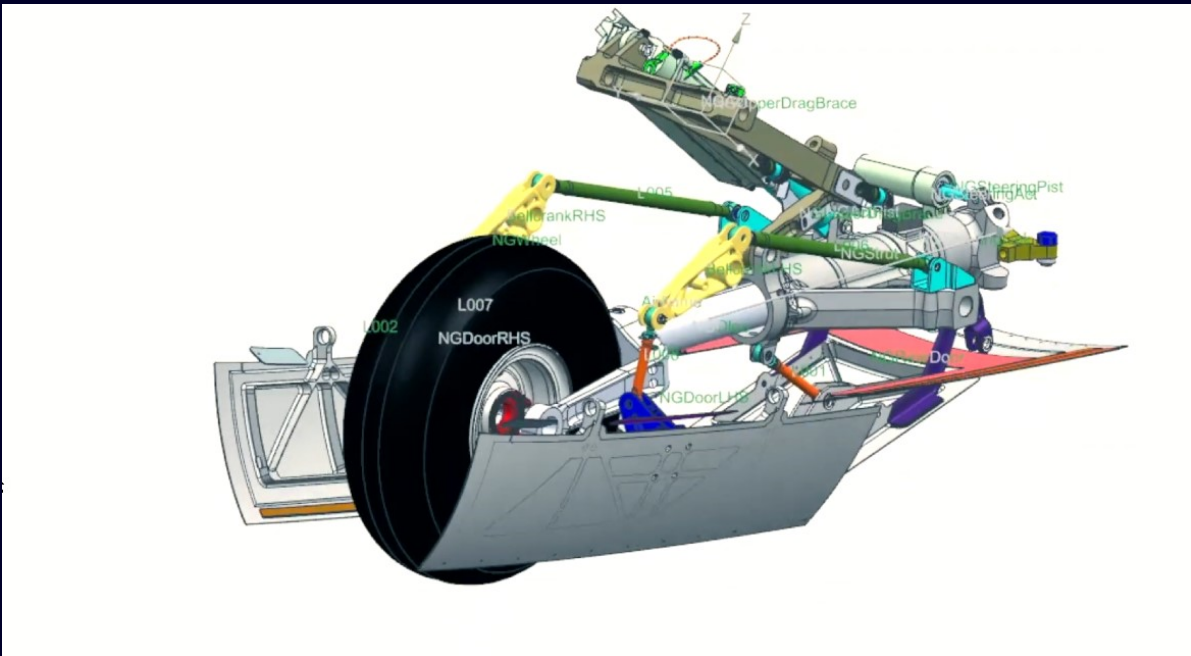


New aircraft program

What if you could...







Physical Ground Vibration Testing

Accelerating the tests and gaining more insights

PRODERA shakers on Airbus 340-600 engine



Accelerometers on F16 structure



Instrumentation:

- Modal Shakers
- Sensors
- Suspension systems (Aircraft and shakers)
- Simcenter SCADAS Data acquisition system

Measurement:

- FRF acquisition (Random / Sine)
- Normal modes for critical modes

Modal Analysis:

- Extraction of modal parameters
- Quick correlation with FE predictions

SIMCENTER SCADAS



SIMCENTER Testlab Software



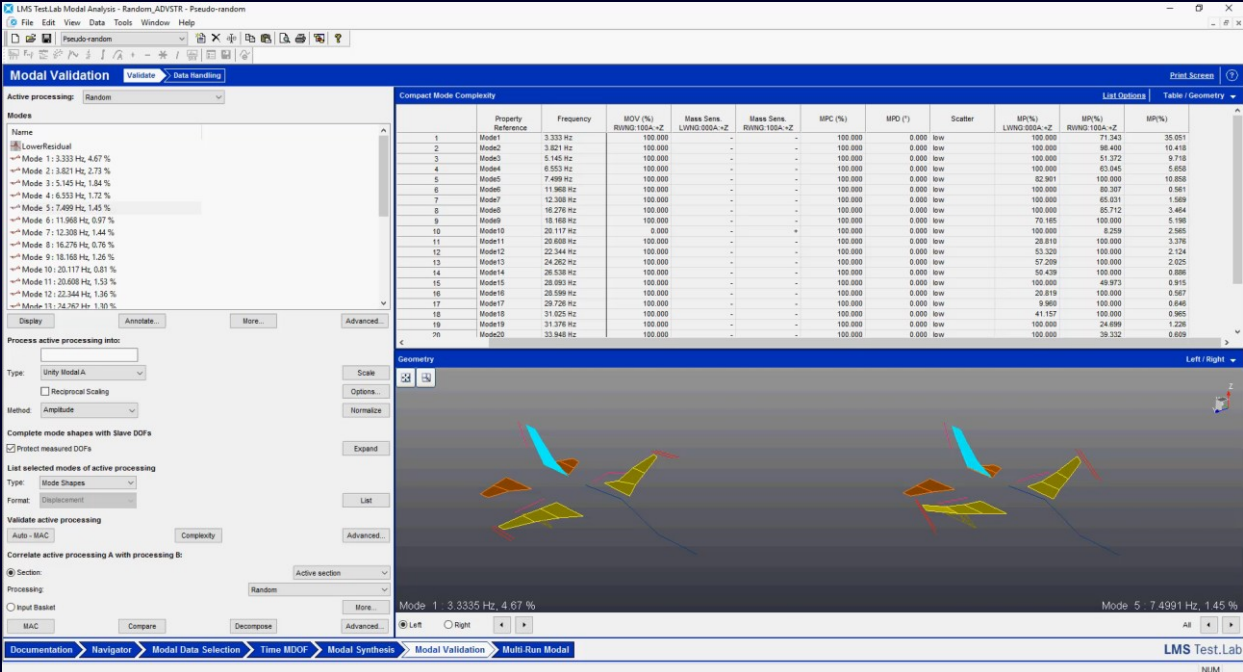
Sheer measurement productivity

Flexibility fitting industry needs

From measurements to insights

Physical Ground Vibration Testing

Sharing our expertise



Thank You!



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