# Research

## Prognostics and Health Management (PHM)

Evaluation and regulation of the remaining useful lifetime of systems in operation.

*Poject focus*
- Function-based predictive diagnosis of batteries for autonomous vehicles
- Development of virtual sensors
- Cost analysis and concept development of PHM systems
- Analysis and development of smart maintenance concepts

## Renewable Energy

Methods and analyses for the development and assurance of reliable and sustainable energy supply.

*Poject focus*
- Reliability analyses of different inverter technologies
- Comparison of module and string inverters
- Extension of the remaining useful life of wind turbines using adaptive operating strategies
- Damage detection in transmissions of wind turbines

## Life Testing and Reliability Demonstration

Statistical test planning to model reliability on component and system level considering test effort and confidence interval.

*Poject focus*
- Efficient planning of life tests
- Optimized accelerated life testing
- Design of Experiments (DoE) for normal and non-normal distributed data
- Reliability-DoE
- Consideration of prior knowledge in test planning
- Field data analysis and reliability predictions based on field data
- Determination of customer-relevant load spectra
- Reliability analysis and testing of electronic components and systems
- Development of degradation models for gear pitting
- Reliability prediction on the basis of findings from remanufactured car transmissions

## Drive technology

Methods and analyses for the development and assurance of safe systems and system states.

*Poject focus*
- Risk assessment of safety-critical systems
- Methods and technologies for fail-safe elements of adaptive structures
- Proven in use verification for control systems of tooling machinery

## Simulation of Repairable Systems

Realistic analysis of reliability and availability to optimize maintenance planning taking components, costs and confidence intervals into account

*Poject focus*
- Modeling and analysis of reliability and availability with confidence interval
- Investigation of the properties of industrial production systems 4.0
- Prognosis of availability considering random failures and stochastic processes
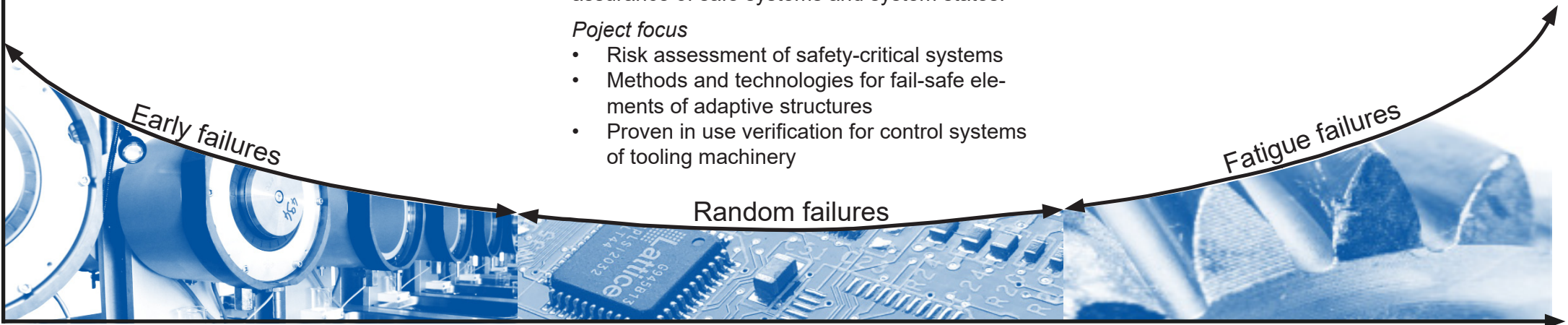
## Project partners
- Mercedes-Benz AG
- thyssenkrupp Presta AG
- Robert Bosch GmbH
- SMA Solar Technology AG
- ELECTRONICON Kondensatoren GmbH
- MERZ Schaltgeräte GMBH + CO KG
- SEG Automotive Germany GmbH
- Forschungsvereinigung Antriebstechnik e.V.
- Forschungsvereinigung Verbrennungskraftmaschinen e.V.

Early failures

Random failures

Fatigue failures

Obejcts of research at the Department of Reliability Engineering at the Institute of Machine Components (IMA) are methods for reliability analysis and reliability assurance of technical components and systems. An average of 20 academic researchers conduct research in the four main areas of Life testing and reliability assurance, Prognostics and Health Management, Functional Safety and simulation of repairable systems.

The institute's philosophy encompasses a close connection of research, teaching and industry, with the highest value being placed on the practical relevance of research and the transfer of knowledge to industry. The students are given a future-oriented and practical education.

## Equipment for studies and industry
- Electrical stress test bench for transmissions
- Gear clatter and rattle noise test bench
- Vibration measuring laboratory
- High-frequency pulsator
- 3D coordinate measuring machine
- Surface testers

## Consulting and Cooperations
- FMEA – Projects
- System analysis
- Design of Experiments
- Reliability demonstration and assurance
- Risk managament
- Life data analysis
- Load analyses and load spectra determination
- Consulting and Coaching in the field of reliability and design of experiments
- Trainings in the field of reliability and design of experiments
- Cooperation with Korean Institute KIMM
- Cooperation with CERN

## Contact

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**Institute of Machine Components**
Reliability Engineering Department

Studies

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