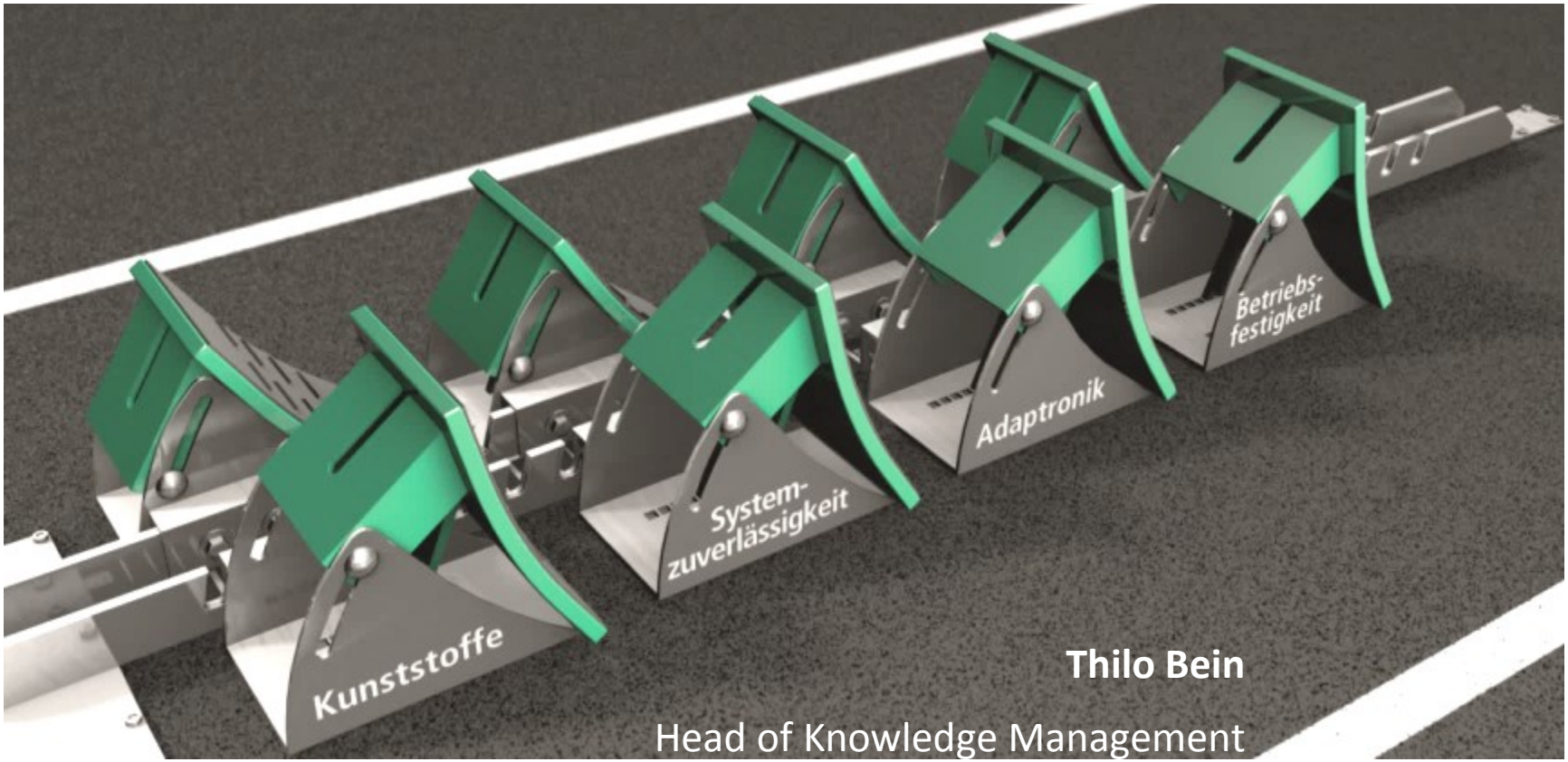
LIGHTWEIGHT RESEARCH FOR MARITIME APPLICATIONS AT THE LBF

Fraunhofer Institute for Structural Durability and System Reliability LBF



Thilo Bein

Head of Knowledge Management

Fraunhofer LBF

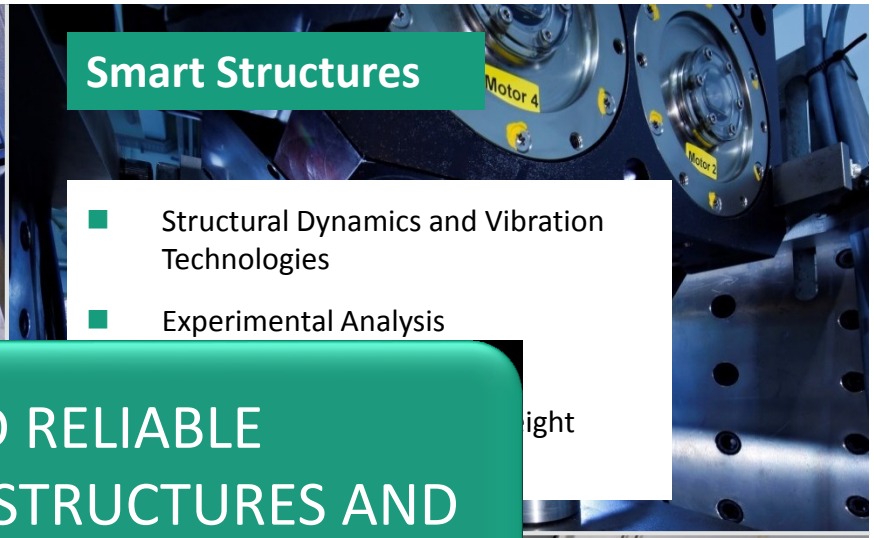
Fraunhofer LBF

4 Research Divisions

Structural Durability

- Material and Com
- Assemblies and Sy

Smart Structures



- Structural Dynamics and Vibration Technologies
- Experimental Analysis

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SAFE AND RELIABLE
SOLUTIONS FOR STRUCTURES AND POLYMERS!

System Reliabili

- System Reliability of Electrified Vehicles
- Future Mobility Concepts

- Polymer Synthesis
- Formulations and Durability
- Design and Processing

Fraunhofer LBF

Fraunhofer LBF in Darmstadt

Darmstadt City site

Fraunhofer LBF

Facts & figures

Annual statement 2017

Staff

- 396 at Fraunhofer LBF
- 53 at TU Darmstadt

Budget 2017 28.19 Mio €

Facilities

- Office facilities: ca. 6.300 m²
- Lab facilities: ca. 11.560 m²

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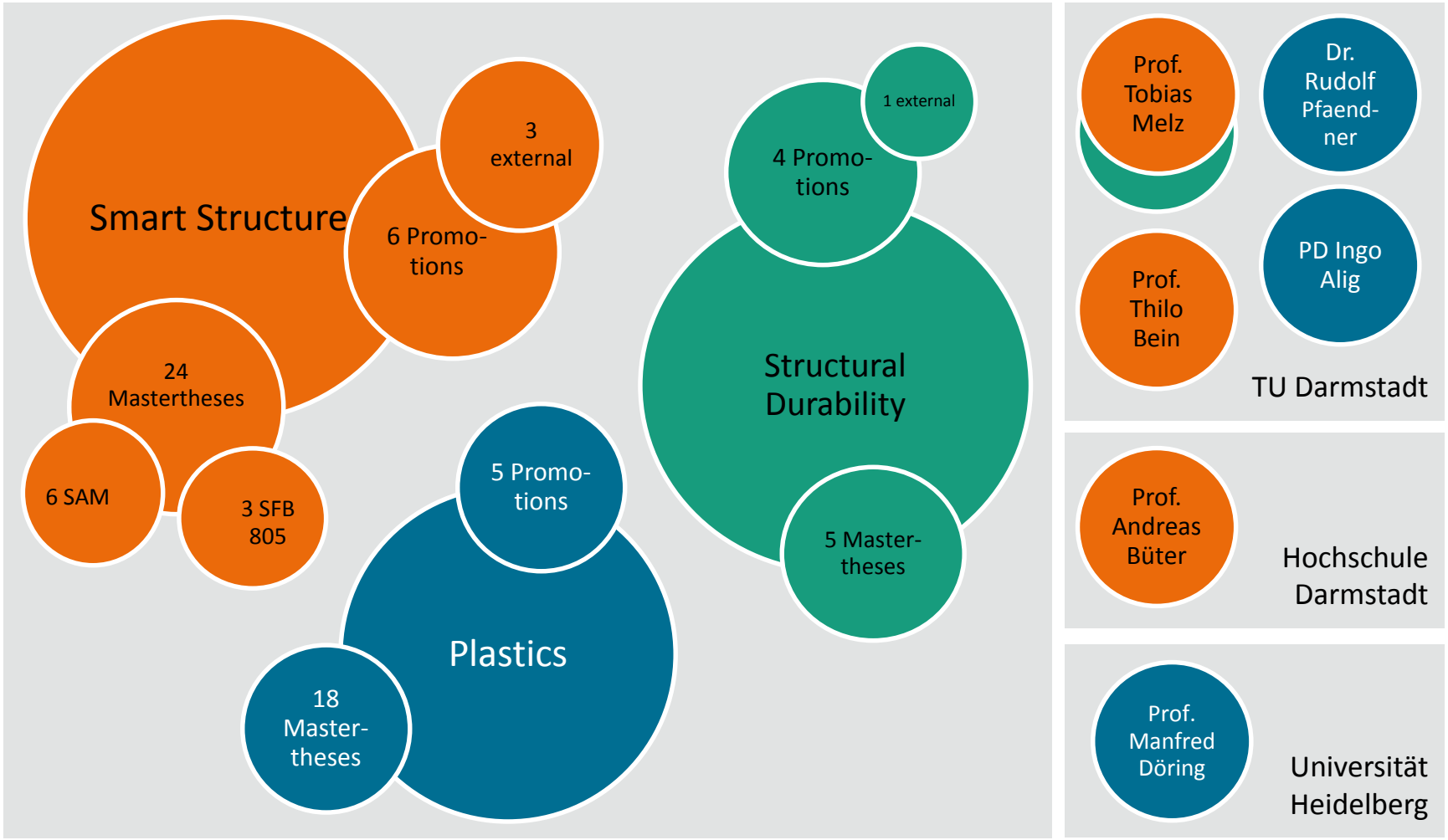
Promotions and Master theses 2016

15 PhD & 47 Master theses



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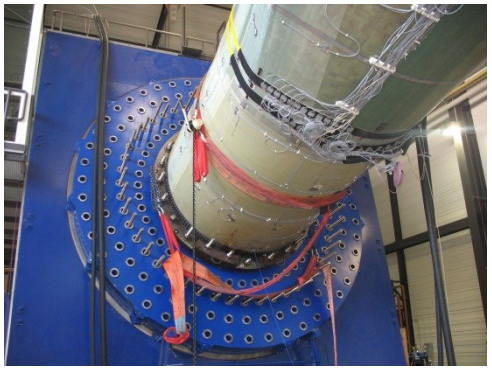
Markets

- Automotive and supply industry
- Rail vehicle industry
- Aviation
- **Shipbuilding**
- Mechanical and plant engineering
- Special machine construction
- Power engineering
- Chemical industry
- . . .

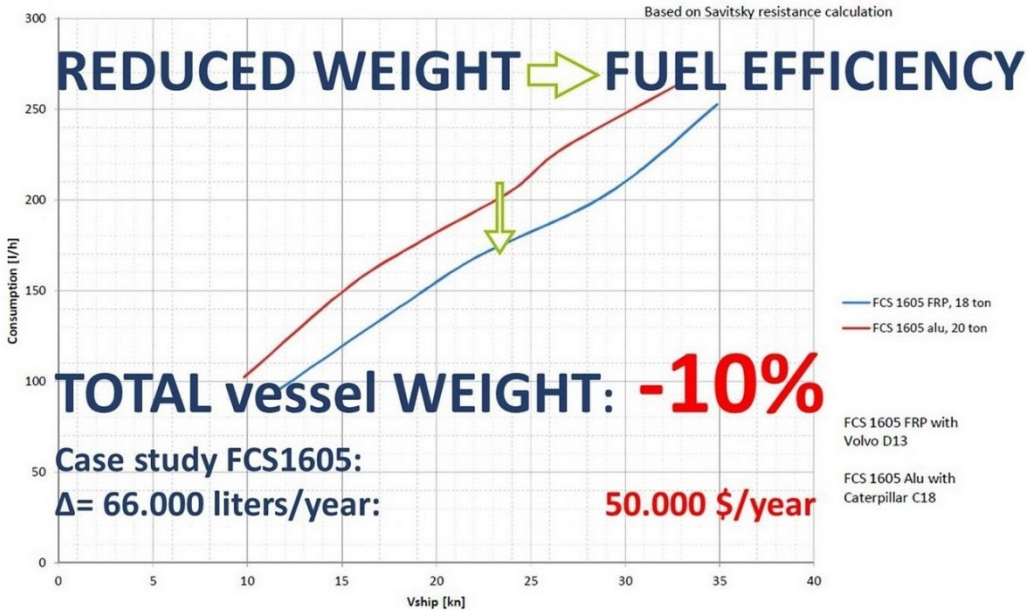


Why shipbuilding?

Key technologies as defined in the WATERBORNE SRA

- Smart and Autonomous ships
  - **Internal and external monitoring tools**
  - **New sensors** and real-time collection of ship parameters
  - Integrated safety and security systems
- **Fire resistance** and prevention
  - Use of new materials
- Innovative and **smart materials** and combinations
  - More extensive use of **composites**
  - New **advanced composites** (fire resistant)
- Increased vessel survivability
  - Damage stability (tools to evaluate hull resistance)
  - Damage stability (e.g. watertight integrity)
    - **Test and validation of monitoring system**

Why shipbuilding?



https://magazine.damen.com/editors-choice/composite-materials-for-the-next-generation-of-ship-owners/

Lightweighting has some drawbacks

- More sensitive to damages and degradations → **Health and Usage Monitoring, SHM**
- More sensitive to noise and vibration (NVH) → **Active noise and vibration control**

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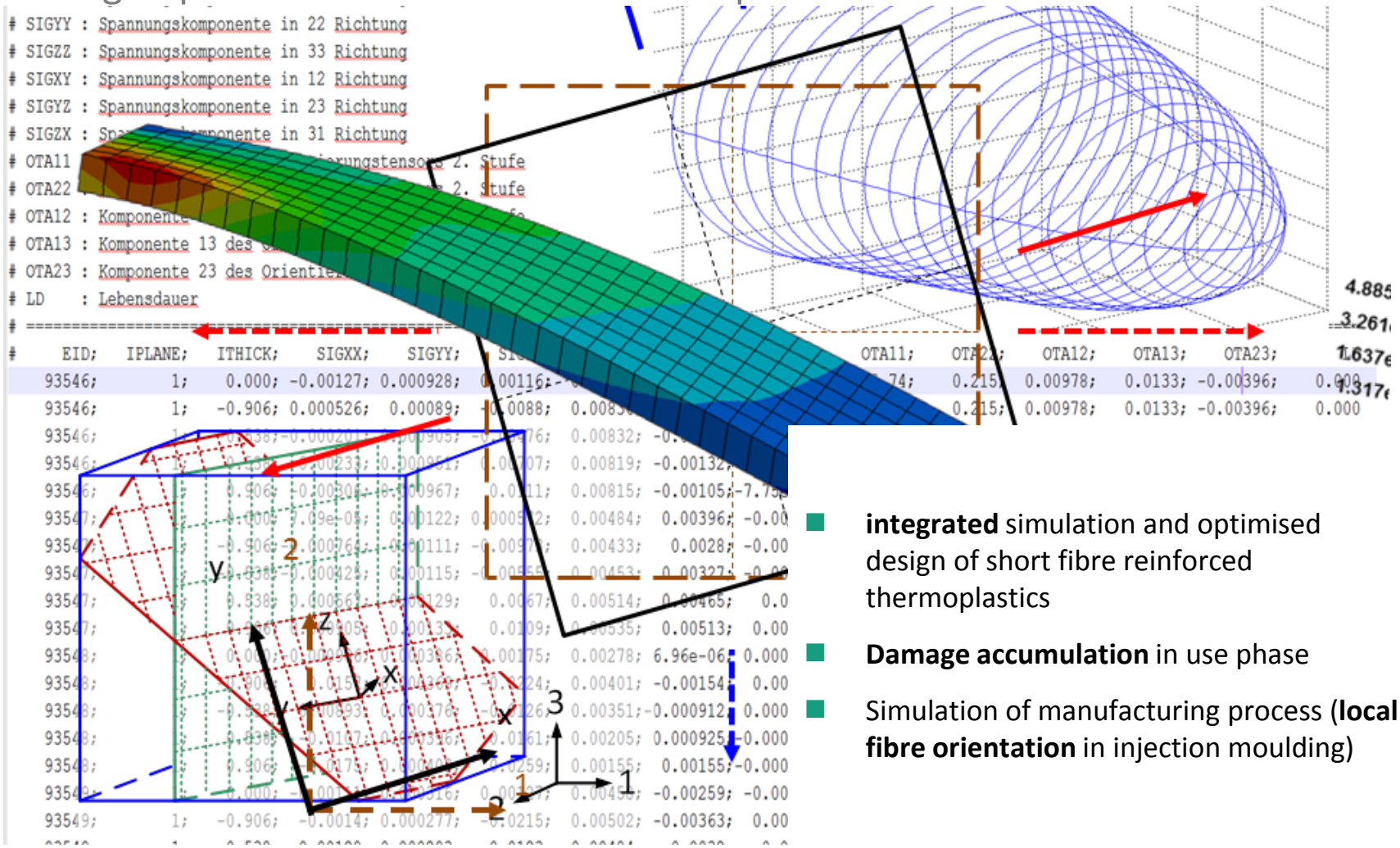
Systems-based research

Examples

Lightweight Structures

through optimised short fibre reinforced plastics …



- **integrated** simulation and optimised design of short fibre reinforced thermoplastics
- **Damage accumulation** in use phase
- Simulation of manufacturing process (**local fibre orientation** in injection moulding)

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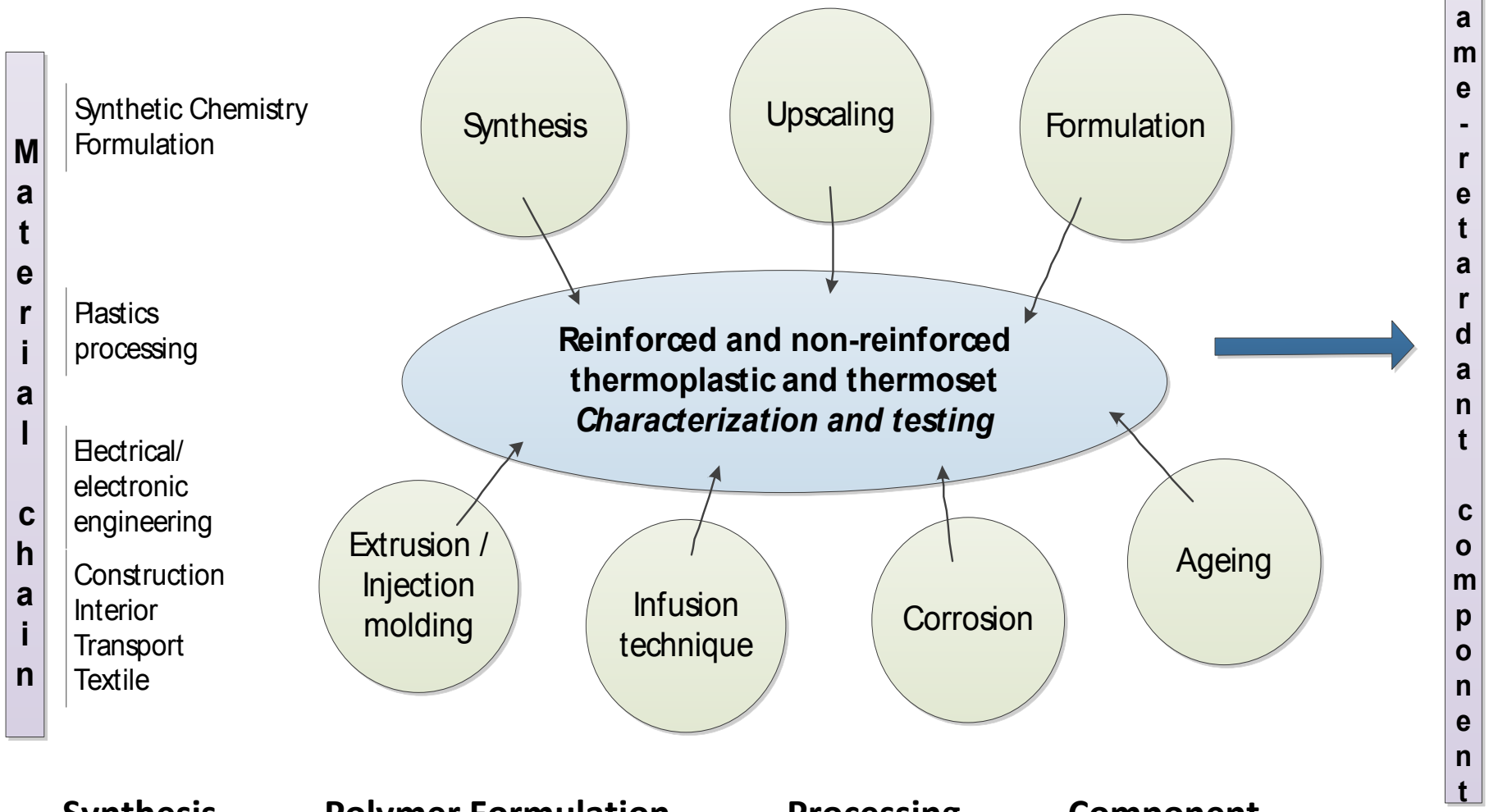
Development of Flame-Retardant Plastics



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Plastics Flame Retardancy: Goals and Tasks

- Characterization and assessment of flame-retardant plastics (thermoplastics, thermosets, elastomers, composites)
- Synthesis, development, and optimization of new flame retardants and plastic formulations
- Processing of flame-retardant polymers and optimization of the formulations
- Research and development projects for fire-resistant plastics or flame retardants and formulations as well as testing

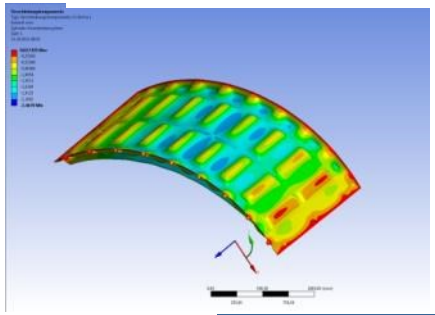
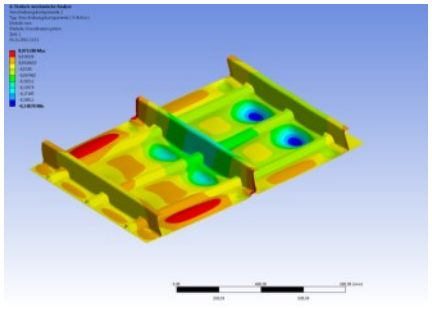
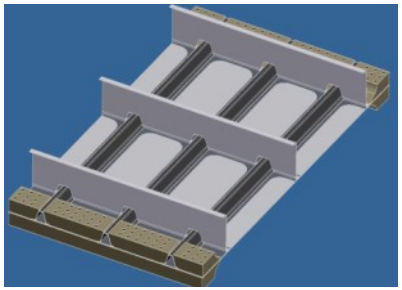
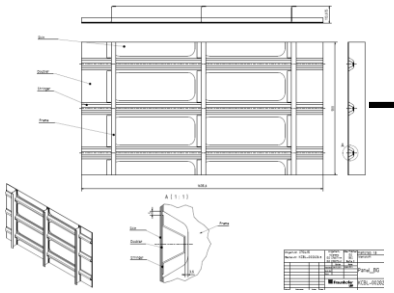
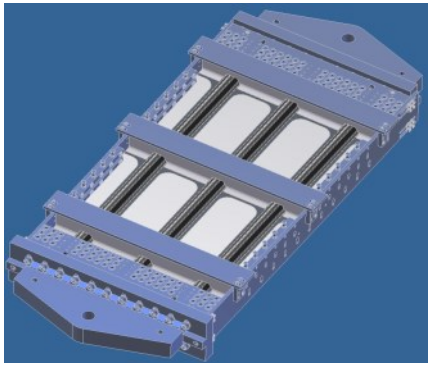
Intermediary between producers of flame retardants and compounders through to the OEMs

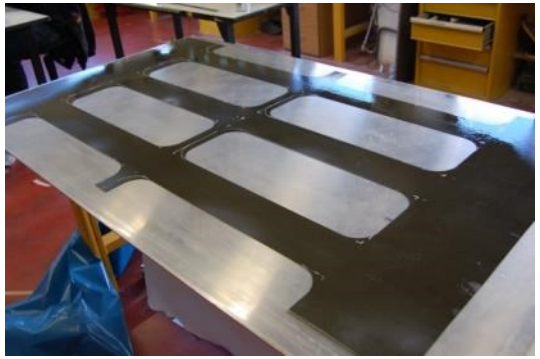
Systems-based research

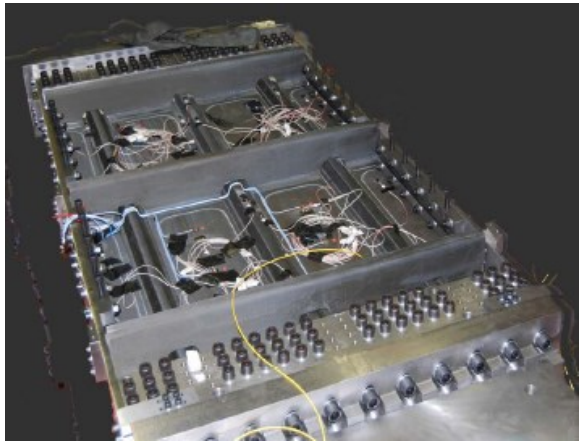
Examples

Lightweight

Design, manufacturing and test of sensorized composite panels (prepreg autoclave)



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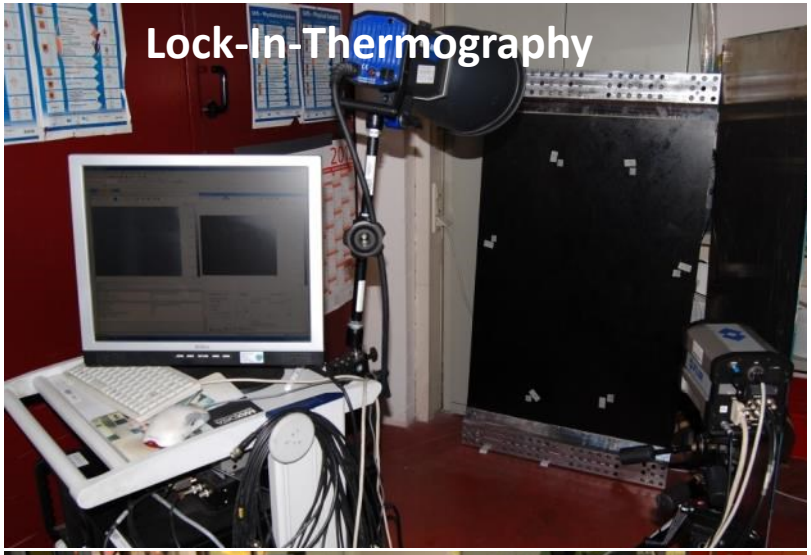
Verification and Qualification of sensor systems with non-destructive testing



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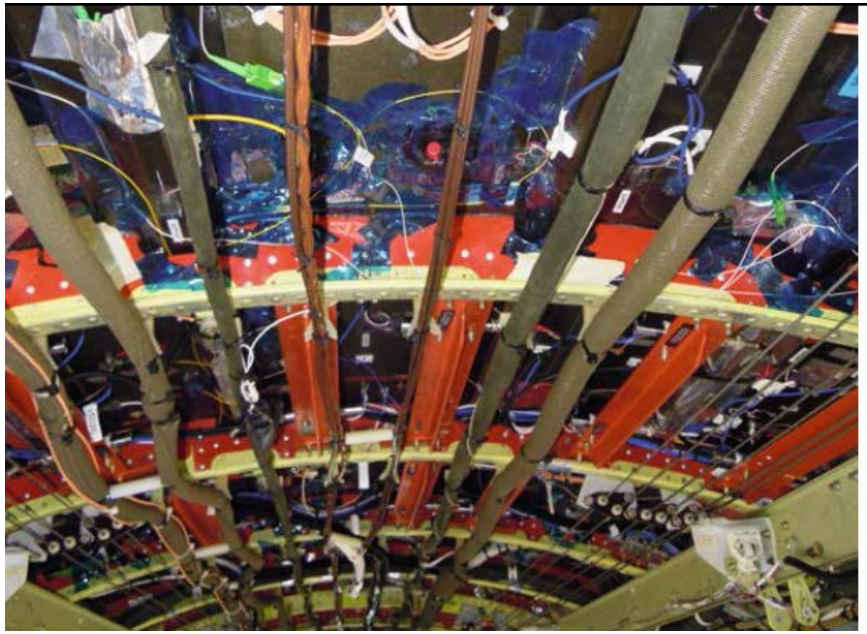
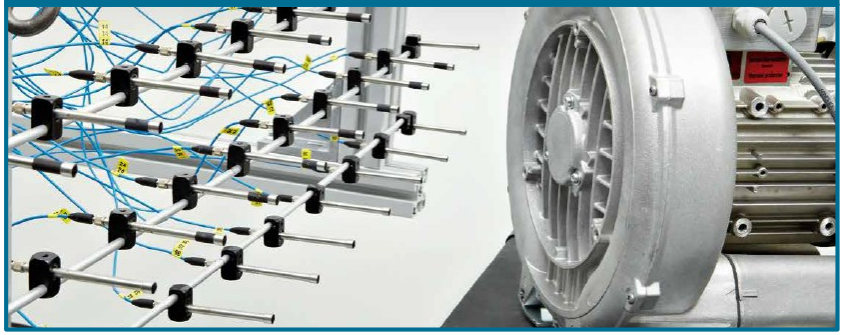
Flight test of a composite panel with 50 fiber optic as well as piezo sensors



Systems-based research

Examples

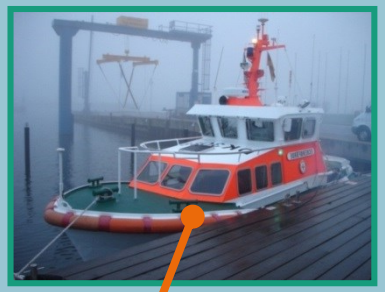
Vibration Technologies

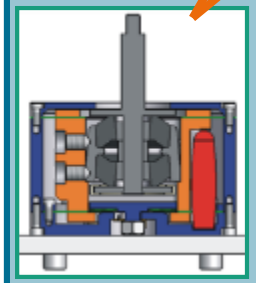


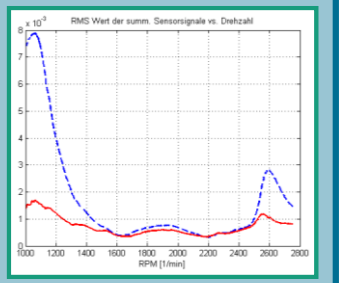
Funded projects in context of shipbuilding (finished)

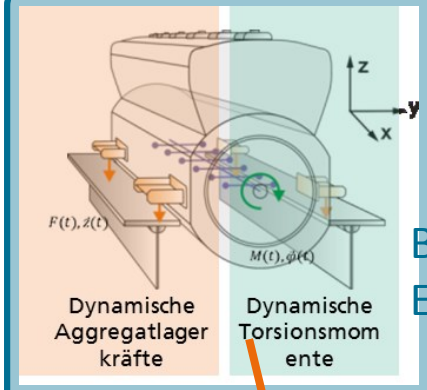
Fokus on vibration control

BMWi - AAL

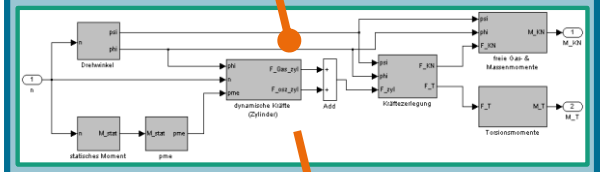


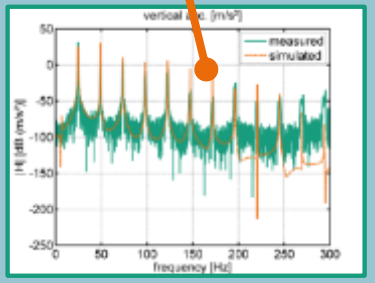




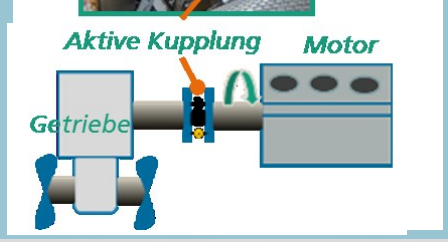


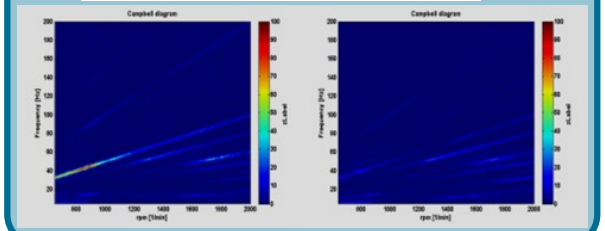
BMWi – EPES





BMWi - AKTOS





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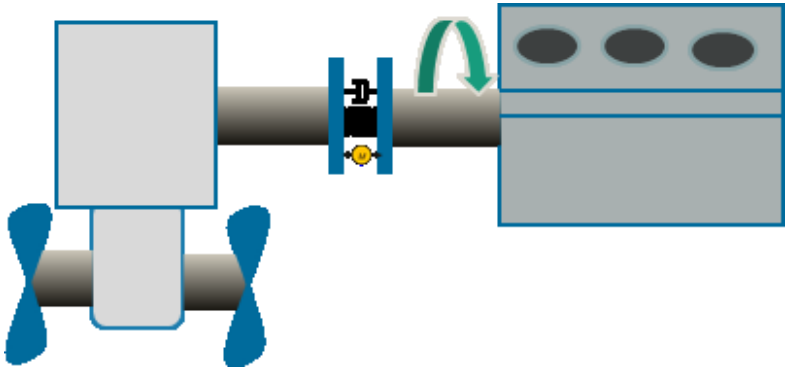
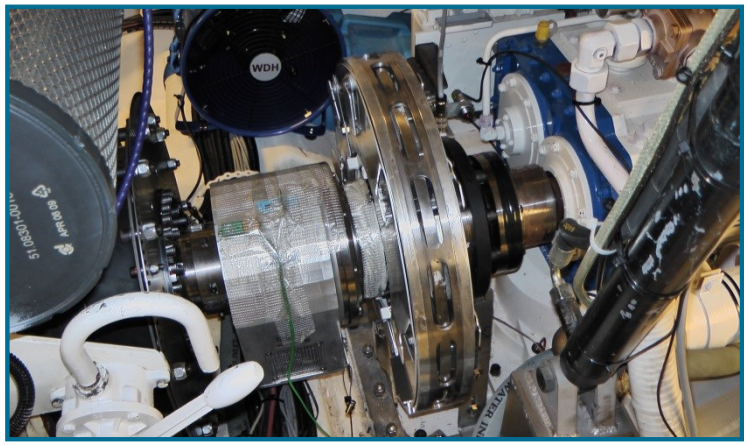
Example Aktos

Control of torsional vibrations in drive trains

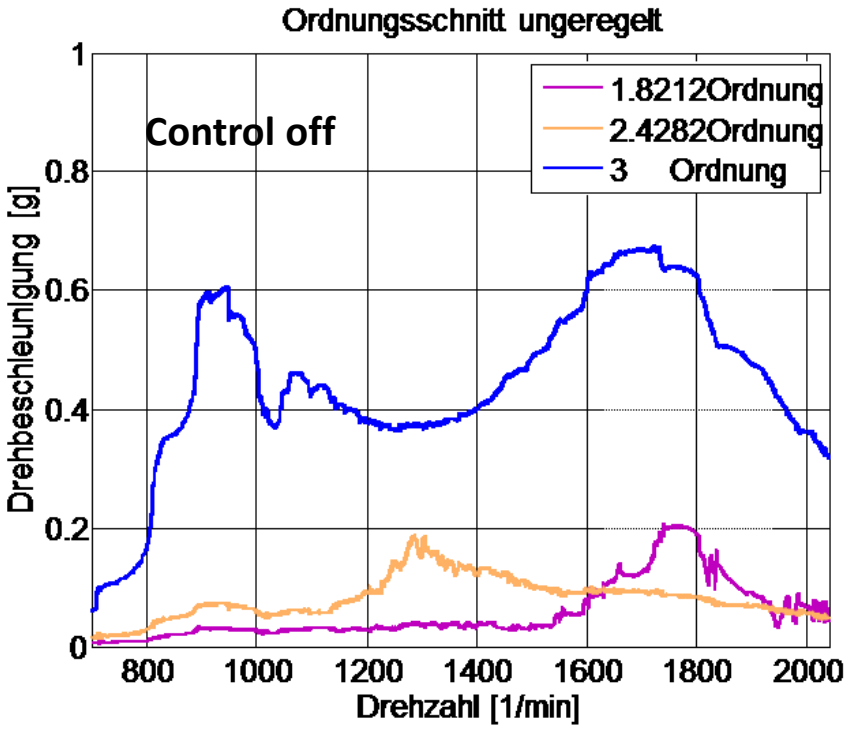
- Validation in a motor yacht
  - V6-motor with 441 and 449 kW, resp.
  - Gearbox in pod design
  - Only one drive train with active measure
- Excitation through the propeller

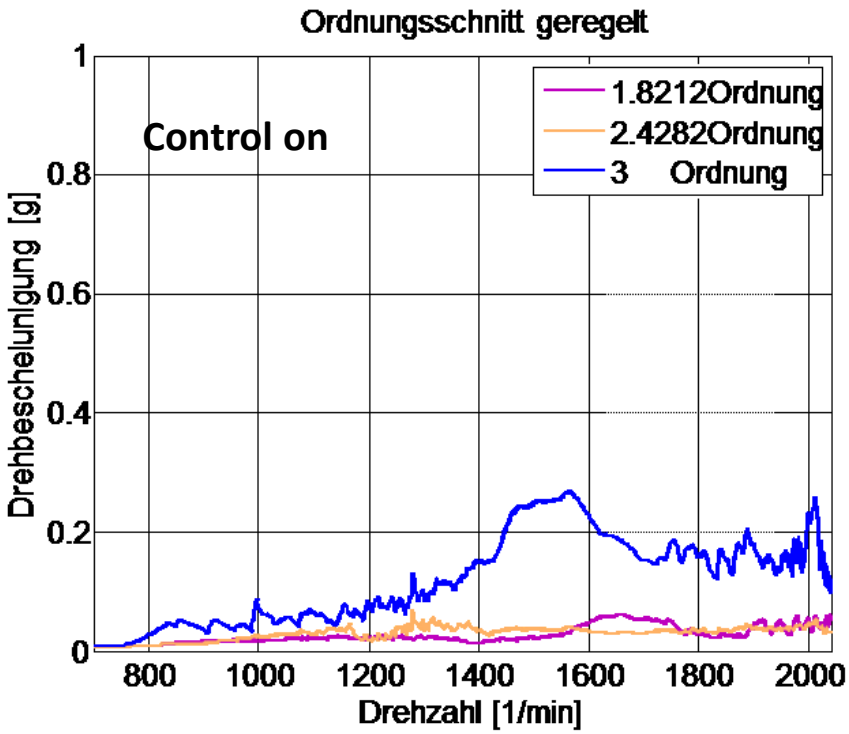




Example Aktos

Control of torsional vibrations in drive trains





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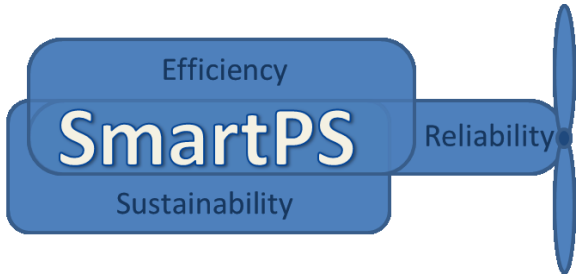
Funded projects in context of shipbuilding (MARTEC)

Smart Propulsion Systems (SmartPS)



- increase the efficiency of ship propulsion system by 10%
- reduce negative impact on the environment (noise, emissions)
- increase the durability of propulsion system components
- increase the safety of ship operations
- increase comfort by reducing vibration and noise, and
- reduce the operational costs of propulsion systems by 5%

REINTJES

Continental CONTITECH

DELTAMARIN

BNTU

GDAŃSK UNIVERSITY OF TECHNOLOGY

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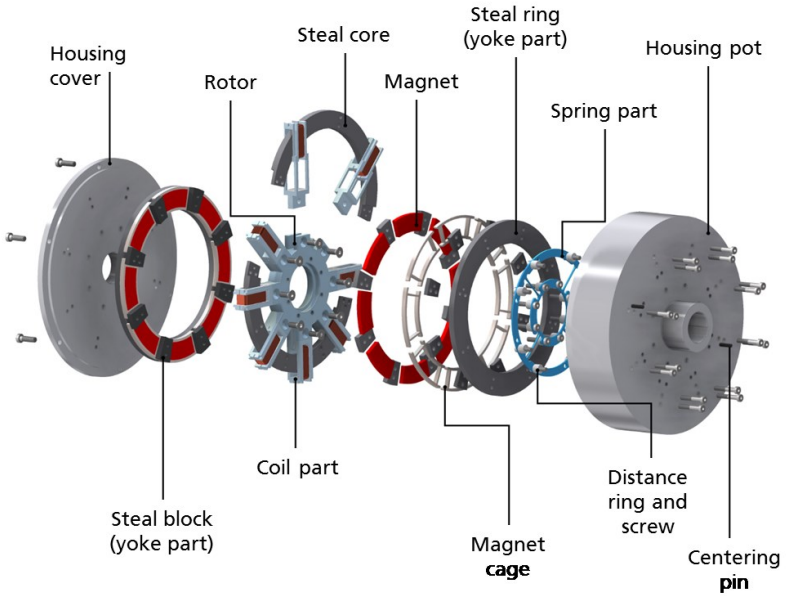
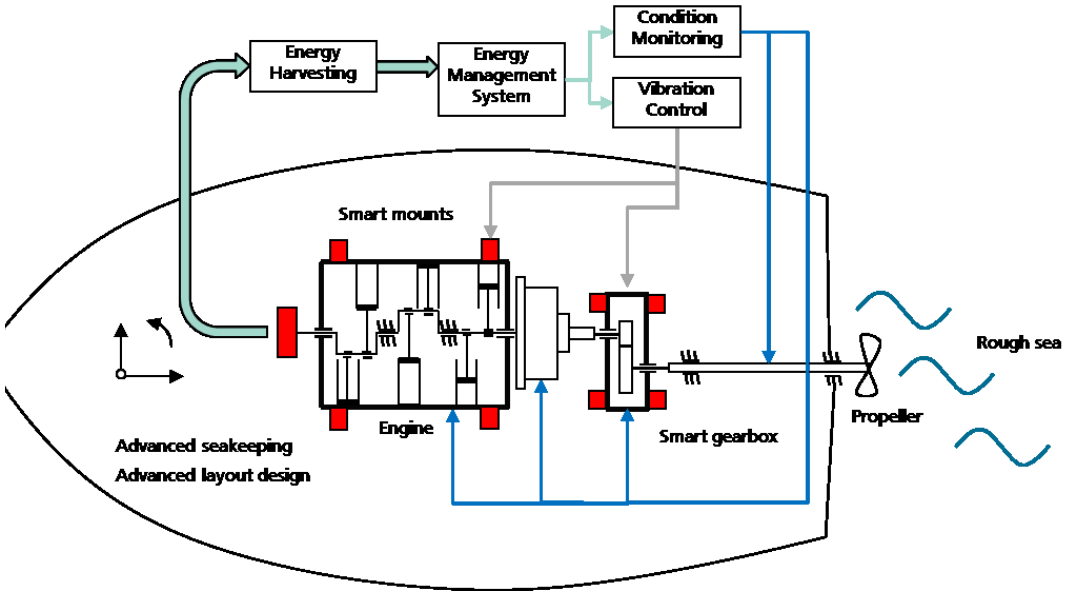
Smart Propulsion Systems (SmartPS)

- Design and validation of an energy harvesting concept
  - Energy recovery from torsional vibrations
  - Damping of the torsional vibrations
- Strategy for the efficient operation of the drivetrain under rough sea
- Experimental analysis and system validation





Efficiency SmartPS Reliability Sustainability

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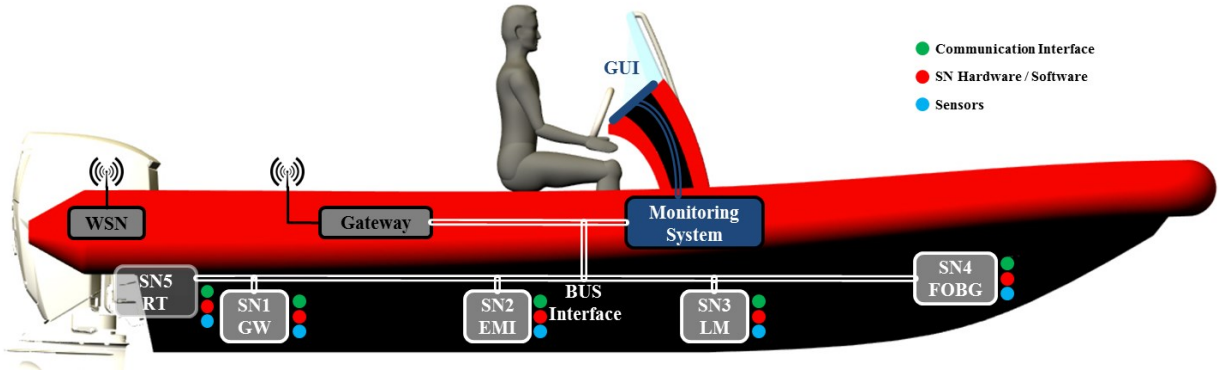
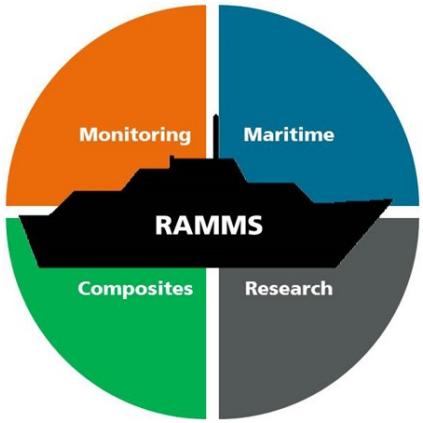
Funded projects in context of shipbuilding (MARTEC)

Reliable and Autonomous Monitoring system for Maritime Structures

- Monitoring concepts for maritime structures to optimise maintenance and to increase safety
- Accelerating the implementation of composite structures in shipbuilding through monitoring of loads and failures with smart sensors
- Increased efficiency through new designs and advanced manufacturing
- Transfer to offshore applications



composite rudder shaft and composite hull



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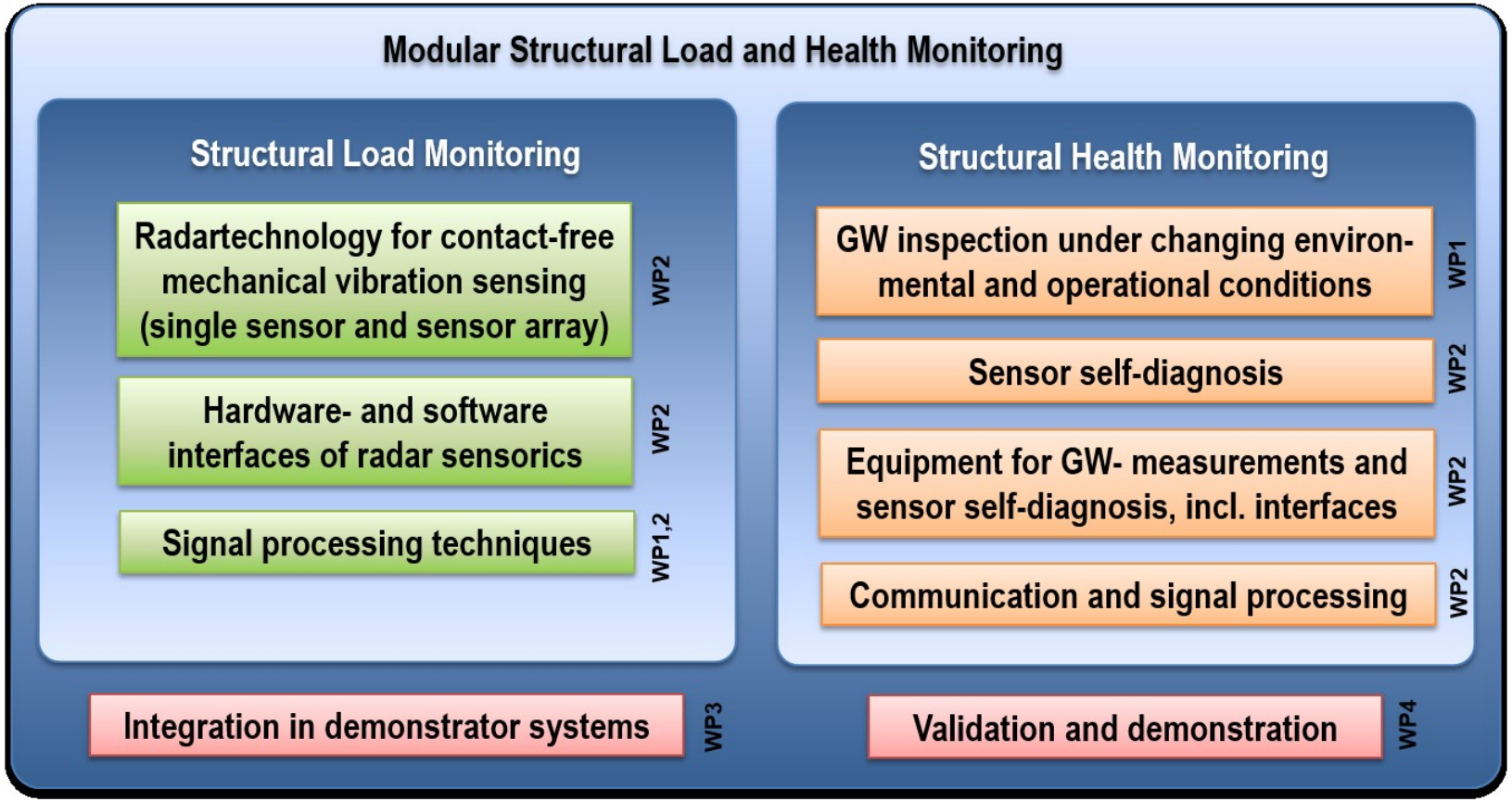
Reliable and Autonomous Monitoring system



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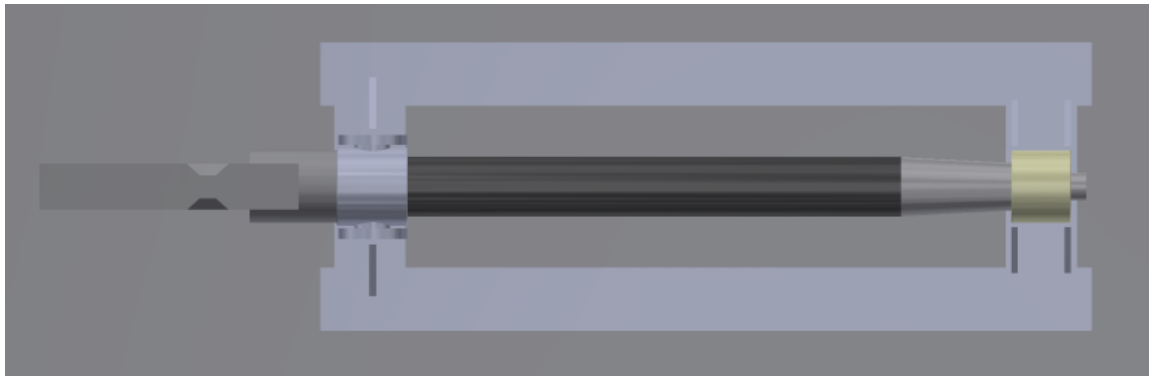
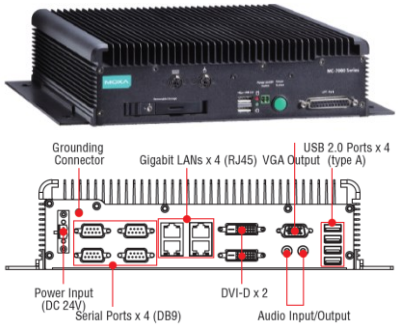
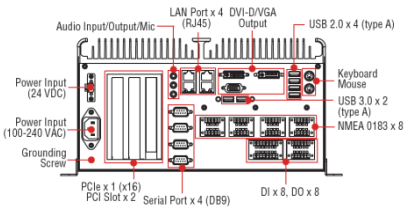
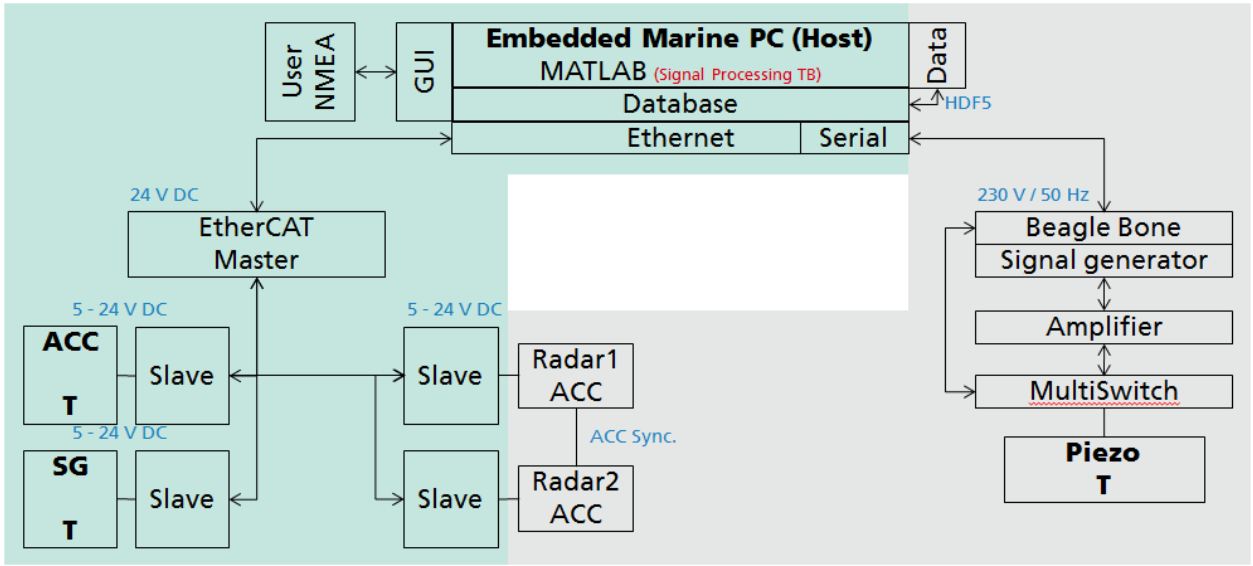
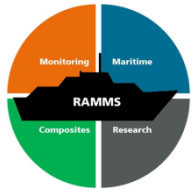
Rudder shaft solution











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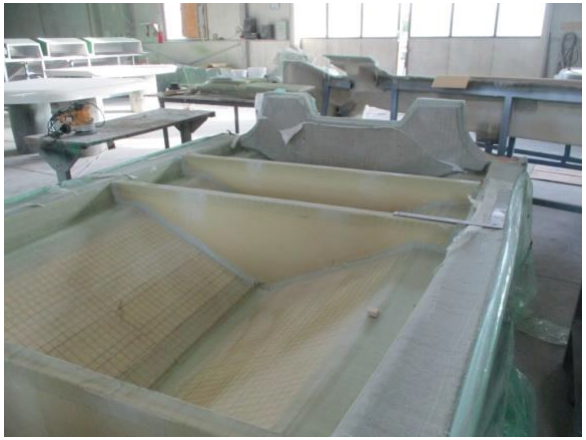
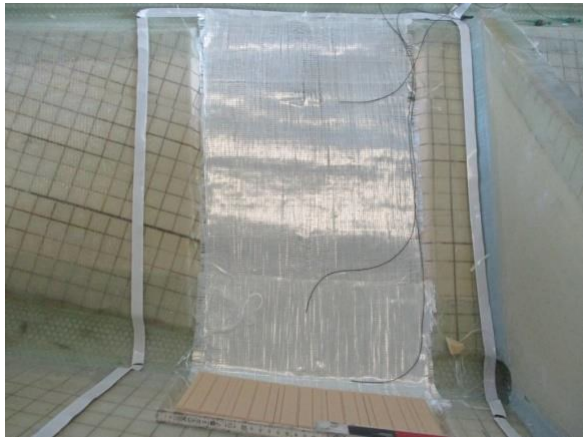
Hull solution

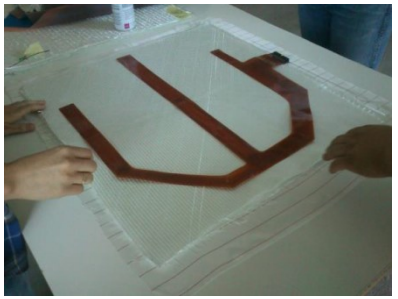
FBG sensors placement in the CreeYacht

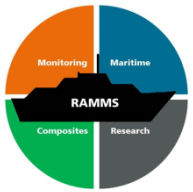




Alternatives

piezoelectric layers





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