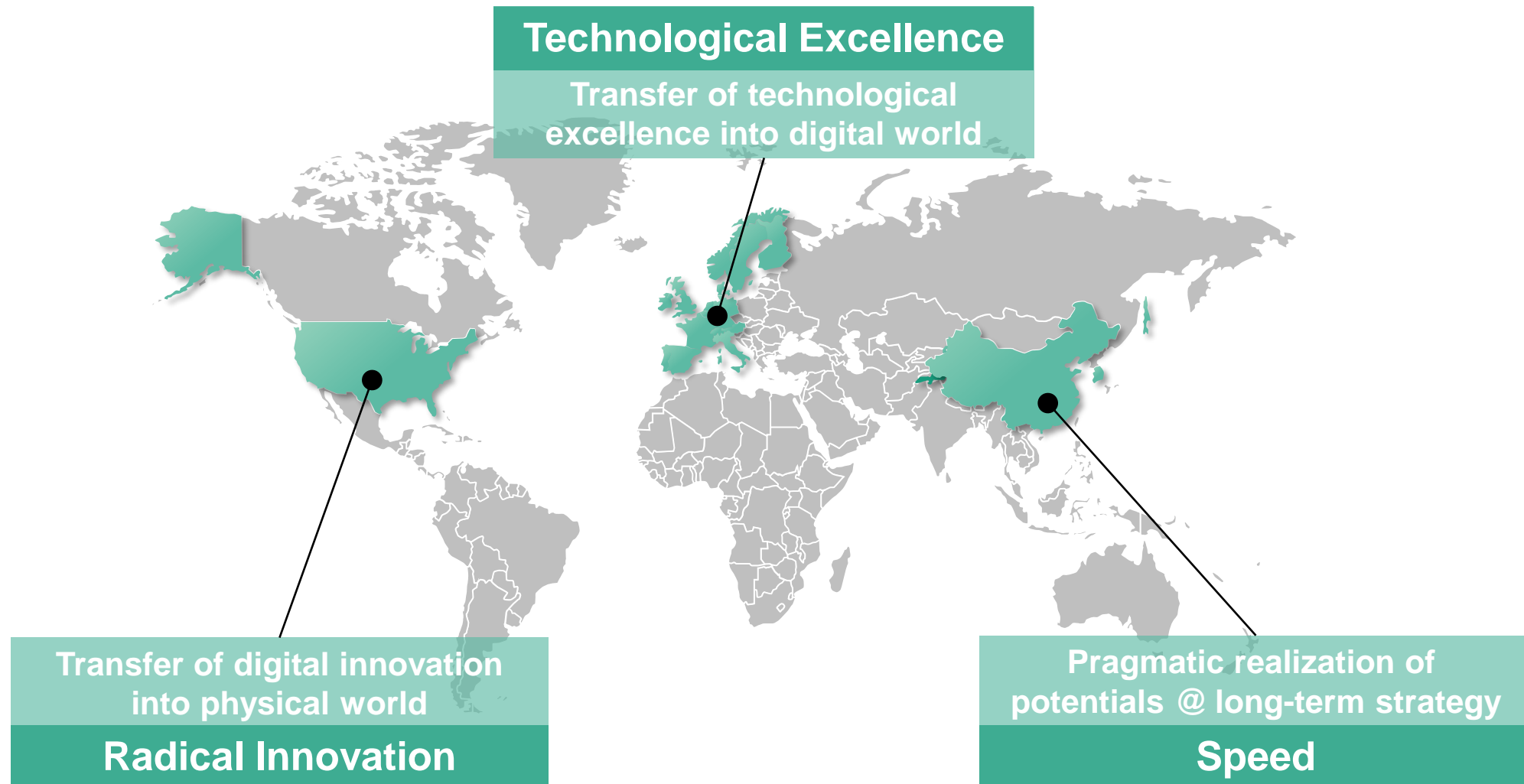


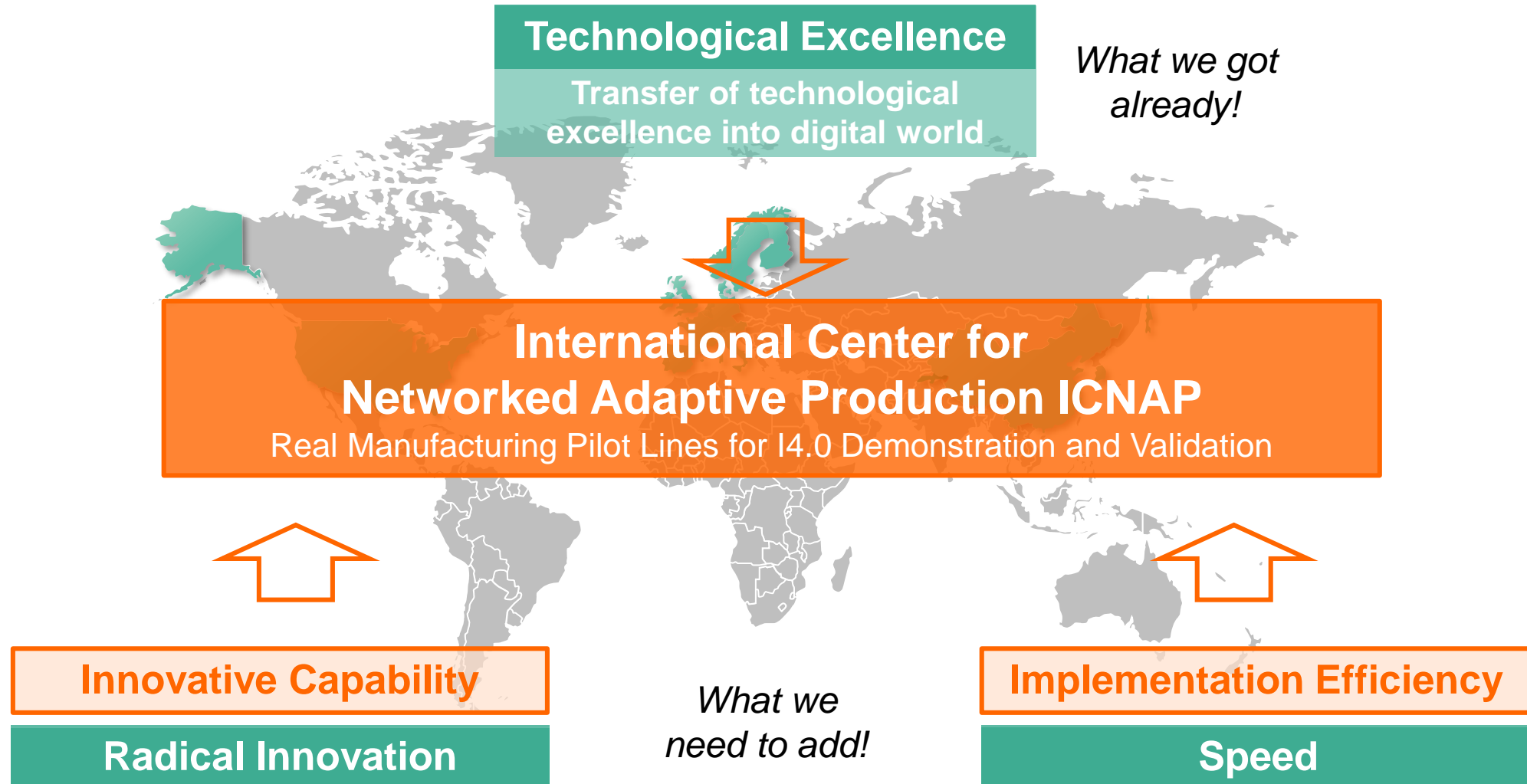
TRENDS IN DIGITAL MANUFACTURING

Prof. Dr.-Ing. Thomas Bergs MBA | Fraunhofer-Institute for Production Technology, IPT, Aachen

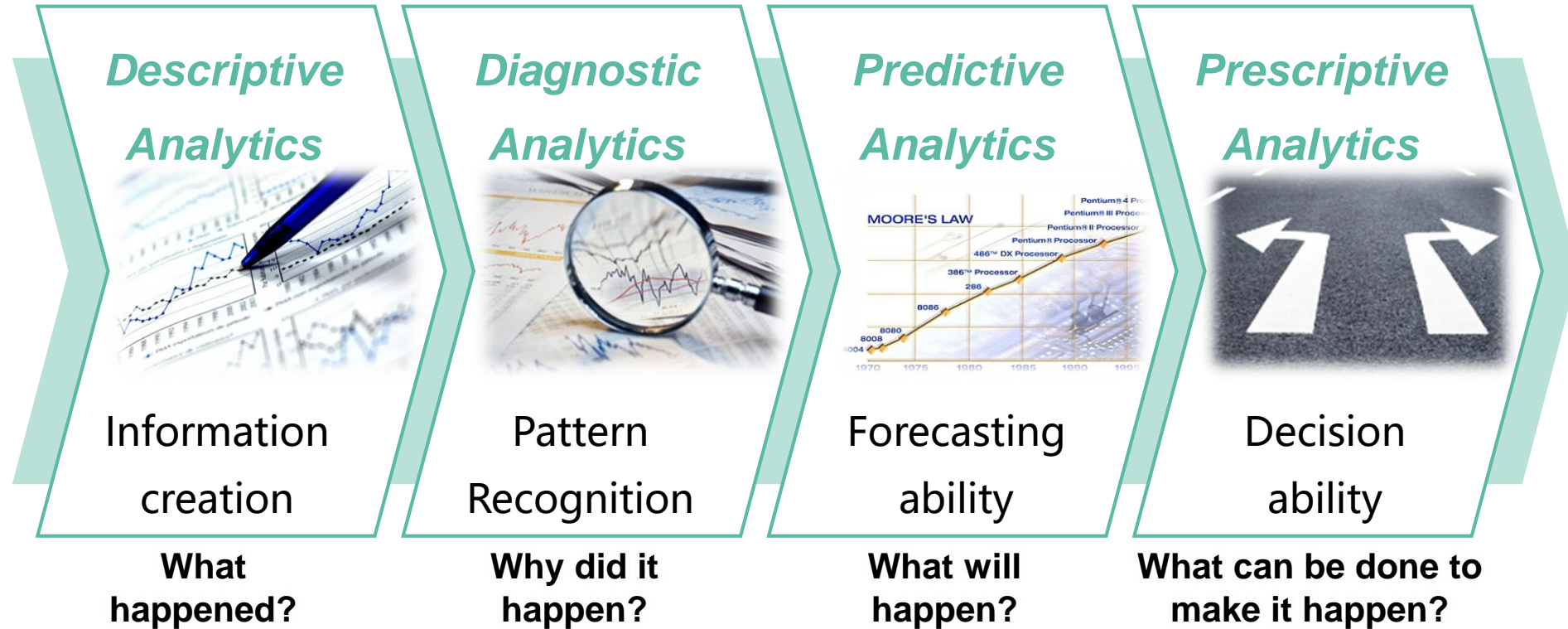
Industrie 4.0 - What happens worldwide?



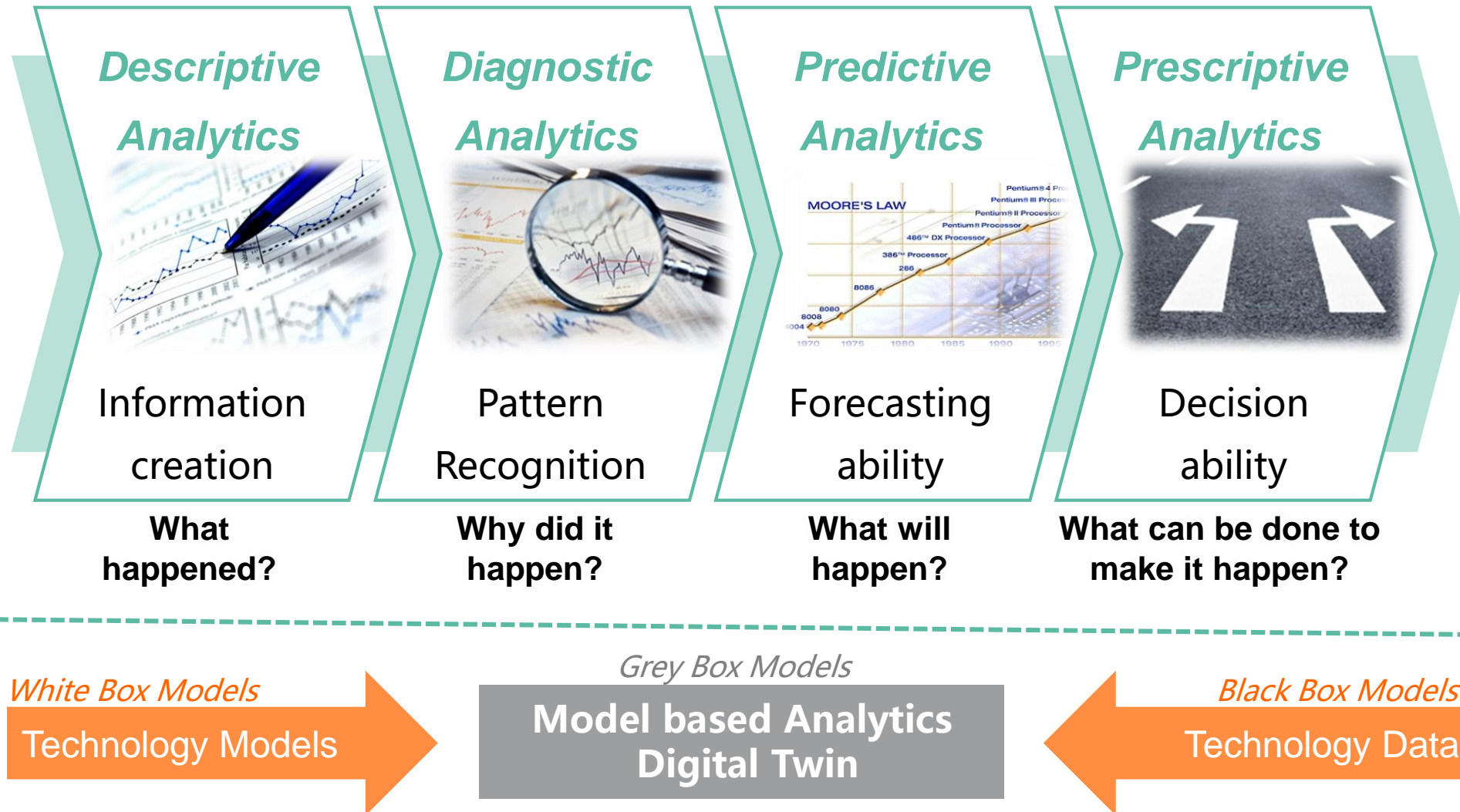
Industrie 4.0 - What is our approach?



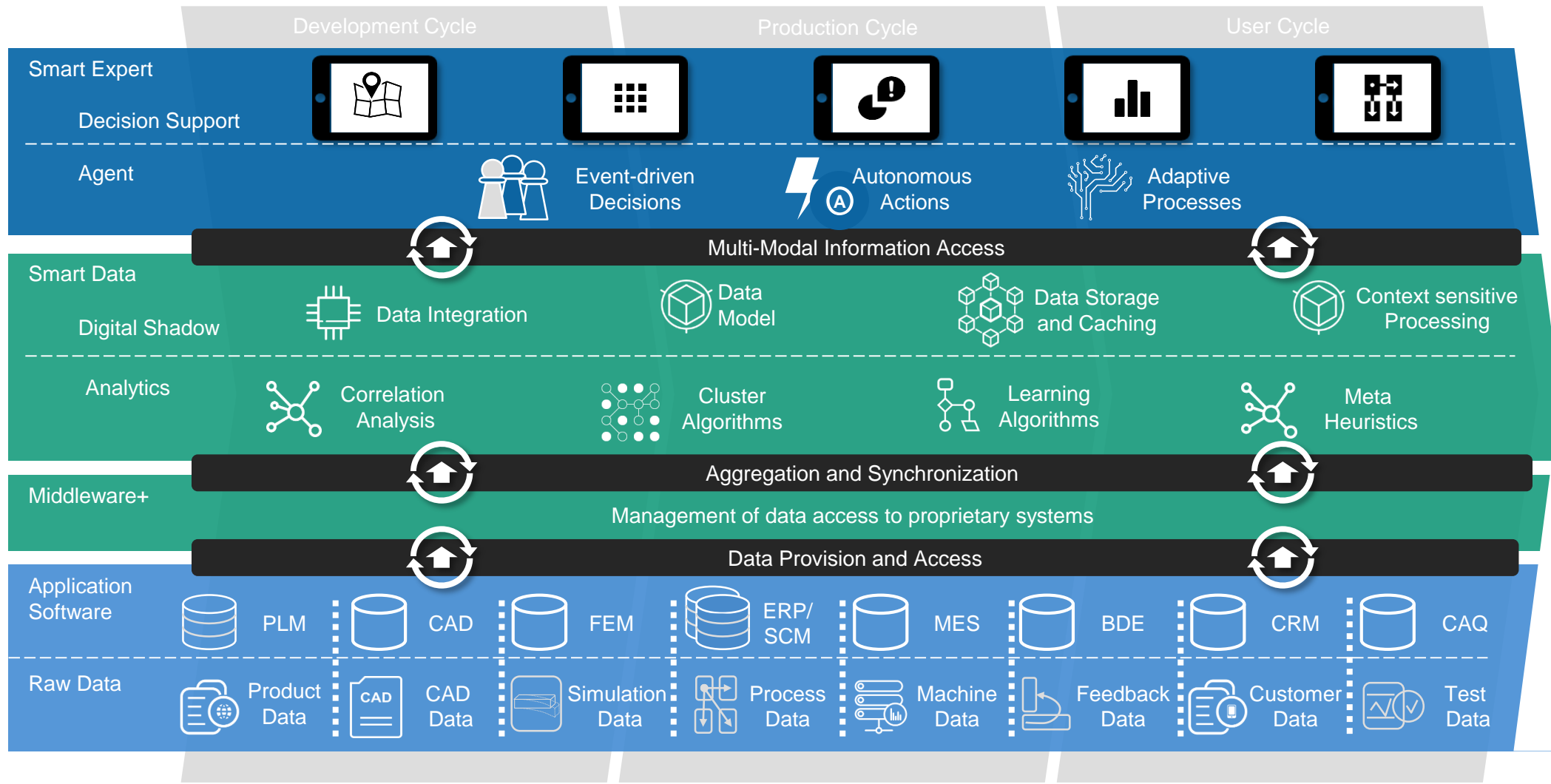
Utilizing Data for Manufacturing as Principle of Industrie 4.0



Utilizing Data for Manufacturing as Principle of Industrie 4.0

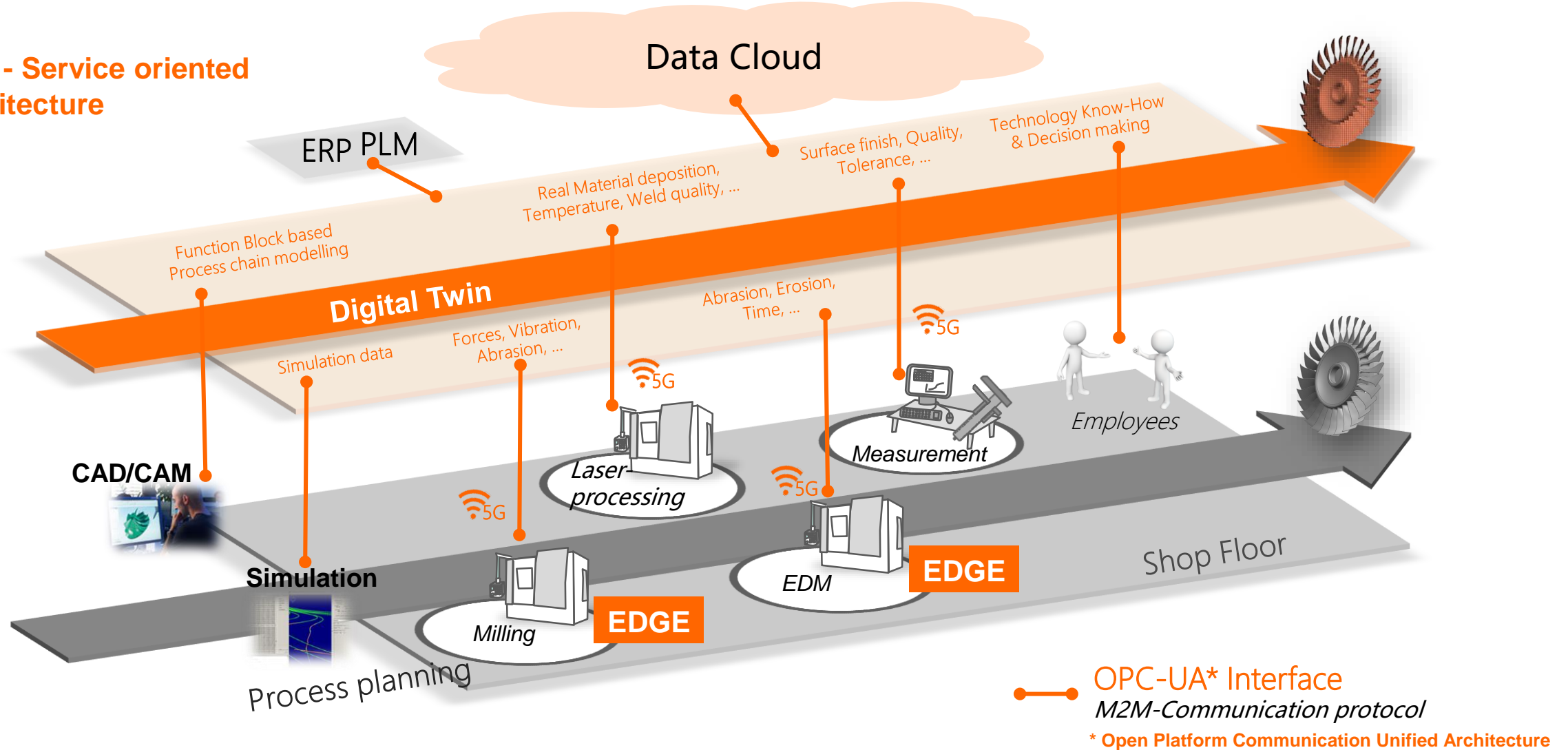


“Internet of Production” as Reference Data Architecture

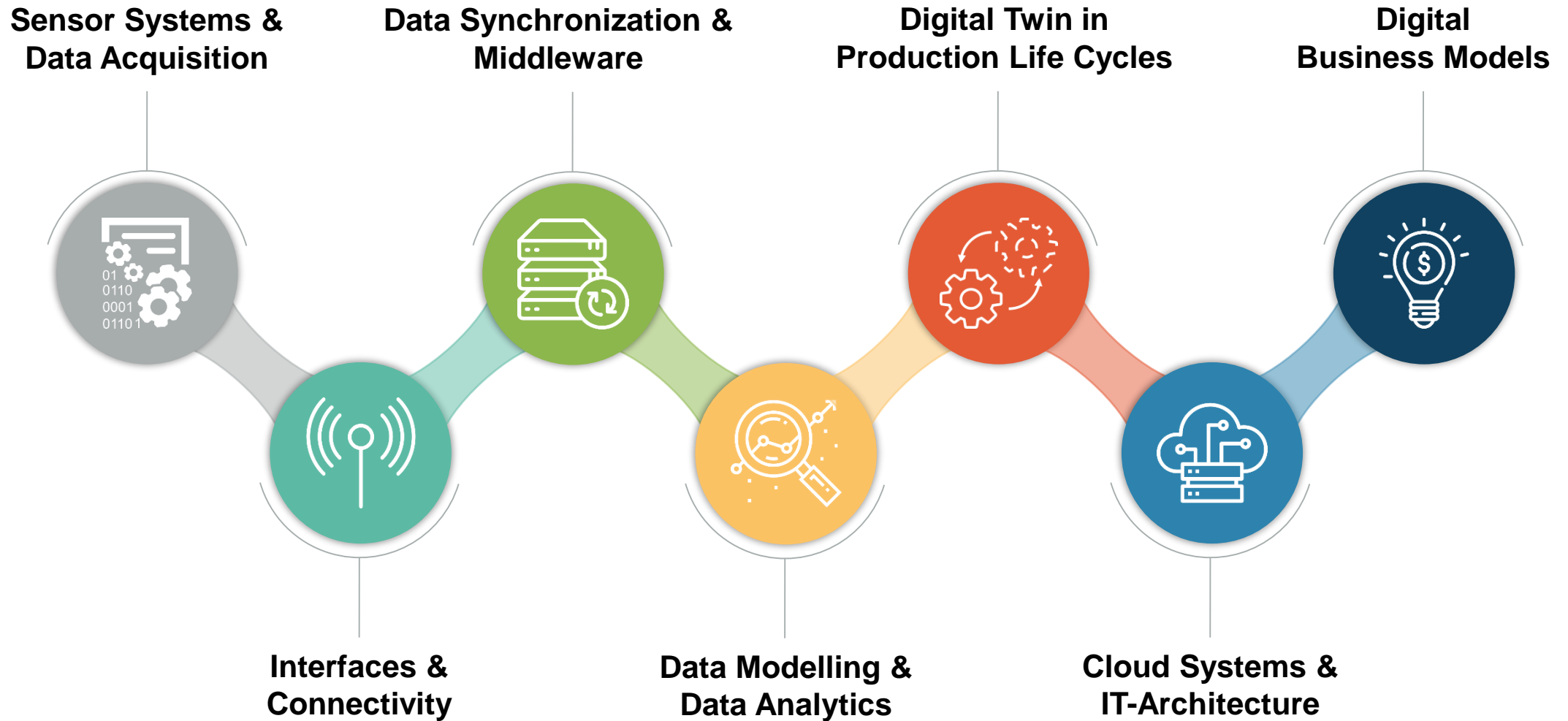


Pilot Lines for Validation – Principle Architecture

SOA - Service oriented
Architecture



New Disciplines - From Data Acquisition to Digital Business Models



Pilot Line »BLISK Manufacturing«

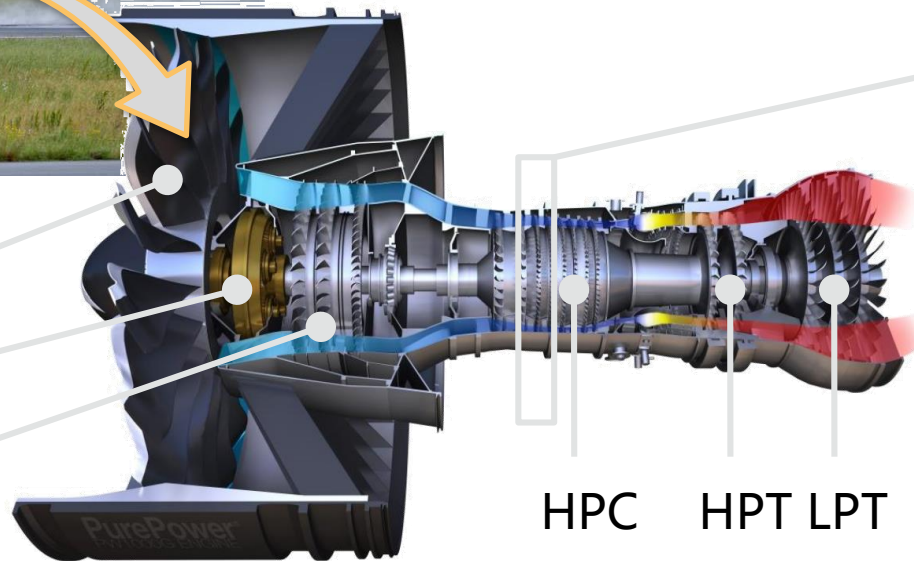
New Airbus 320 neo



Fan

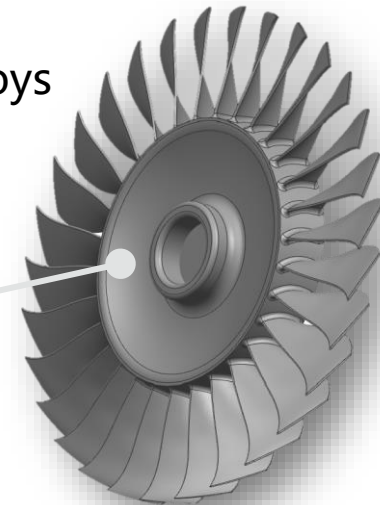
Gear

LPC



High Pressure Compressor Front Stage

- BLISK Design
BLade Integrated *disk*
- Ti/ Ni-based Super Alloys
- Tolerances $\sim 20 \mu\text{m}$



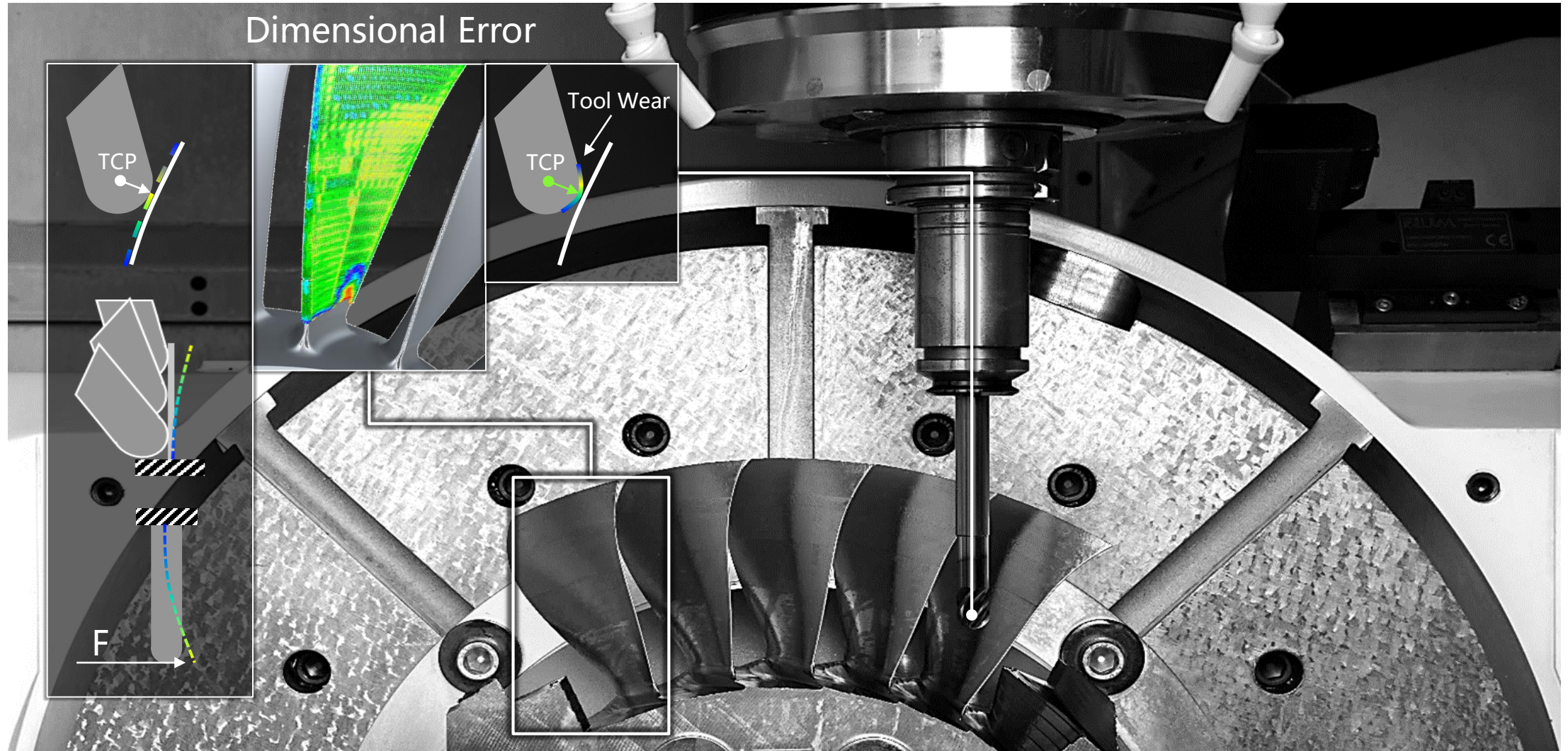
Pratt & Whitney PW1100G Engine

Quelle: Airbus, Pratt & Whitney

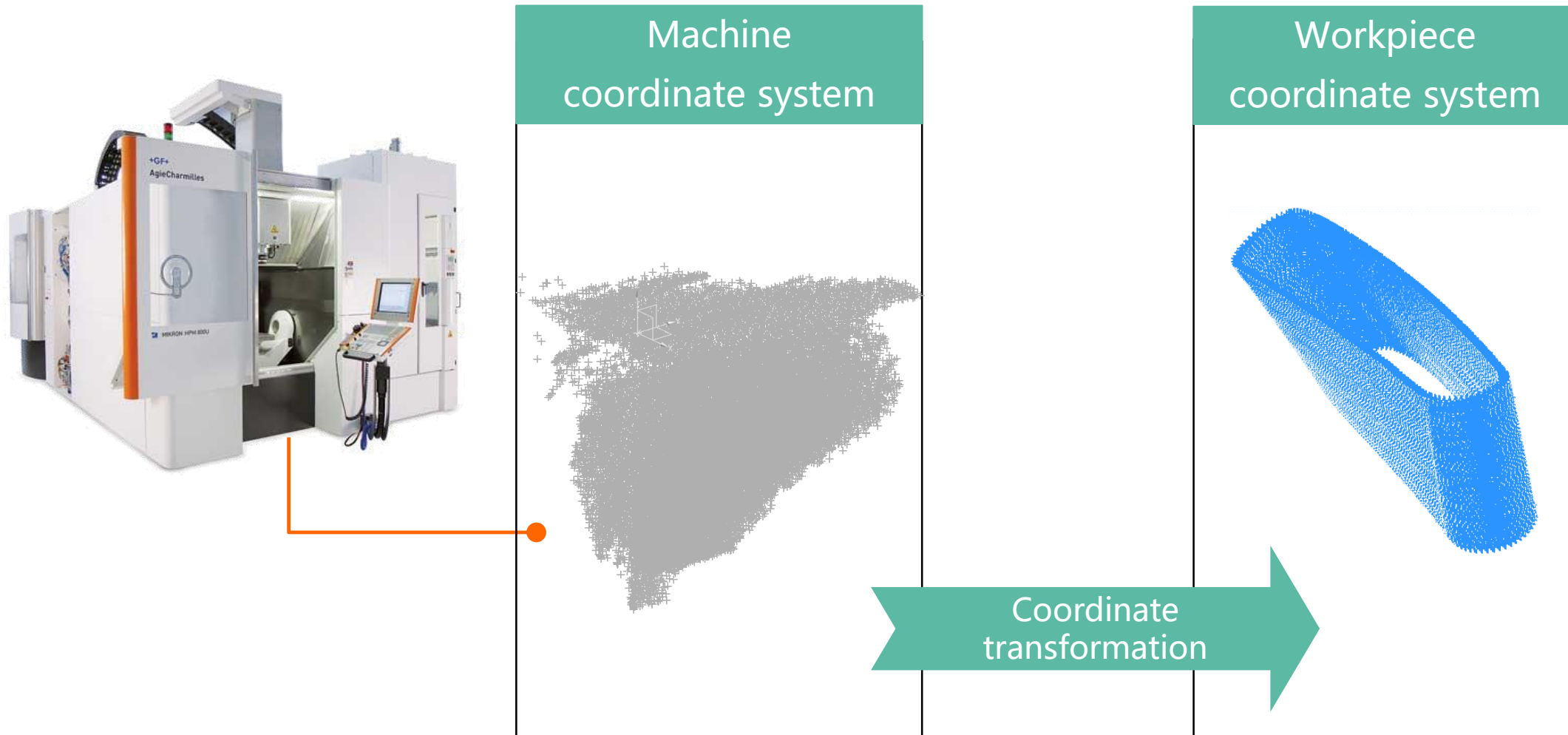
Pilot Line »BLISK Manufacturing« – Challenges in Blisk Finishing



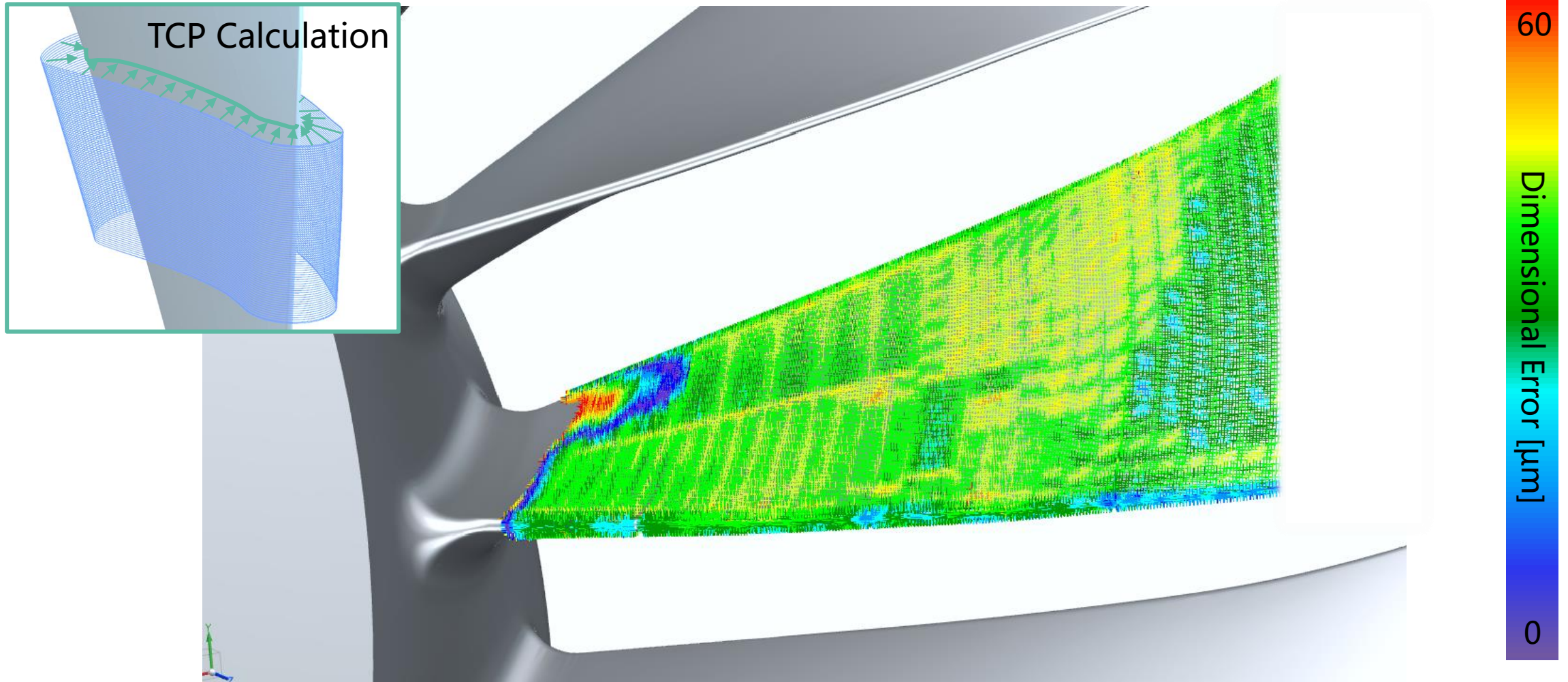
Pilot Line »BLISK Manufacturing« – Challenges in Blisk Finishing



Pilot Line »BLISK Manufacturing« – Data Acquisition

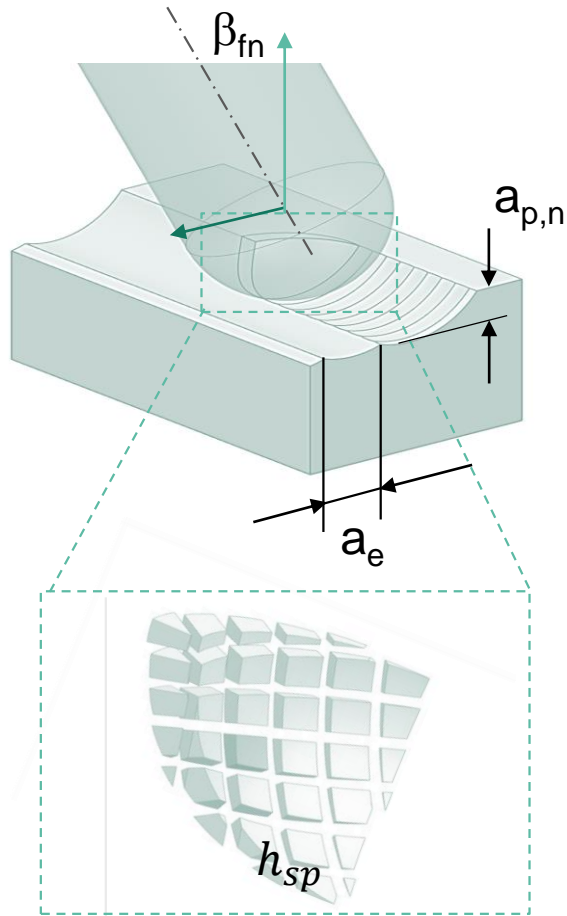


Pilot Line »BLISK Manufacturing« – Geometry Deviation Analysis

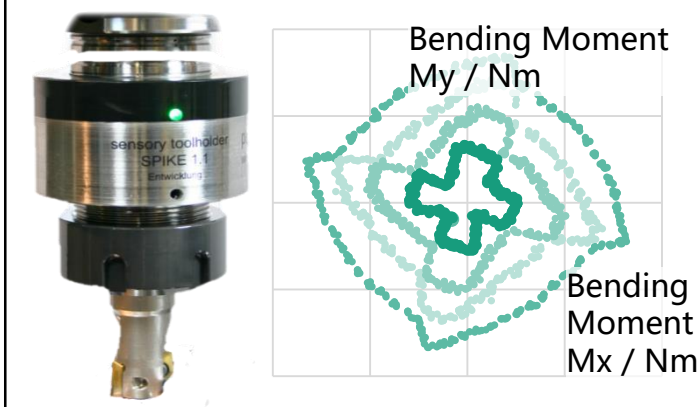


Pilot Line »BLISK Manufacturing« – Referencing of Cutting Forces

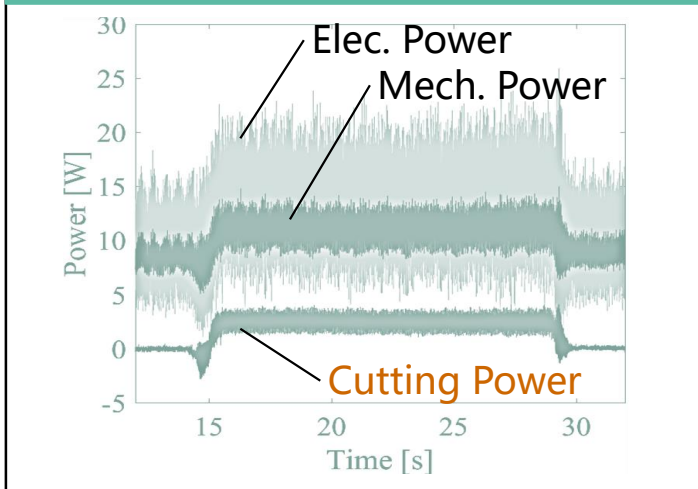
Engagement Simulation



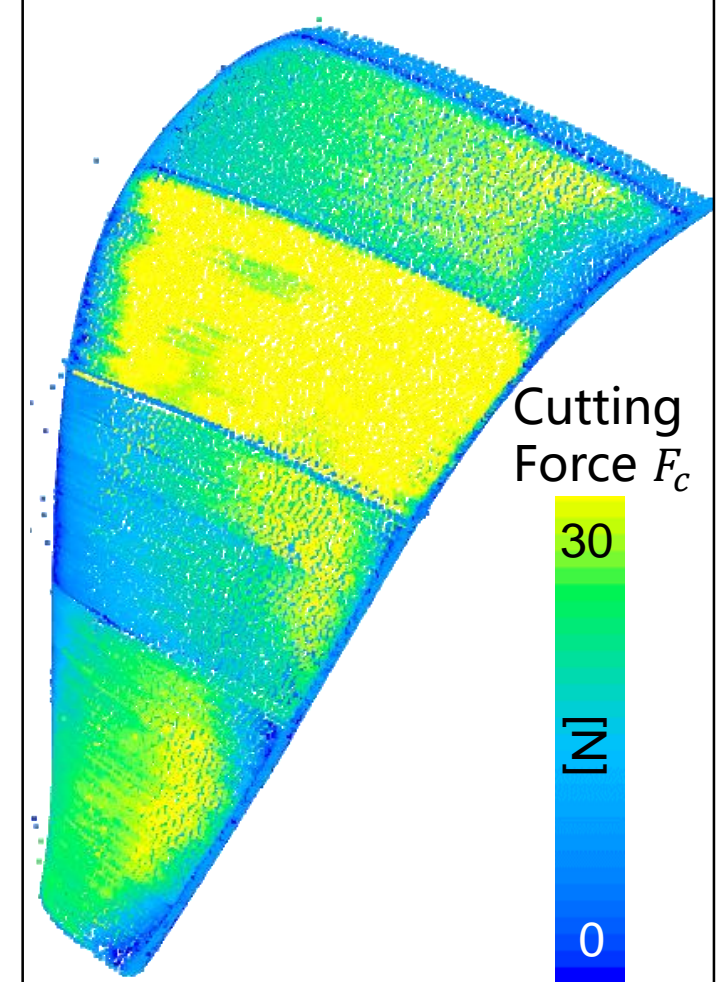
Tool Integrated Sensors



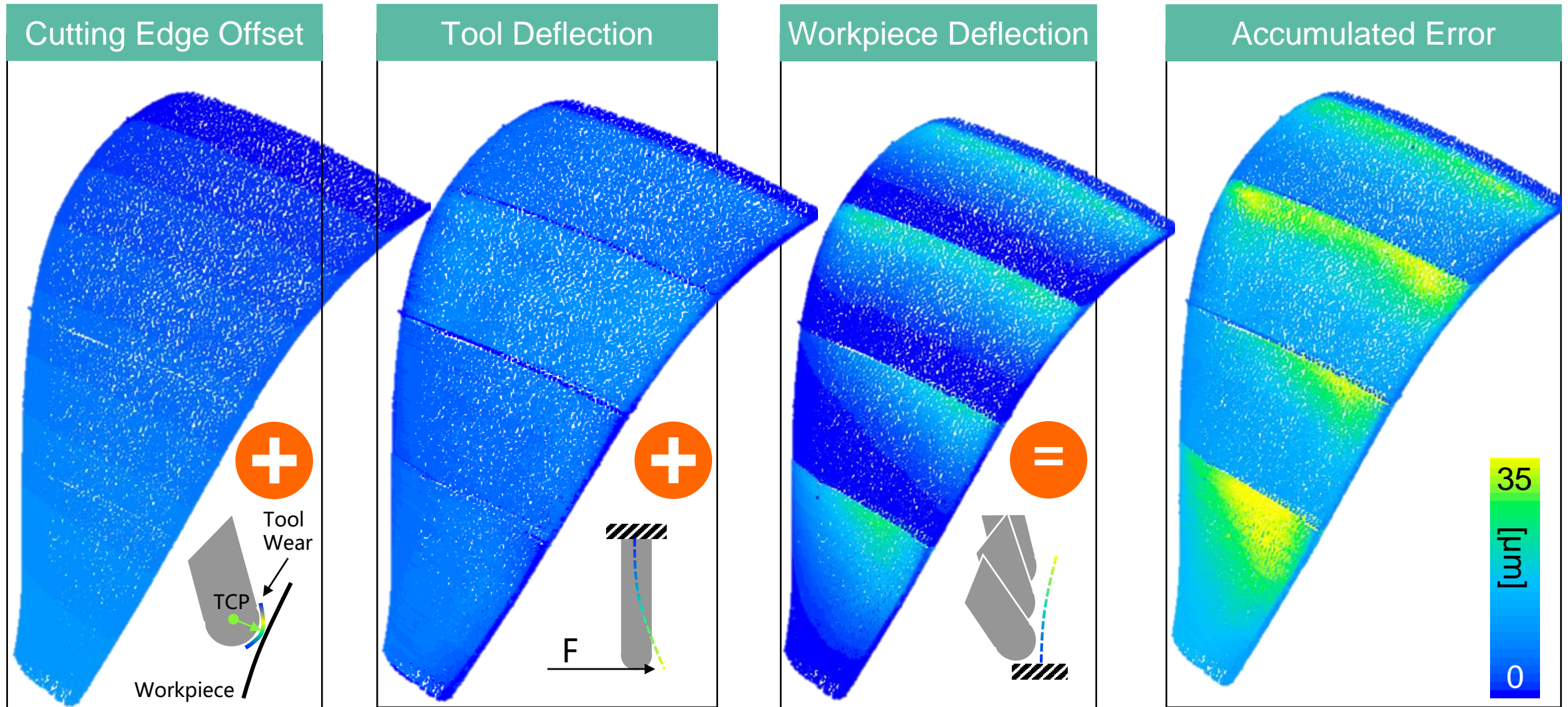
Power of Drives



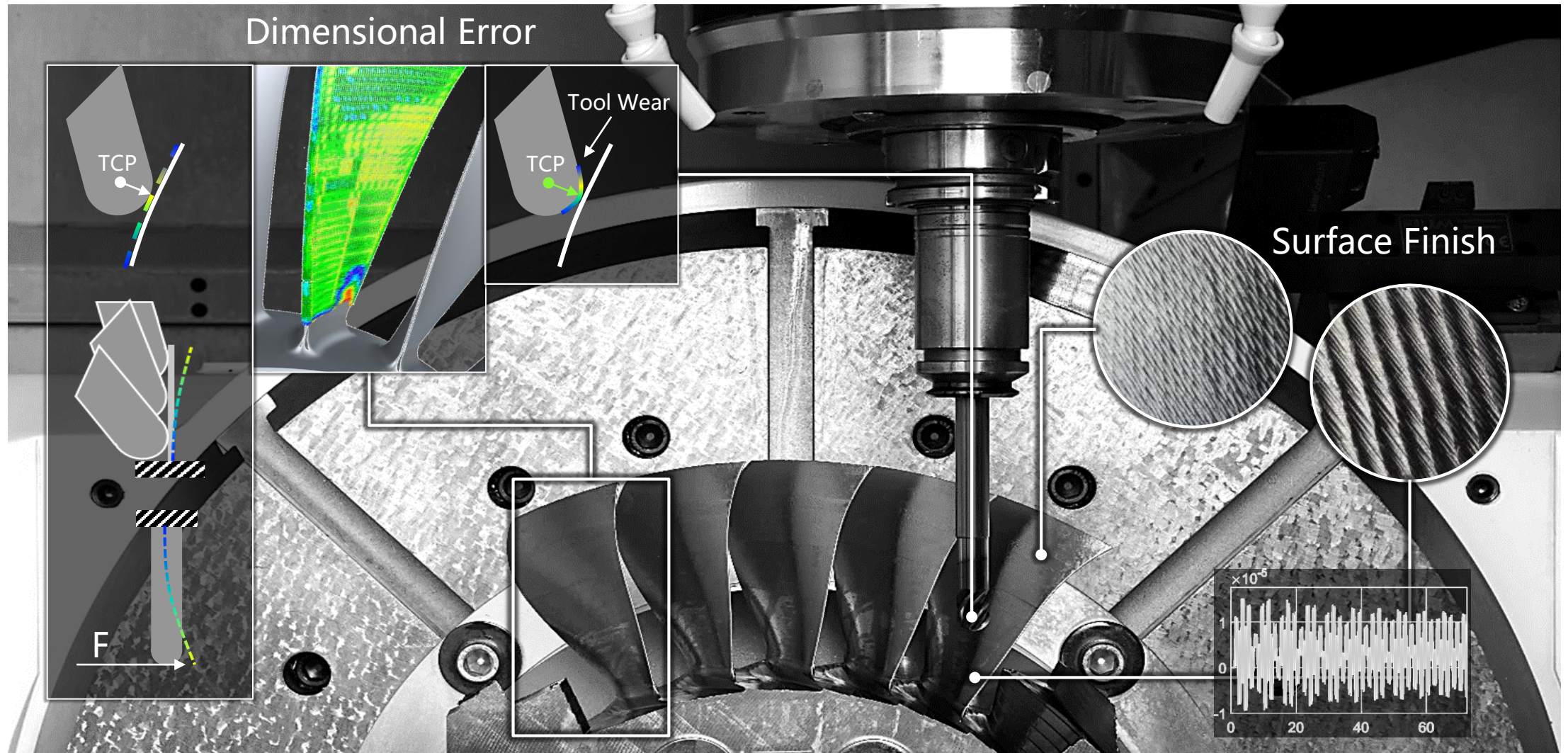
Referenced Cutting Forces



Pilot Line »BLISK Manufacturing« – Data Driven Calculation of Dim. Error



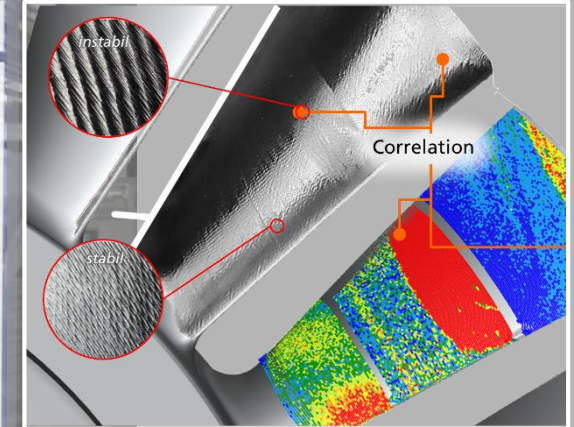
Pilot Line »BLISK Manufacturing« – Challenges in Blisk Finishing



5G Testbed for Smart Manufacturing at Fraunhofer IPT

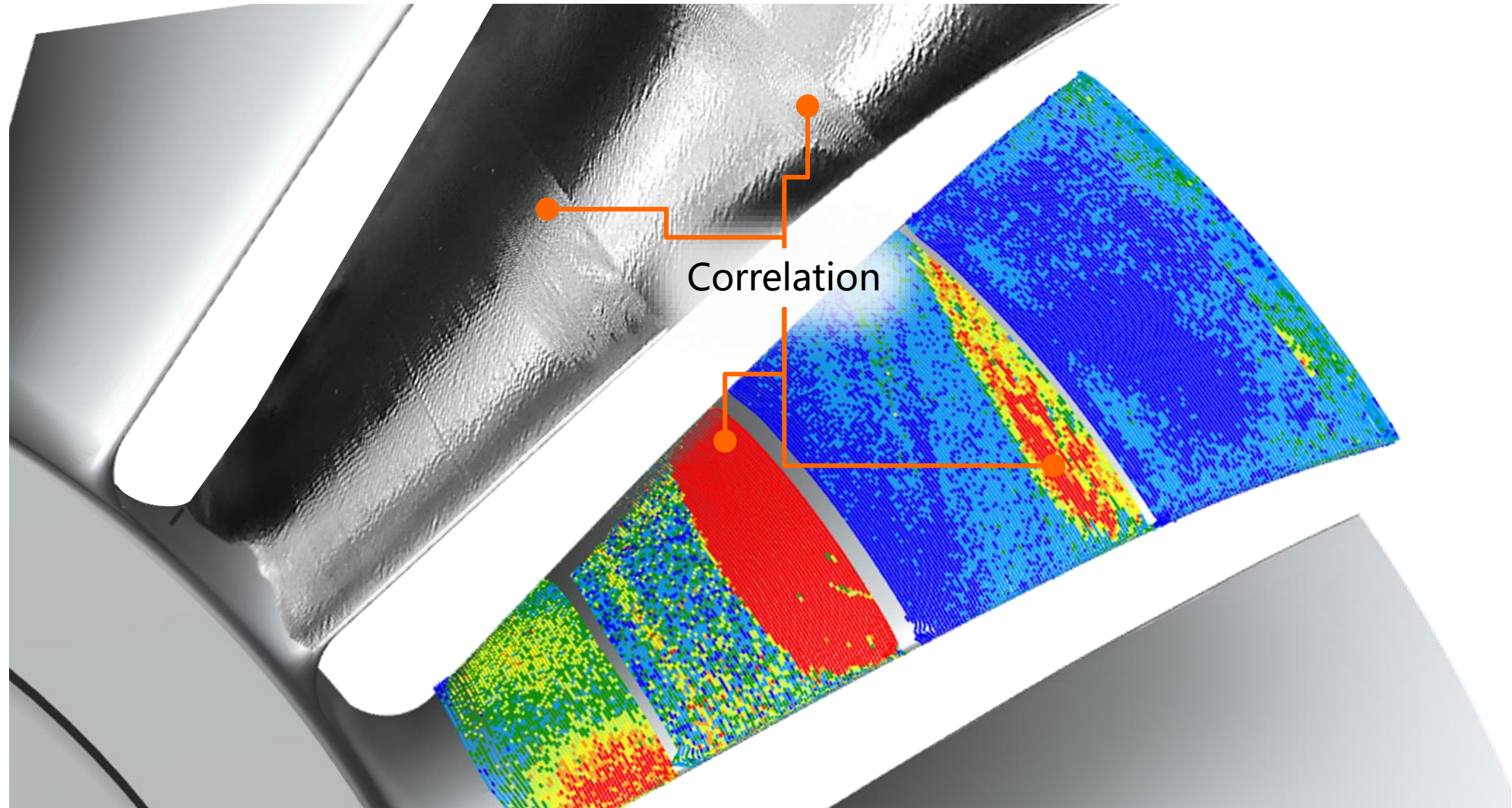


Visualizing of vibrations in BLISK manufacturing



- 5G Testbed in operation at Fraunhofer IPT since March 2018
- Extreme Low Latency < 1ms (20 μ s jitter) with data rates of 10 Gbit/s
- Full spec 3,5 GHz 5G NR pre-commercial prototype system
- Worlds first public In-Process installation of 5G in manufacturing

Pilot Line »BLISK Manufacturing« – Visualization of Part Vibration



5G-Industry Campus Europe will be the Largest Industrial 5G Testbed



CREATING THE
5G-MANUFACTURING
ECOSYSTEM
5G INDUSTRY
CAMPUS
EUROPE

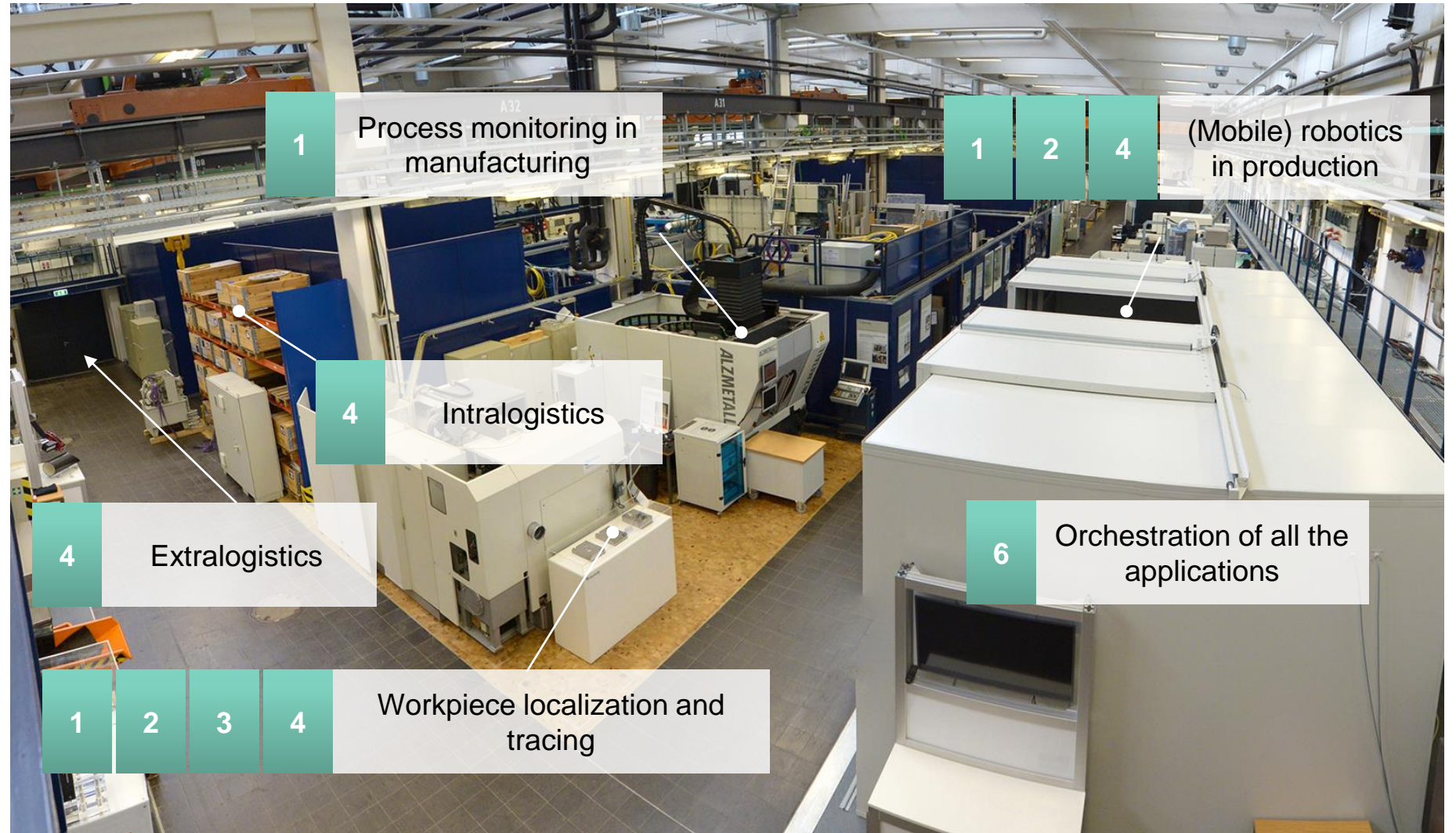
5G-Industry Campus Europe will be the largest industrial 5G testbed

- 5G indoor networks on 4 different shopfloors fully equipped with machines and robots
- 5G outdoor network of 1 km² at the RWTH Aachen Campus
- 5G-NSA running on industry spectrum @3.7 – 3.8 GHz
- Simultaneous 4G network running @2.3 GHz as anchor band


5G Offers Several Possibilities for Production



- 1 Ultra-reliable low latency communication
- 2 Enhanced mobile broadband
- 3 Massive machine-type communication
- 4 Localization
- 5 Cross-site communication
- 6 Slicing

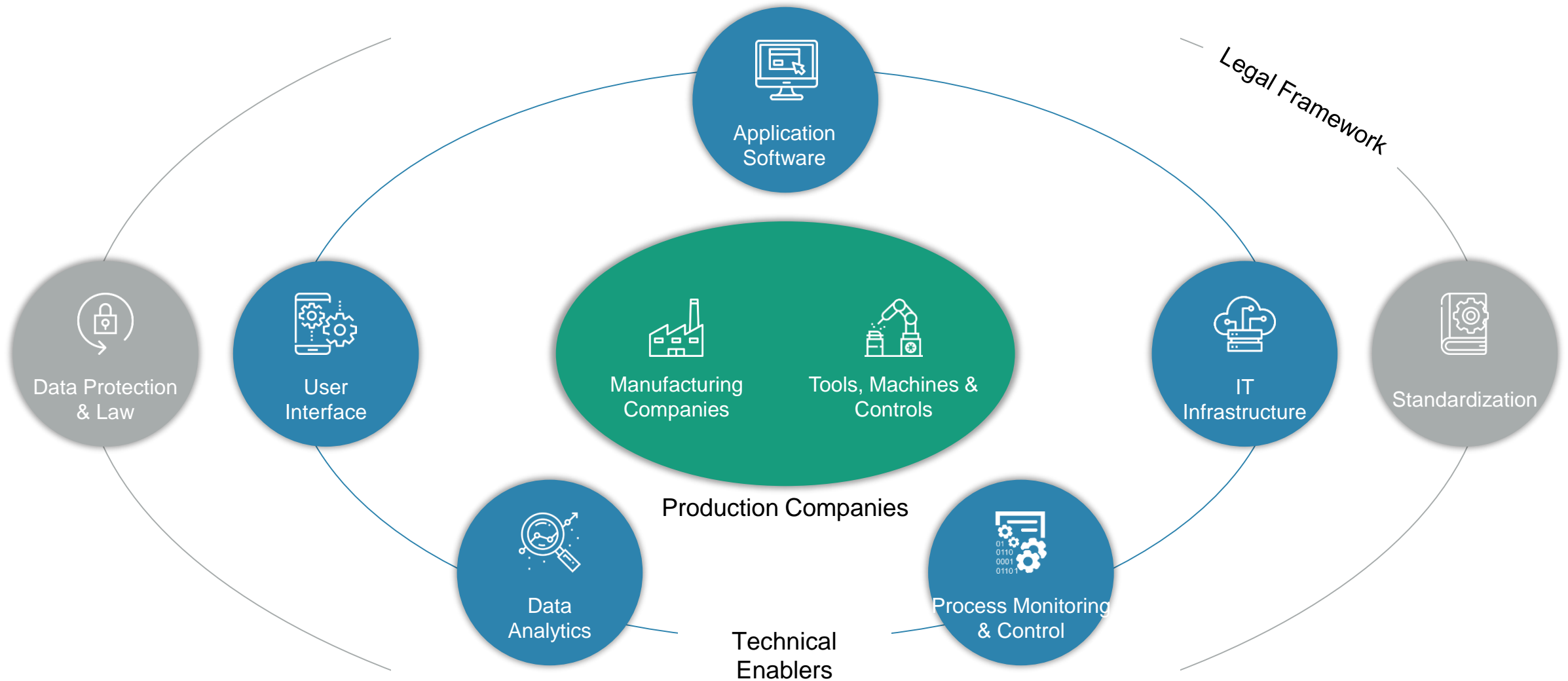


What is our approach to find solutions for a
»Networked, Adaptive Production«?

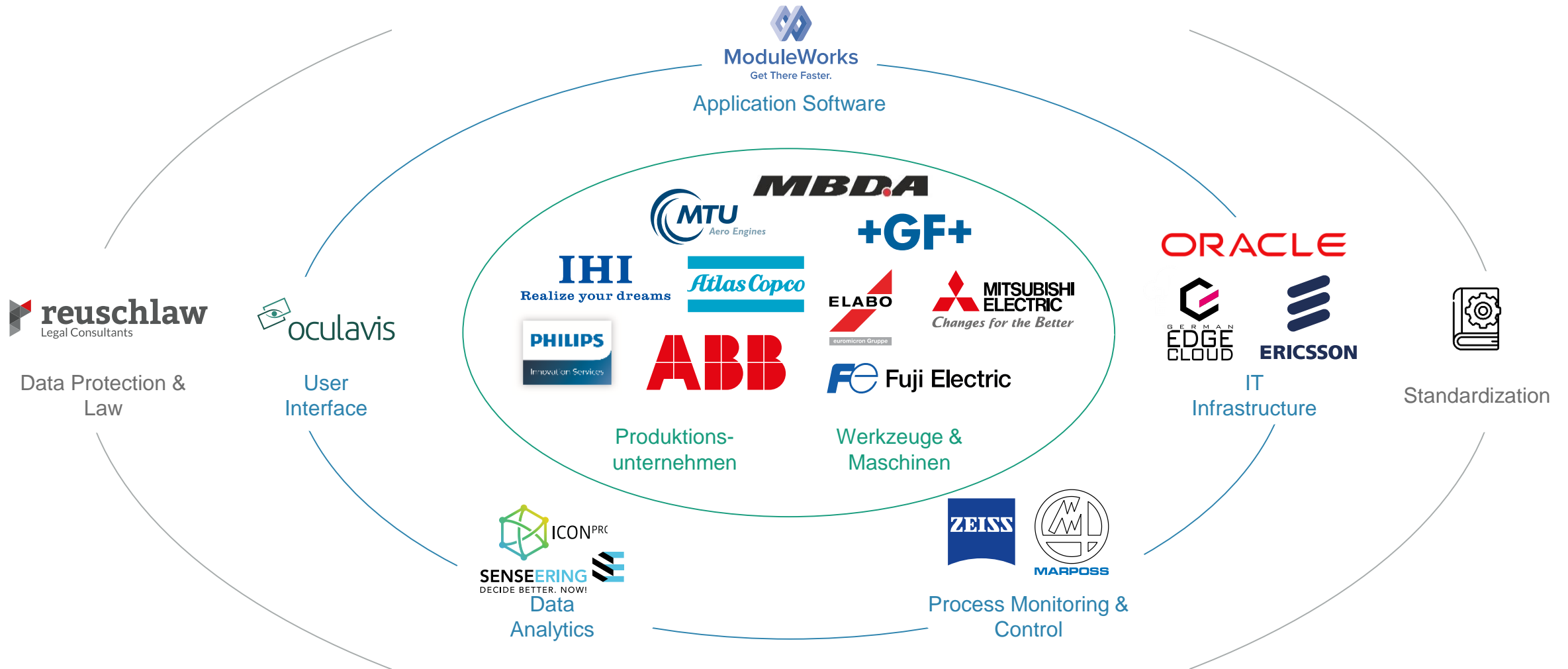


Together we are strong!
Our Community for »Networked, Adaptive Production«

Users and Enabler of Digitalization have to Join Forces to Reach the Vision!



Overview of 20 ICNAP Community Member (November 2019)



9 Collaboration Possibilities in ICNAP to Work on the Presented Topic Fields



First Community Meeting: 12th and 13th December 2018



80
participants



14 community
members in first year



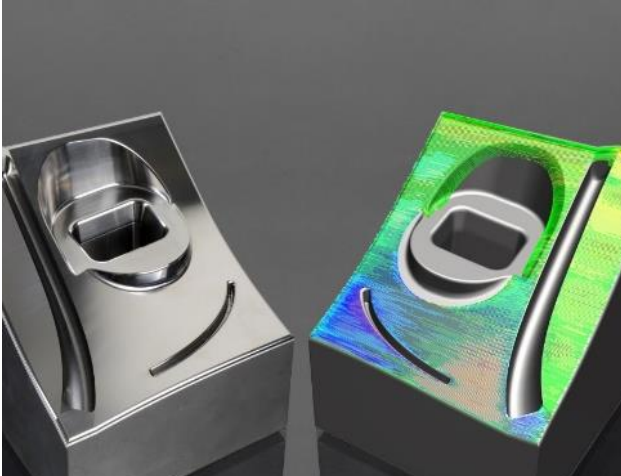
Choice of three
collaborative studies



Choice of two
working groups



Three studies in different areas started in 2019



Merging data from different manufacturing sources in one Digital Twin



Development of a reference architecture for 5G-enabled production

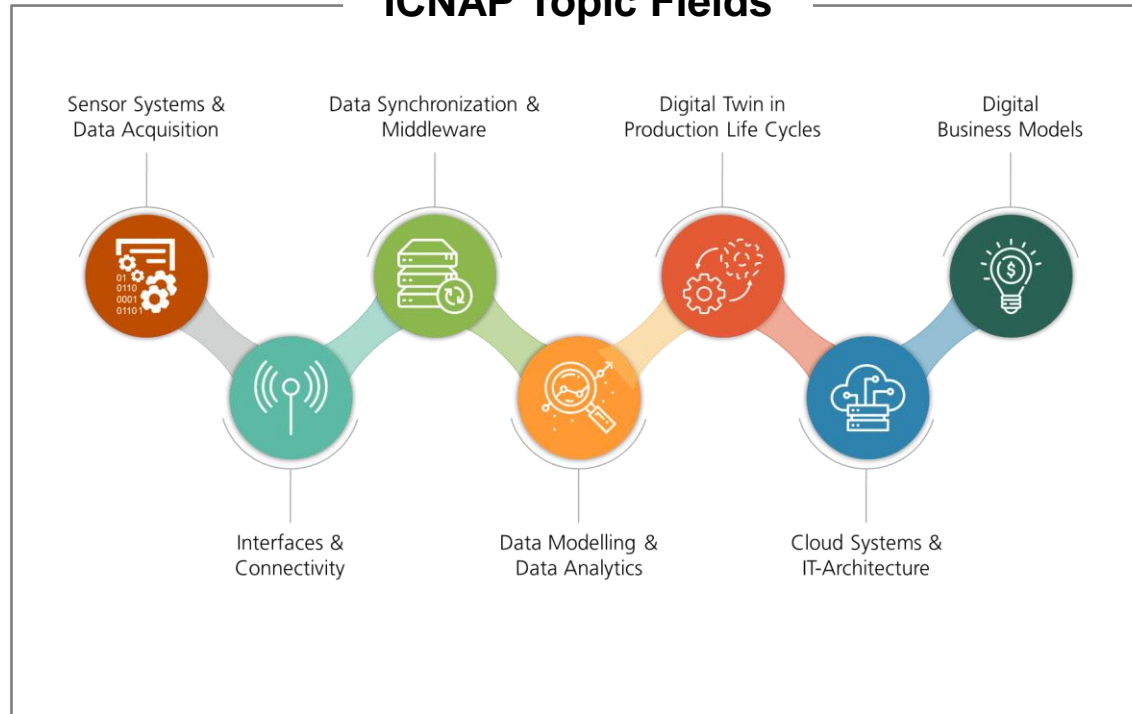


Middleware Software for Industrial Internet of Things (IIoT)

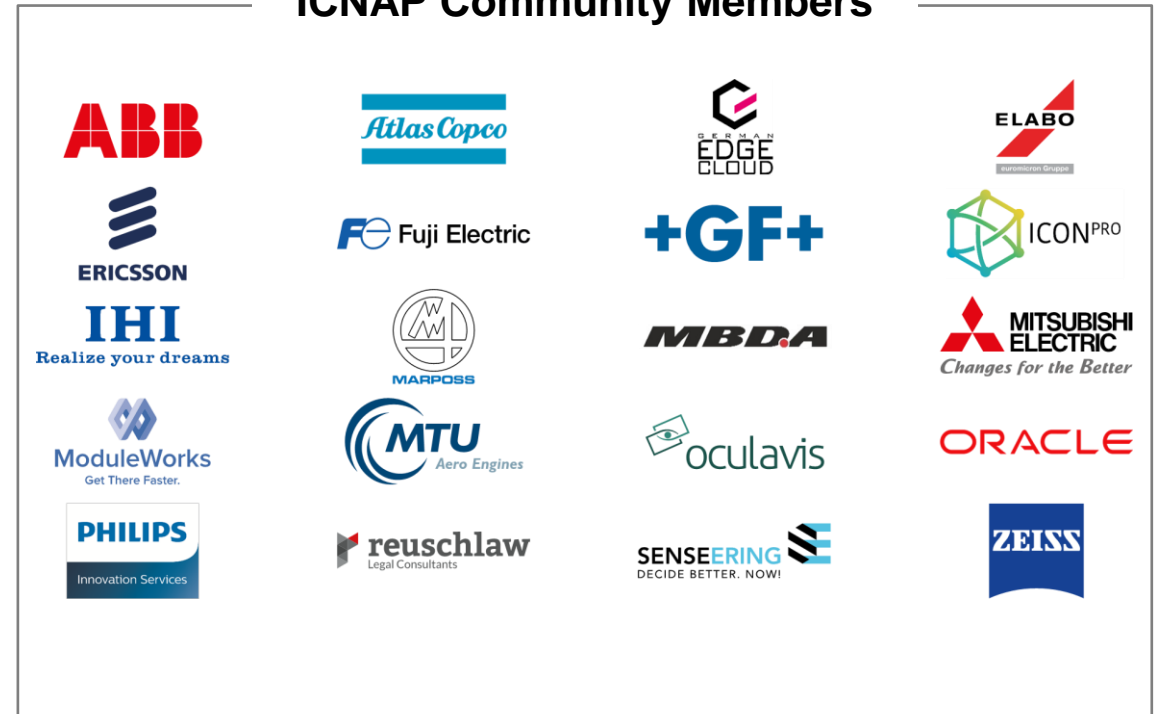
The aim of every study is to develop demonstrators and publish the results in reports, which will be presented during the annual meetings!

Join our International Center for Networked, Adaptive Production (ICNAP)

ICNAP Topic Fields



ICNAP Community Members



Join our 2nd Annual Community Meeting on 04 December in Aachen and get to know our topics and members

TRENDS IN DIGITAL MANUFACTURING



Thank you very much for your attention!