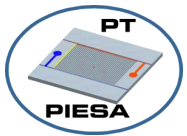


Technology Fusion in Series Production of Lightweight Structures



Univ.-Prof. Dr.-Ing. habil. Prof. h. c. Dr. h. c. Prof. Lothar Kroll

Head of Department of Lightweight Structures and Polymer Technology, Director of IST, Director of Affiliated Institute CETEX, Dean for Research, International Relations and Gender of the Faculty Mechanical Engineering



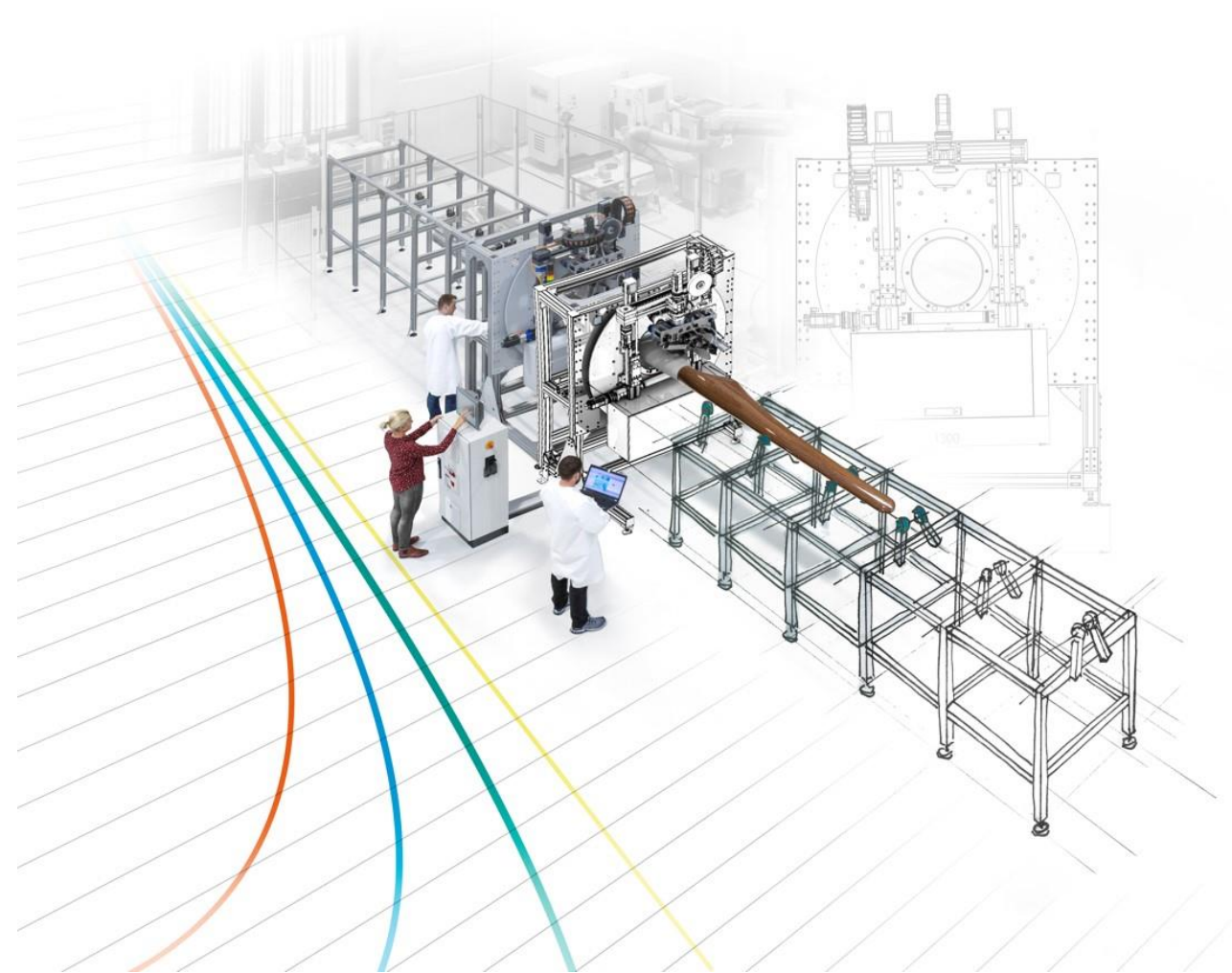
Dipl.-Ing. Patryk Nossol

Research Assistant at Fraunhofer Research Centre for Systems and Technologies for textile Structures STEx

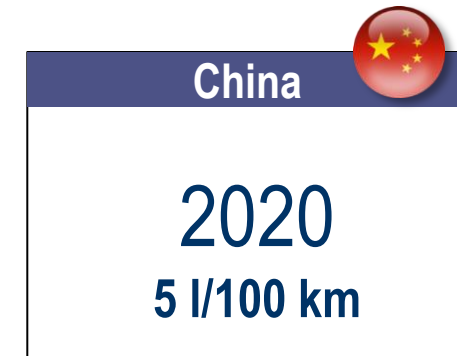


**The Second International Conference on Intelligent Systems in Production Engineering and Maintenance
ISPEM 2018**

17-18.09.2018, Wrocław University of Science and Technology, Poland



Challenge of reducing fleet consumption and CO₂ emissions

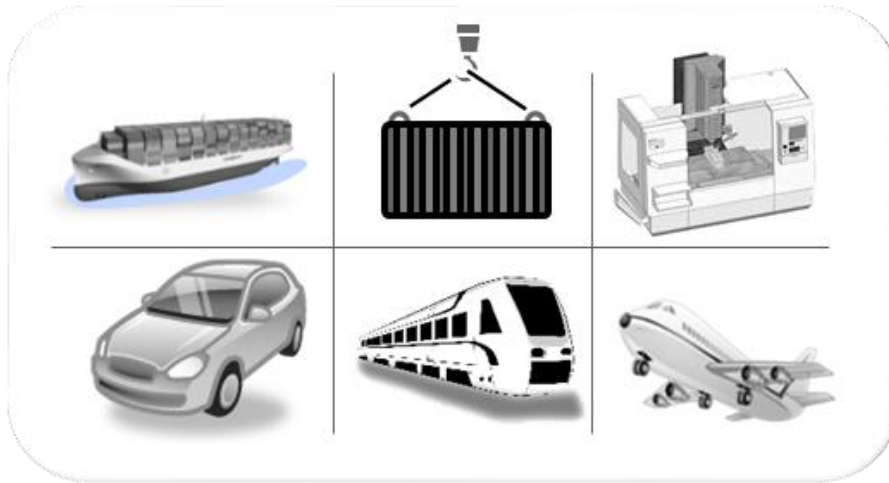


100 kg weight reduction → 8.5 g / km CO₂ reduction!



CO₂ reduction is a key task that affects all markets

Vision



Mobility, moved parts

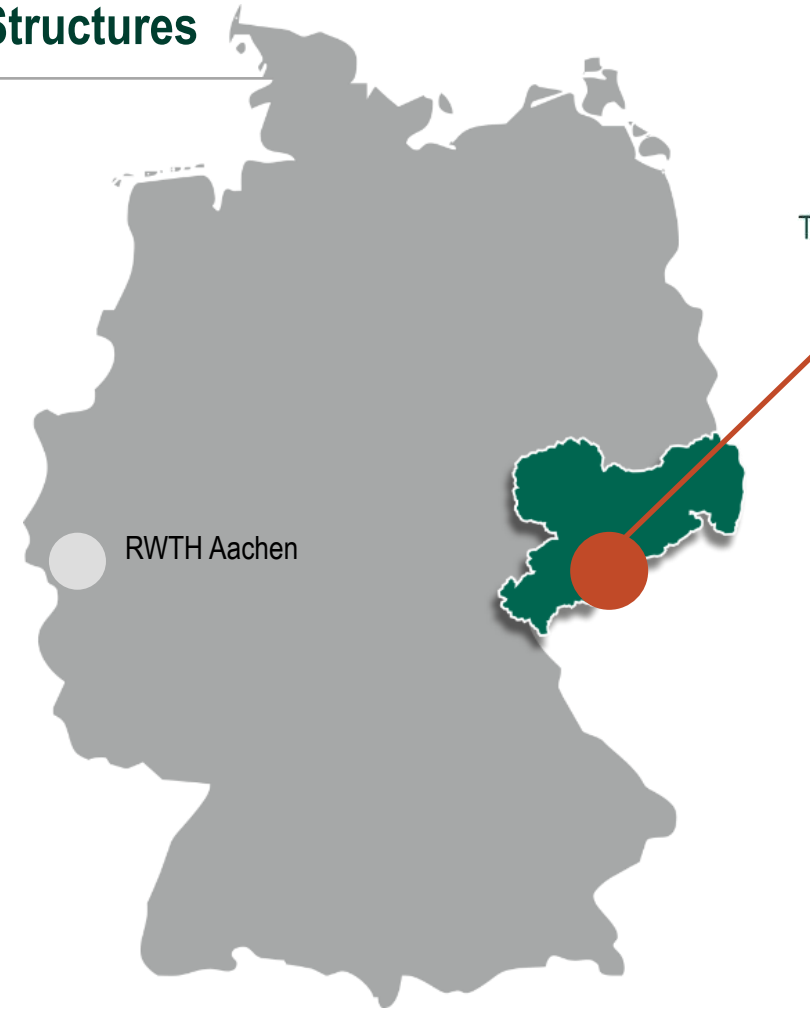


MERGE Technologies for Multifunctional Lightweight Structures

- › Research Cluster within the German Excellence Initiative
- › 2nd Call 2012-2018

Involved Research Institutes

- › 14 Institutes at Chemnitz University of Technology
- › 3 Institutes at Dresden University of Technology
- › 3 Affiliated Institutes at Chemnitz University of Technology
- › 2 Fraunhofer Institutes
- › 1 Leibniz Institute



General Problems

- › Increasing prices of energy and raw materials
- › Climate change by greenhouse effect, global warming

Requirements

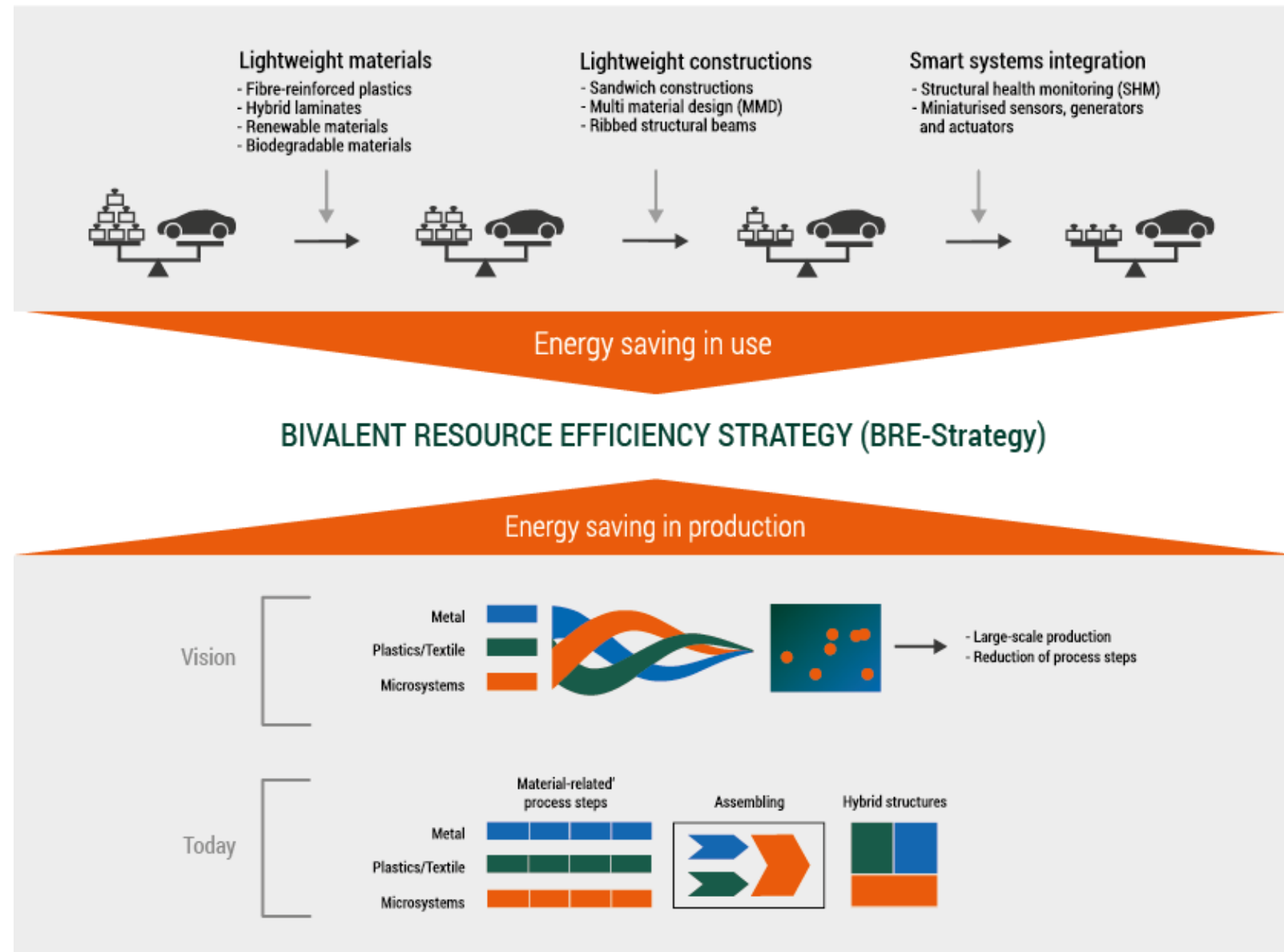
- › Energy savings
- › Mass reduction

Approach

- › Merge Technologies
- › Lightweight Structures

Strategy

- › Bivalent Resource Efficiency

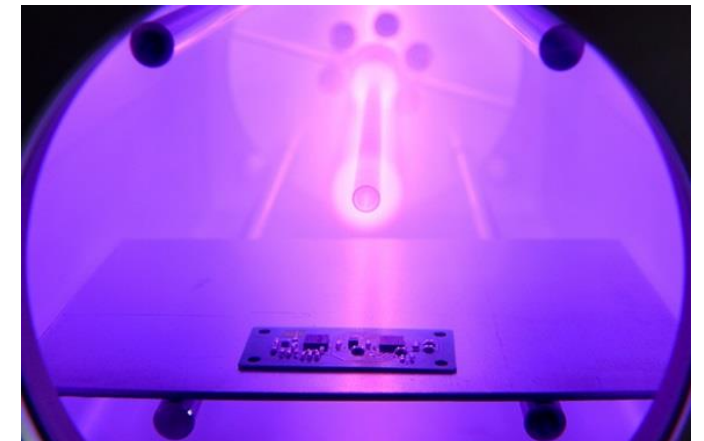


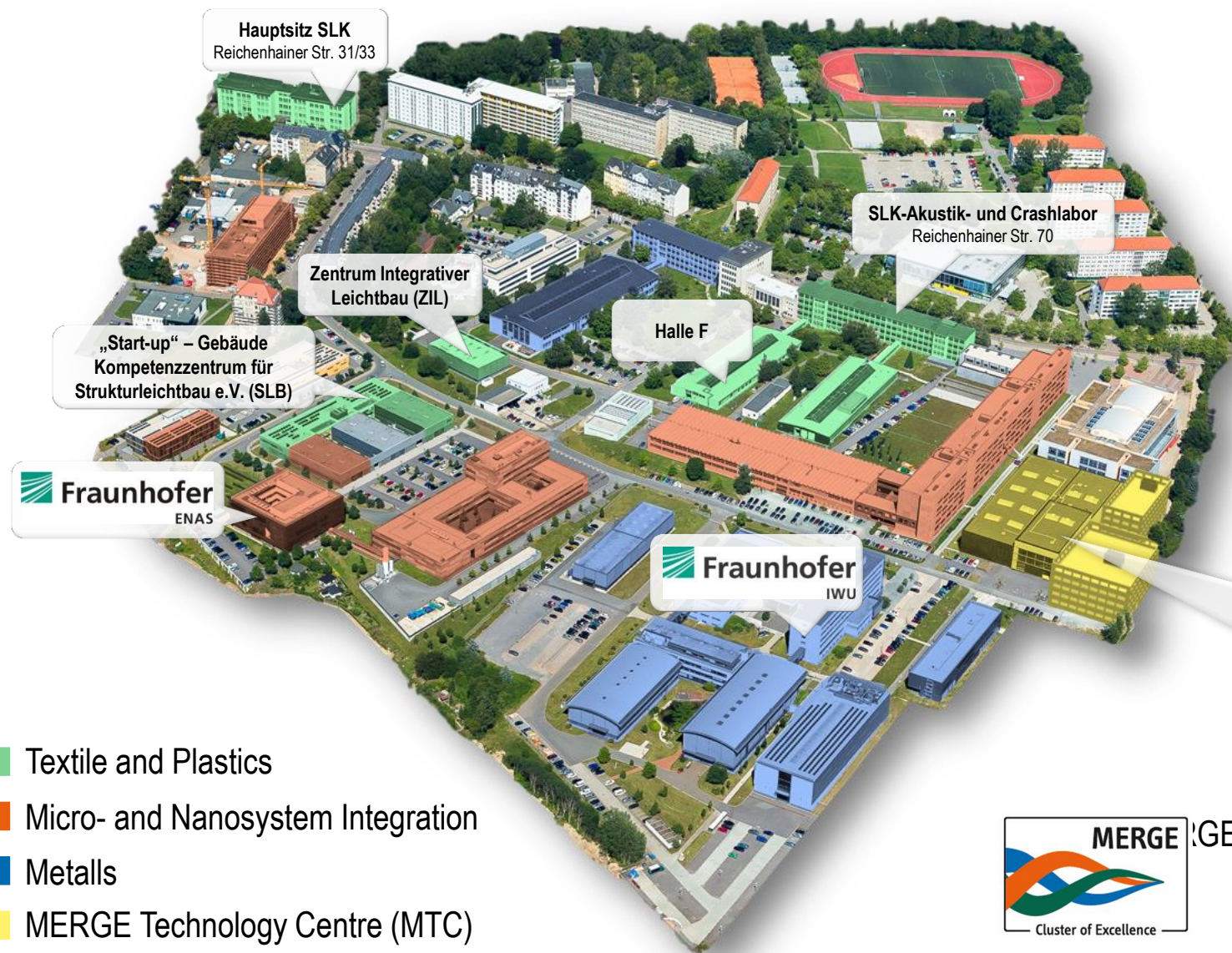
- › Merging of key enabling technologies, which are already technically mature
- › In-line and in-situ technologies predestined for large-scale production

› Metal-intensive technologies

› Textile-/Plastic-based technologies

› Micro- and Nanosystems Integration





MERGE Technology
Centre

Bionic inspired fibre reinforced structures

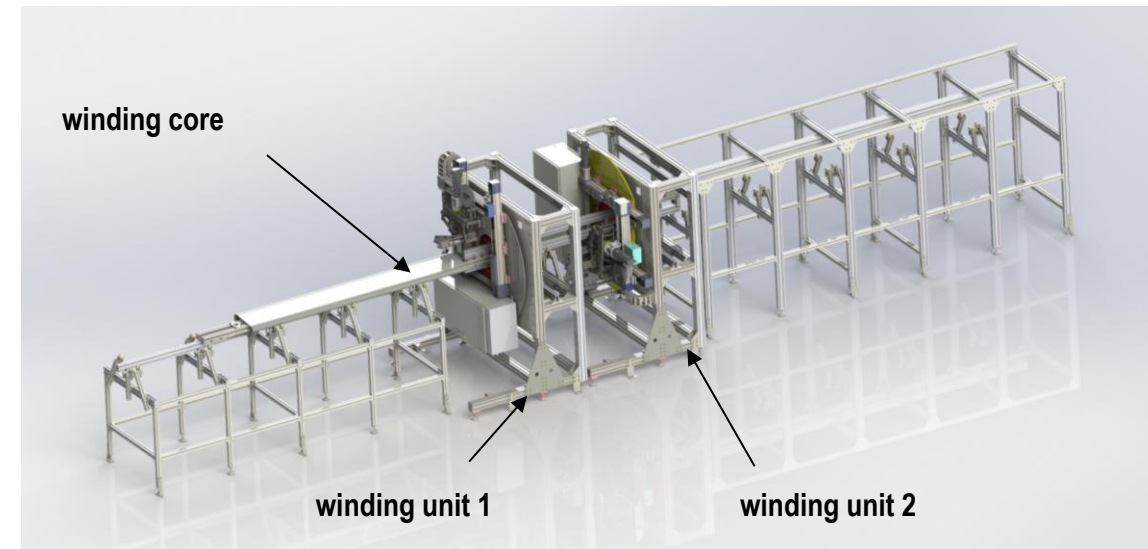
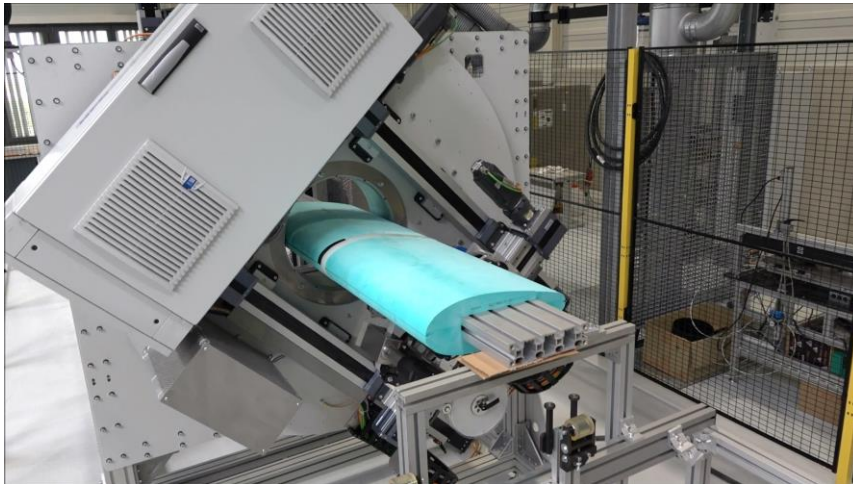
Continuous load path-adapted textile technologies for lightweight structures in mass production

- › Development of high-quality warp and weft offset (K/S-V) technology (based on multi-axial textiles)
- › Production of reduced-shrink and load path-adapted semi-finished textiles and preforms
- › High mechanical properties, high bonding strength, high drape and formability



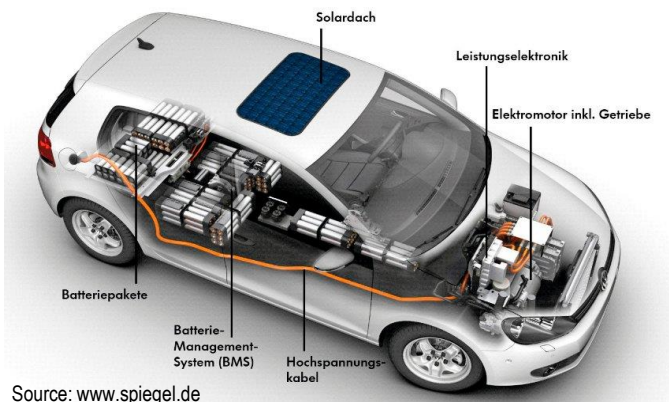
New process combination "hydroforming/injection molding" for hybrid systems

- › Continuous production of non-rotationally symmetrical profiles
- › Combined tape laying and wrapping process
- › Suitable for mass production
- › Application example: instrument panel carrier



Engine carrier for Volkswagen E-Golf

- › Weight saving 2.3 kg compared to conventional metal design
- › Reduction of individual parts and the associated assembly steps
- › Reduction of the total price by 30% through component integration
- › Savings of 2 holding trays and 8 screwing points (M8)



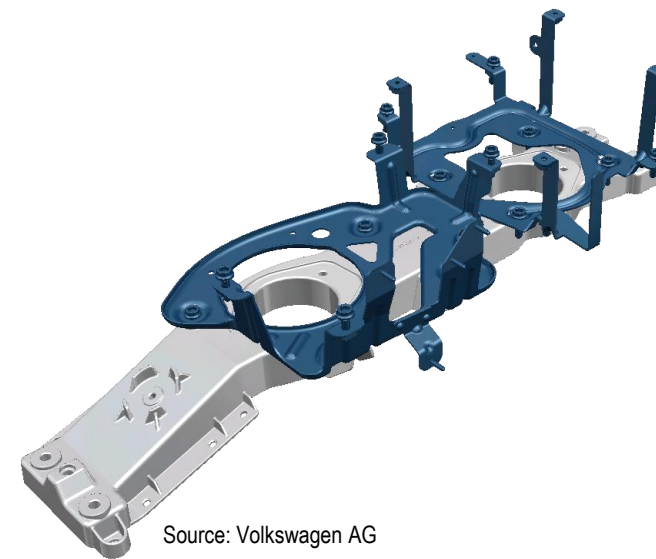
Mass Aluminium/Steel:
7,8 kg

→ Assembly made of Al-carrier and St-holding tray

m = -30%

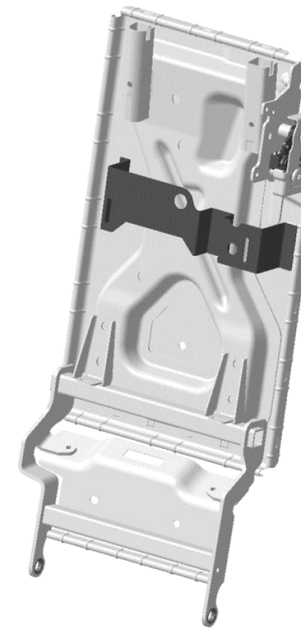
Mass by thermoPre:
5,5 kg

→ Integrated holding shells



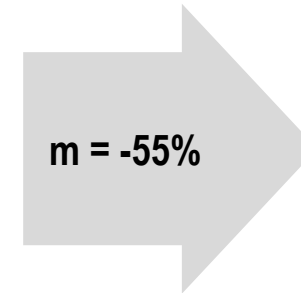
Load through device for Audi Q5

- › Weight savings 2.2 kg compared to conventional metal design
 - › Representation of a large-scale production process chain from material cutting to the removal of the finished component
- **Series use in the Jaguar SUV F-Pace**

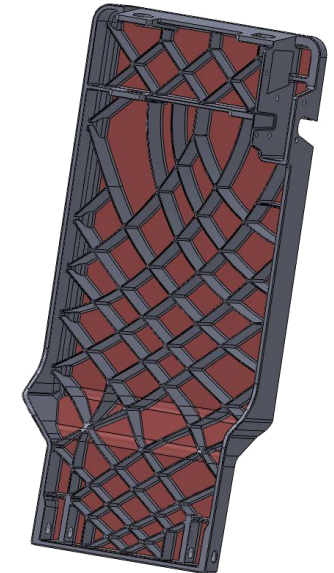


Mass Steel
3,8 kg

→ Welded assembly
made of sheet steel



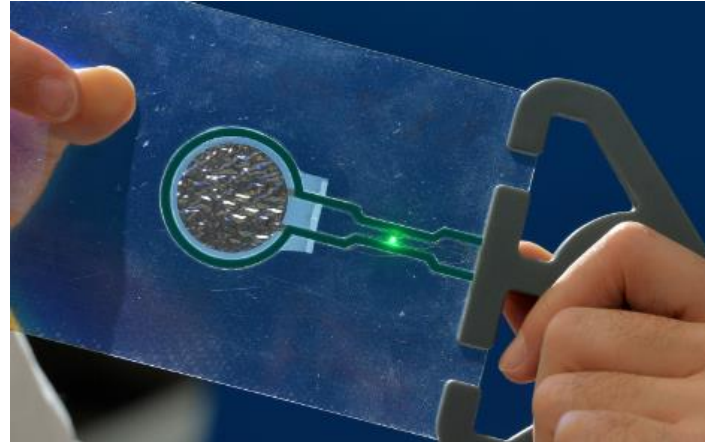
m = -55%



Mass Reinforced Plastic
1,6 kg

→ Organic sheet with
injection moulded
stiffening ribs

Potentials



- › The virtual IT world and the real world of production continue to grow together. [...] i.e. with the networking of (embedded) IT systems with each other and with the Internet, we are in the opinion of many experts and researchers at the beginning of the fourth industrial revolution.

Prof. Dr. Dr. Wolfgang Wahlster, Deutschen Forschungszentrums für künstliche Intelligenz (DFKI)

Current Trends – ICT in production

- › innovative components in production systems
- › „Ressource Data“

- › IoT – Internet of Things
- › Completely transparency
 - › Digital Shadow
 - › Digital Twin
- › Intelligent information retrieval, assistance systems
- › Human in production



View of industry – Why? – because of all it do?

Current Situation

- › Increasing complexity in production
- › Tending upwards functionality
- › Missing transparency

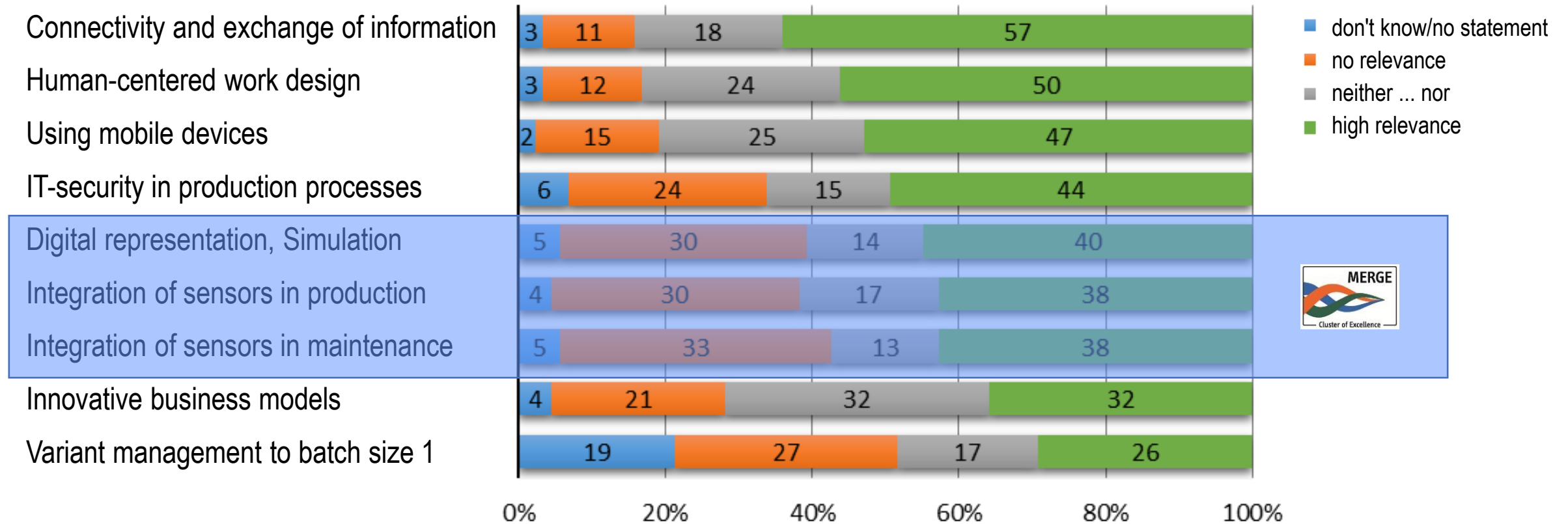
→ New approaches to handle increasing complexity → Concepts of Industry 4.0

Deficits

- › Problem-oriented analysis of production-related data
- BigData to SmartData
- › Consistent identification and localization (tracking/tracing) of smart objects in flexible production systems
- › Industry-relevant solutions to visualize context-based informations



Industry 4.0 – Relevance of trends



Quelle: Bedarfsanalyse der Mittelstand 4.0-Agentur Prozesse „Digitalisierung im Mittelstand“, 2016

Data are “core” and “resource” of intelligent production

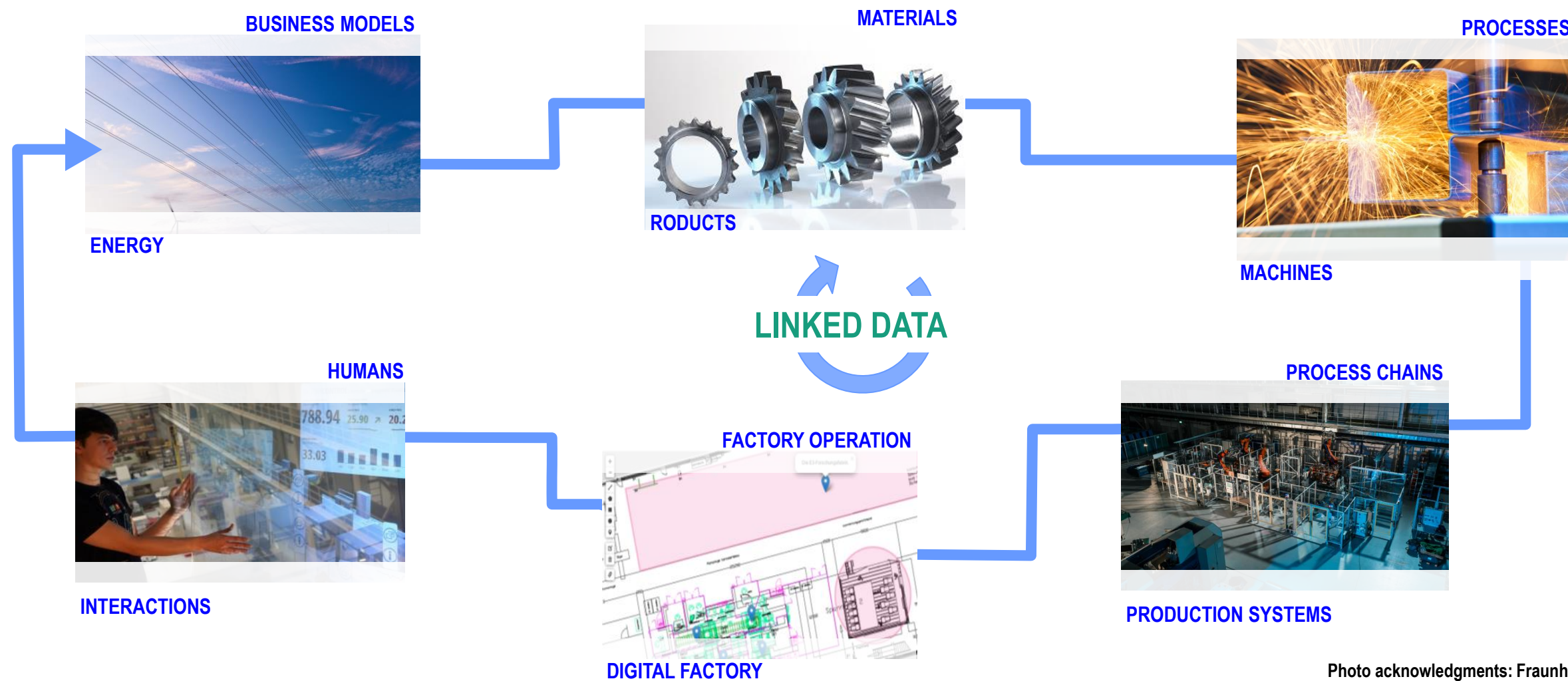
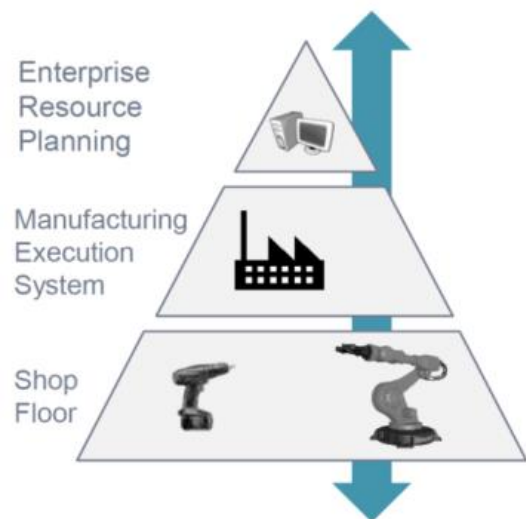


Photo acknowledgments: Fraunhofer IWU

Vertical Integration

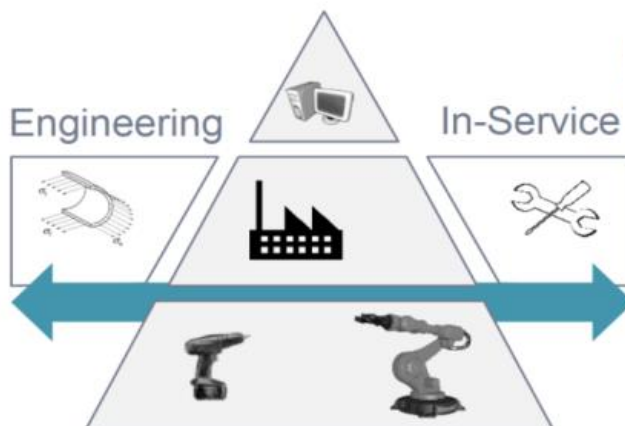
Real time production
data available



2014-2017
Implementation started

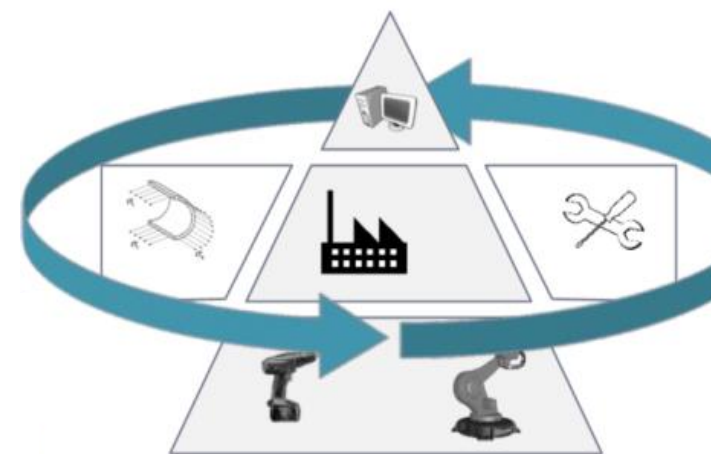
Horizontal Integration

Virtual product
available



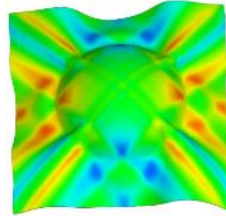
2016-2020

Full Integration



2030+

Infusion Process



Draping

- Simulation
- Drape Test (exp.)



Infusion

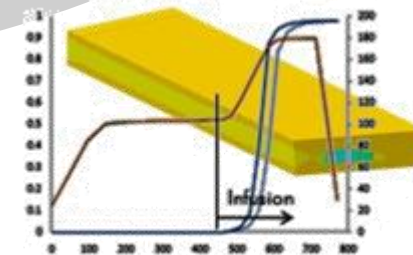
- Monitoring (sensors)
- Resin flow Sim.



Distortion/
Structural
analysis

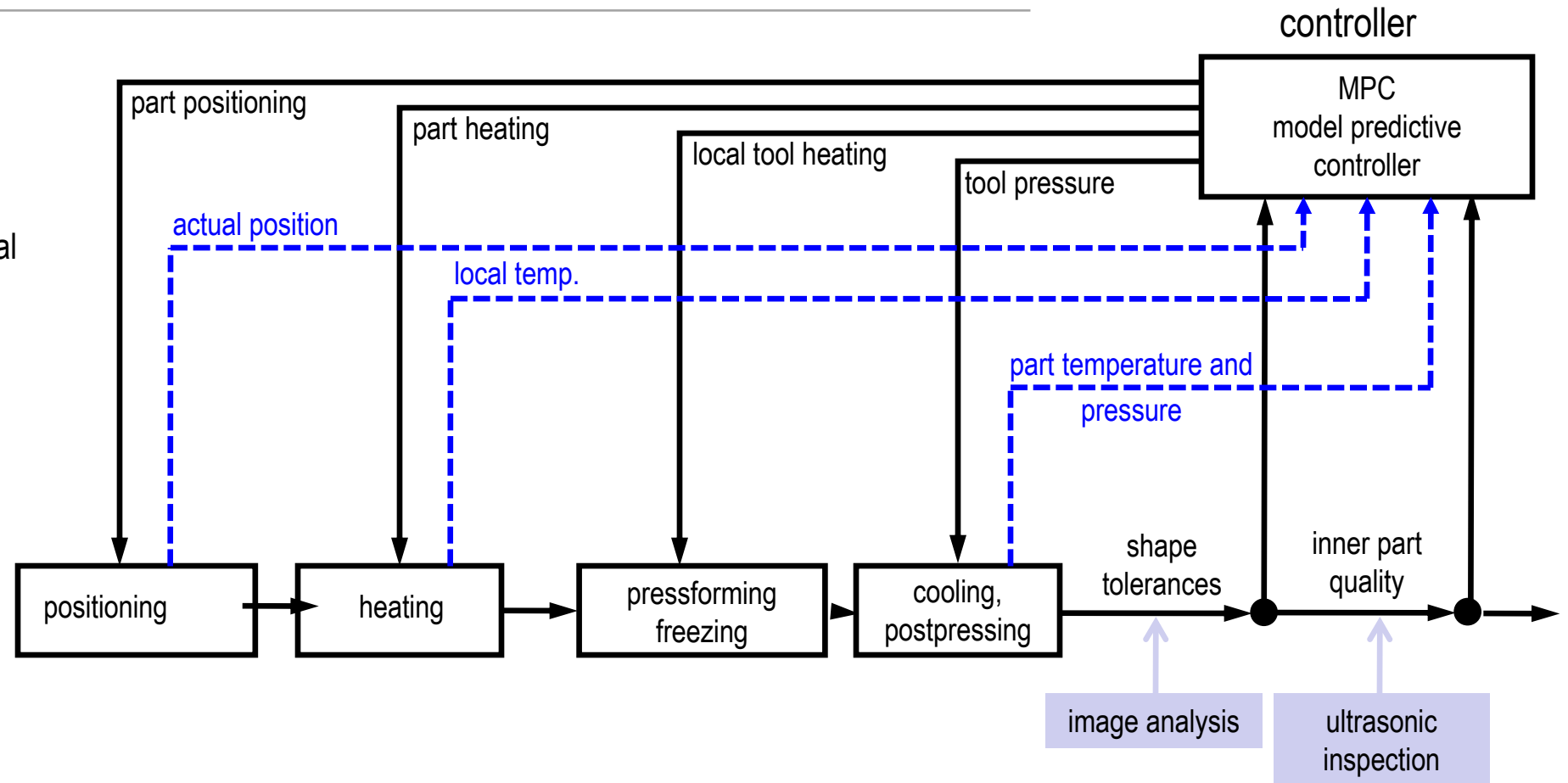
Curing

- Monitoring (sensors)
- Curing simulation

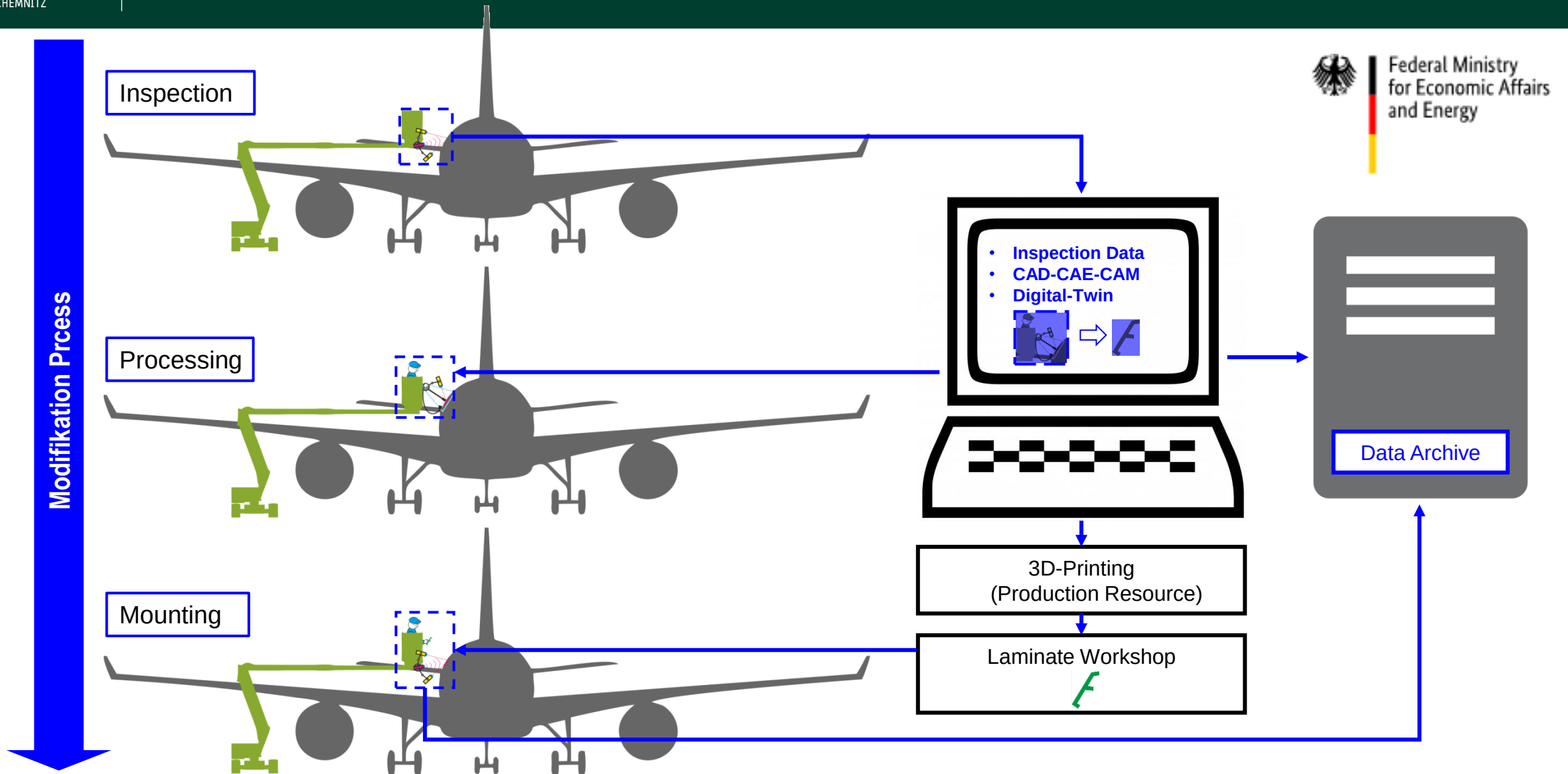


Process

- › zero defect production of composite structures
- › complex, product-individual assembly process

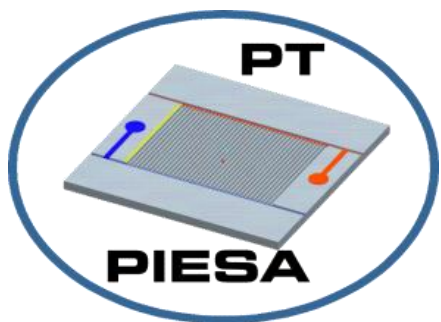


Flexible system solutions for 4.0 modifications on aircraft's CFRP main body section



Thank you for your attention!

We gratefully acknowledge the cooperation of our project partners and the financial support of the Federal Ministry and Economic Affairs and Energy and the German research Foundation (DFG) within the Collaborative Research Center / Transregio 39 “PT-PIESA” and the Federal Cluster of Excellence EXC 1075 “MERGE”.



Contact

Dipl.-Ing. Patryk Nossol

Research Assistant at Fraunhofer
Research Centre for Systems and
Technologies for textile Structures
STEX

Theodor-Körner-Allee 6
02763 Zittau, Germany
Telefon: +49 (0) 3583/54086 4020
Fax: +49 (0) 3583/54086 64020

E-Mail: patryk.nossol@iwu.fraunhofer.de
www.iwu.fraunhofer.de

