

# Megbízhatóság a termékfejlesztésben

## Reliability in Product Engineering

Registration via NEPTUN:  
BMEGEGINVRP (3 credits)

# Introduction for Budapest University of Technology and Economics

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# Introduction for Reliability in Product Engineering

1. What's Reliability?

2. Why do we need Reliability Engineering?

3. What's the daily work of a Reliability colleague?

4. How is this class organized?

5. What can I take from this class?

# Introduction for Reliability in Product Engineering

## Are you aware of all Product uses and loads?



pfiff.de



zuendapp.de



lekkerbikes.com



vintageelectribikes.com



shop.rad-salon.com



newurtopia.de



cube.com



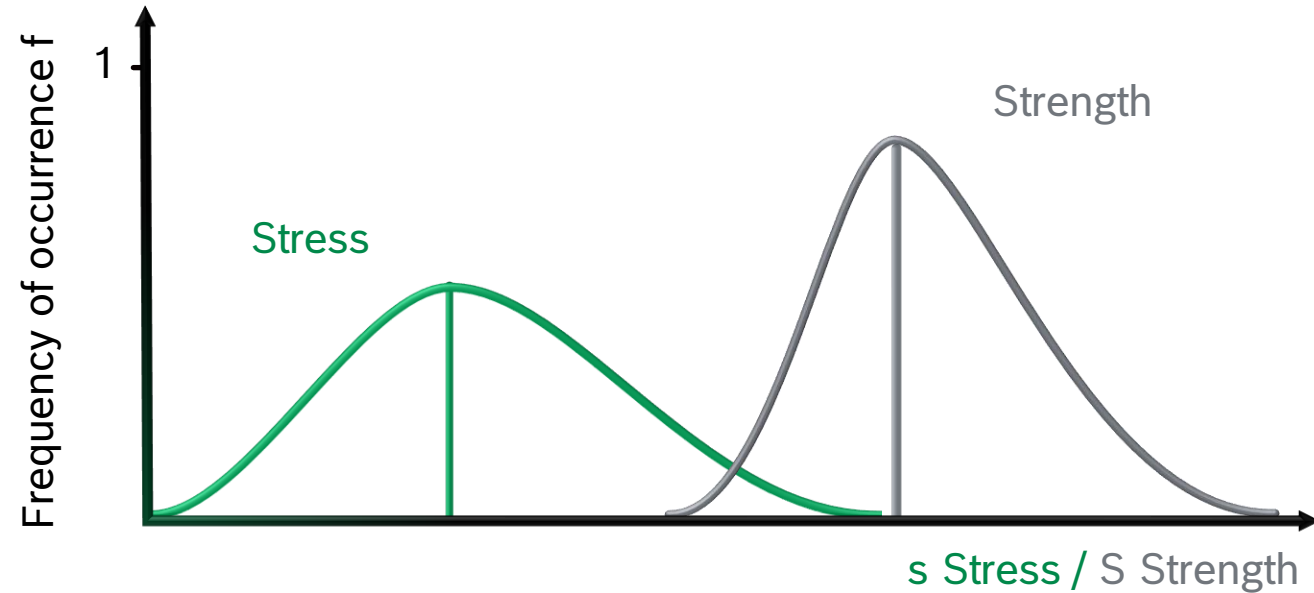
fahrradgigant.de



babboe.com

# 01

## What's reliability?

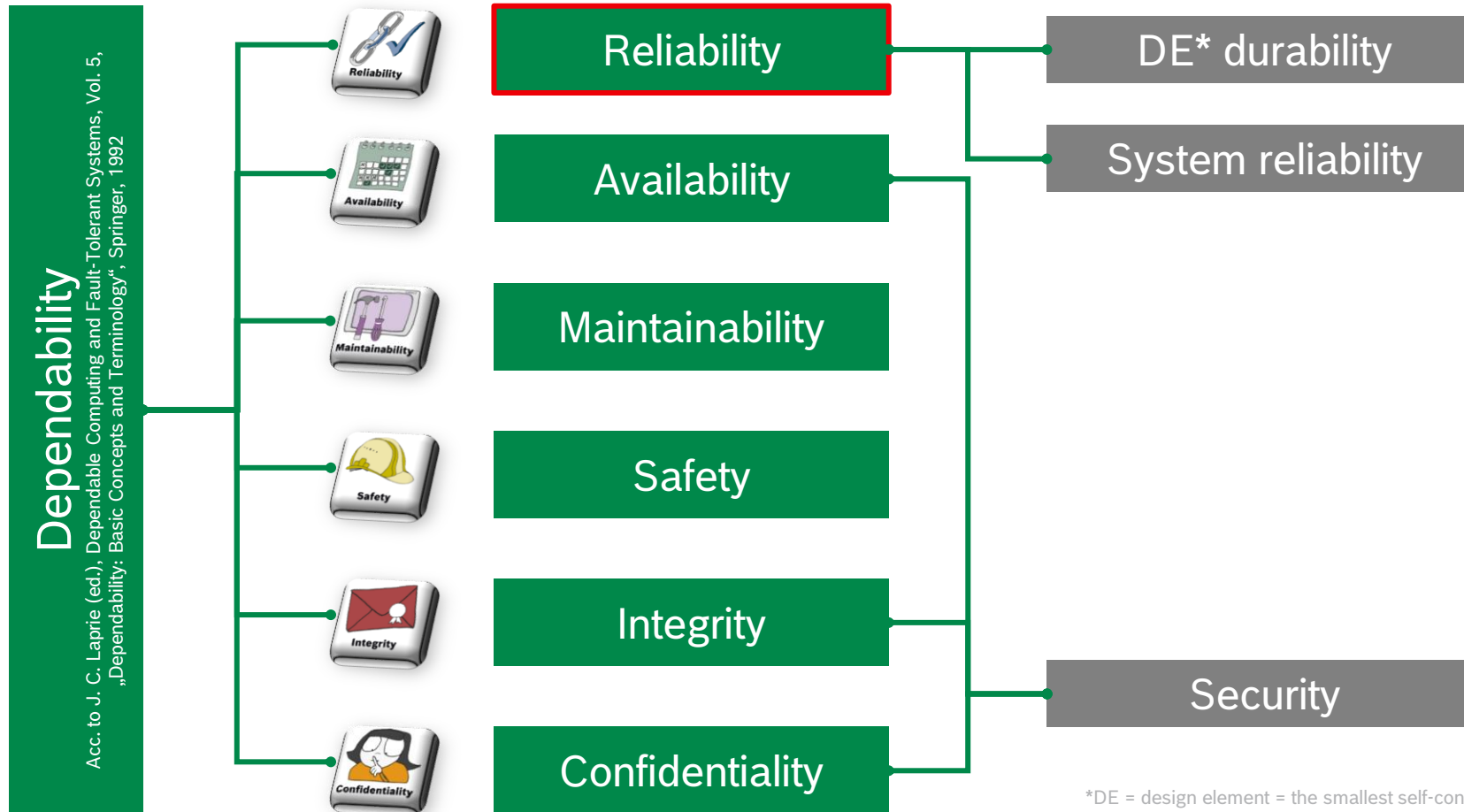


## Reliability in Product Engineering (RPE)

*Dr. Kemmler, Stefan*

# What's reliability?

## Reliability put into perspective



\*DE = design element = the smallest self-contained component that fulfills one or more functions.

# What's reliability?

## Definition of Reliability

**Reliability is the product property**

- to perform a **required function**
- in a **specified operating range**
- for a **defined service time**.

**What is to be done?**

- The function -

**Under what conditions?**

- The loads -

**For how long?**

- The service time -

**To which extent failure is allowed?**

- The failure probability -

**How can I detect that the product/manufactured item has failed?**

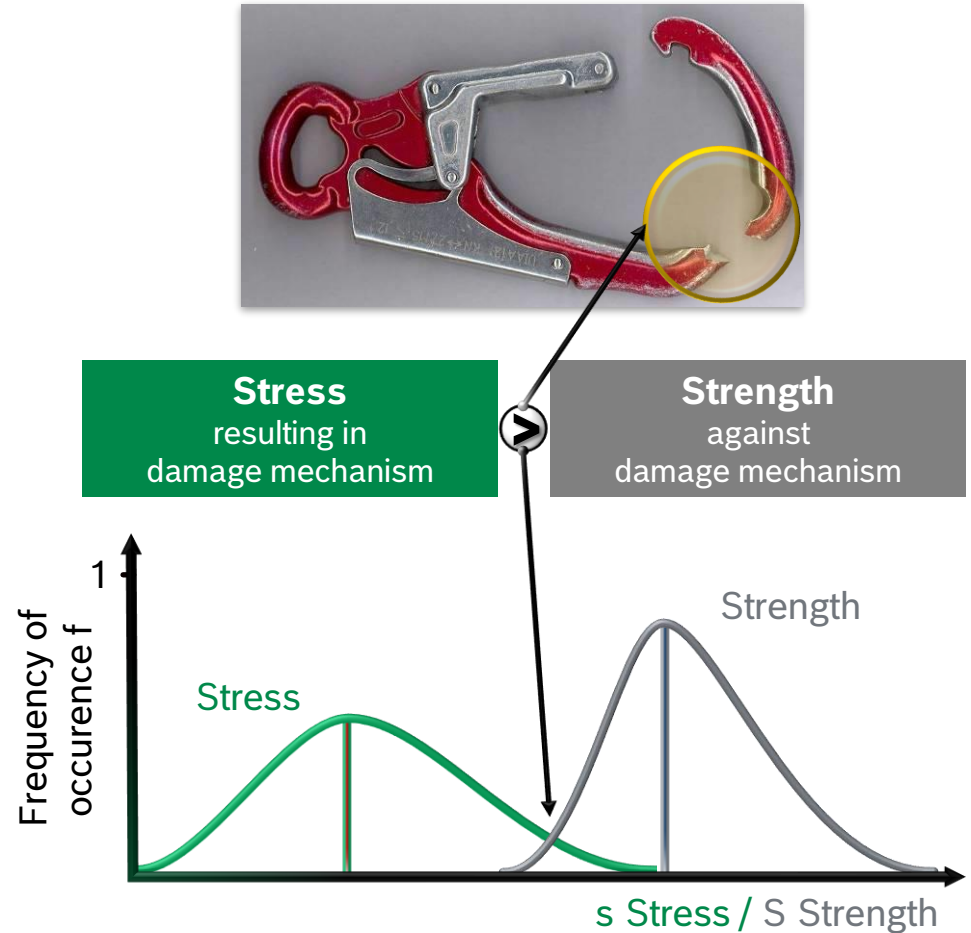
- The failure criteria -

**Product or manufactured item**

# What's reliability?

## Failure model of reliability

- Critical factors for failure are the local stresses and the local strength at the point of failure with regard to the damage mechanism in question.
- A component fails when the local stress at the location of failure exceeds the local strength.
- "Small real-world complication":
  - Stress and strength are distributed quantities.

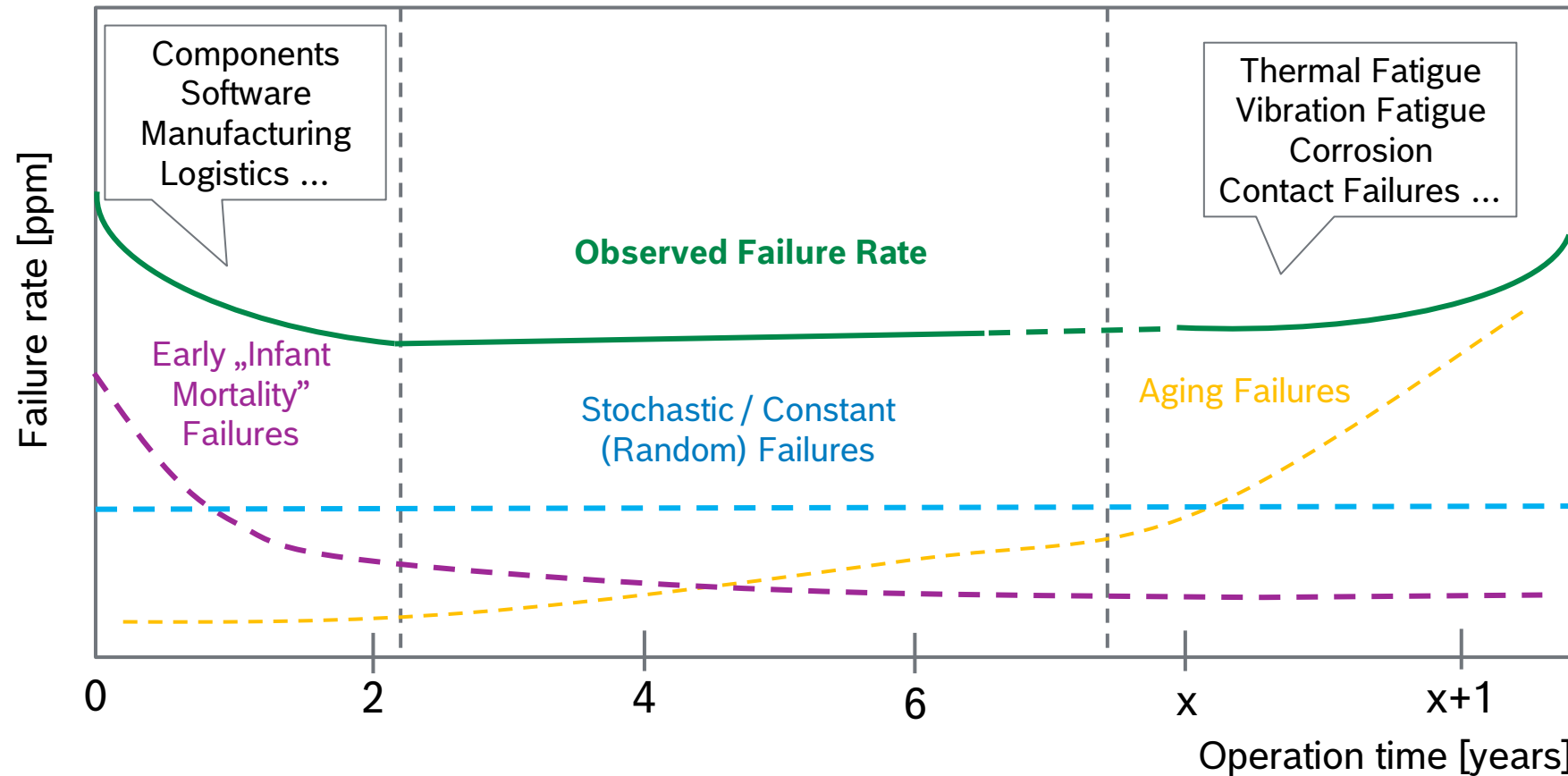


# What's reliability?

## Bathtub model

$$\lambda(t) = \frac{\text{\#Failure}(s)}{\text{Sum of all intact items}} = \frac{f(t)}{R(t)}$$

Anticipated number of times that an item fails in a specified period of time.



# 02

## Why do we need Reliability engineering?



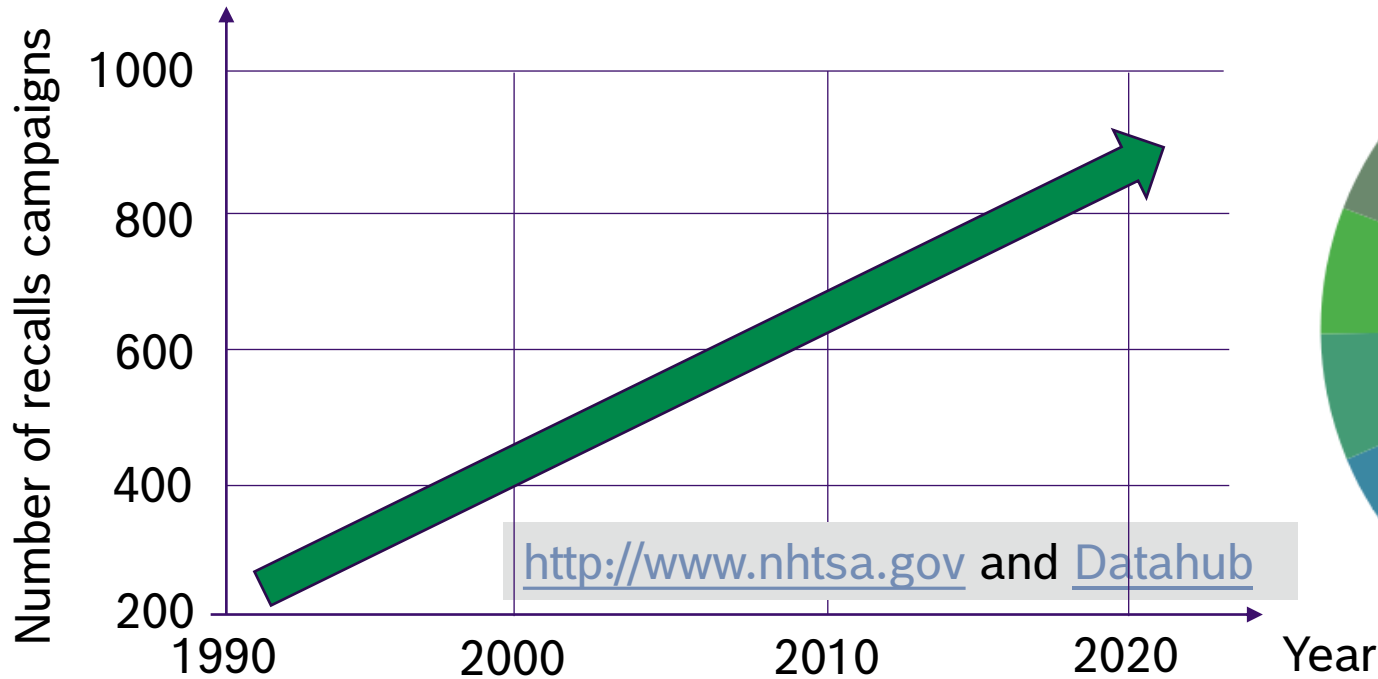
### Reliability in Product Engineering (RPE)

*Dr. Kemmler, Stefan*

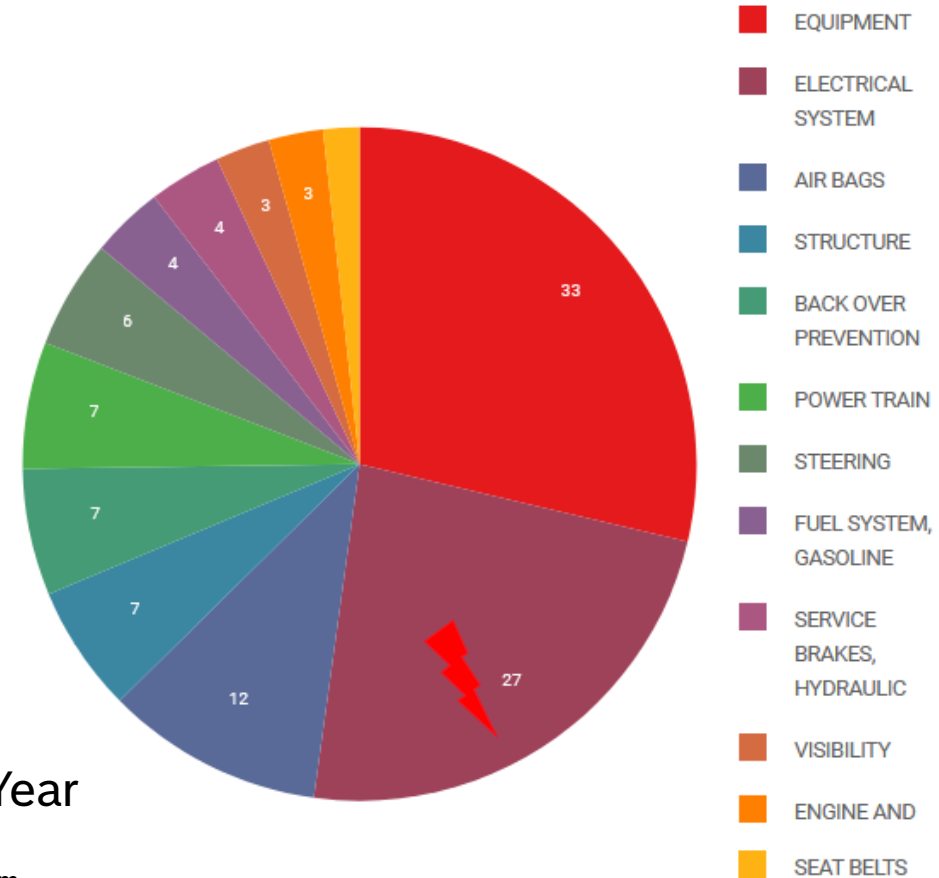
# Why do we need Reliability engineering?

## Why is reliability actually a topic of discussion?

Number of vehicle recall campaigns in USA

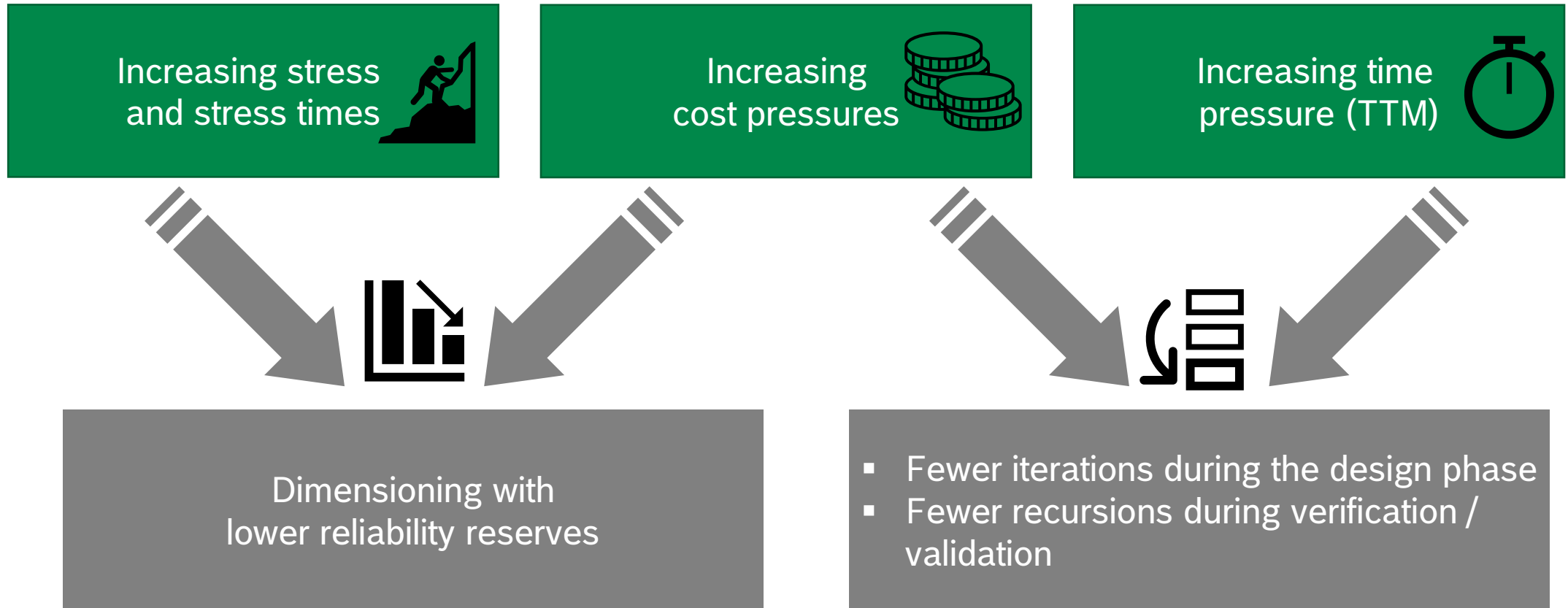


**Source:** National Highway Traffic Safety Administration (NHTSA). Trend from published data from press release DOT 62-16, Wednesday, June 1, 2016



# Why do we need Reliability engineering?

## Why is reliability actually a topic of discussion?



# 03

## What's the daily work of a Reliability colleague?

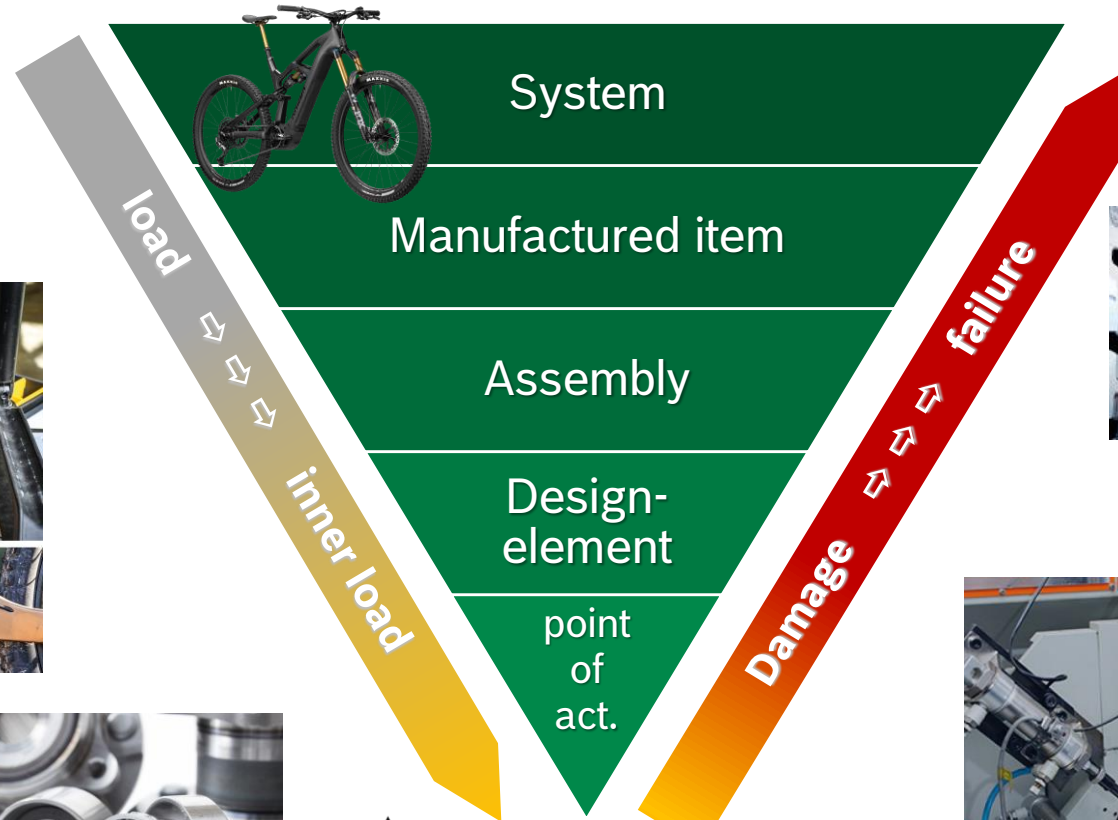


## Reliability in Product Engineering (RPE)

*Dr. Kemmler, Stefan*

# What's the daily work of a Reliability colleague?

## V diagram



bike-magazin.de



qima.com

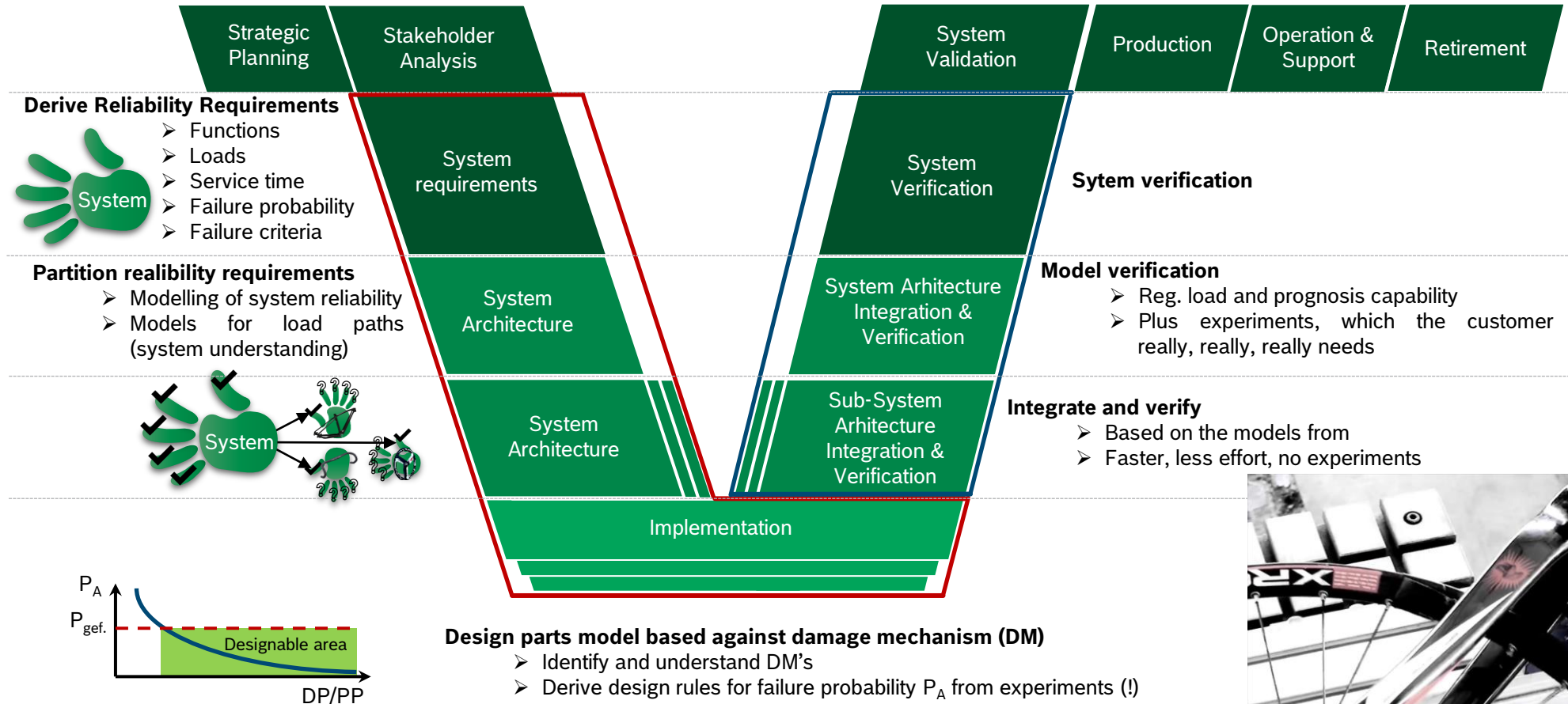


craft-bearings.com



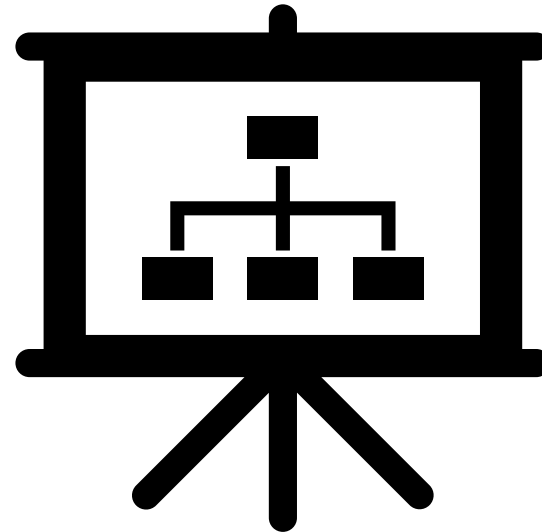
# What's the daily work of a Reliability colleague?

## V diagram



# 04

## How is this class organized?



## Reliability in Product Engineering (RPE)

*Dr. Kemmler, Stefan*

# How is this class organized?

## Short overview



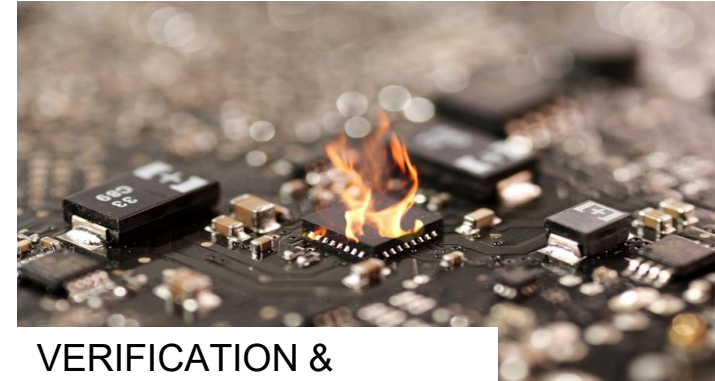
### REQUIREMENTS

*Understand the customer requirements*



### DESIGN

*Understand and design the product*



### VERIFICATION & VALIDATION

*Verify and Validate the product reliability*

Design for Reliability

Reliability verification & validation

# How is this class organized?

## Chapter overview

1. Introduction and motivation for DfR

2. Requirements, load sources, use cases and reliability partitioning

3. Basics and methods of Reliability Engineering

4. Loads, load collectives and Mission profiles

5. Failure mechanism and lifetime models

6. Design of experiments

7. Accelerated test procedures

8. Environmental simulation (EVN)

9. Physical analysis

# How is this class organized?

## Project work

- 4 presentations during semester (see time schedule on next slide):

1. Define Mission profiles / use cases / load profile / load path

2. Load capacities / Physics of failures / Failure mechanism  
Define lifetime model for the respective Design Element

3. Define "virtual test" parameters (excel table which calculates output based on lifetime model parameters and input data) + Execute + Assess and evaluate test results

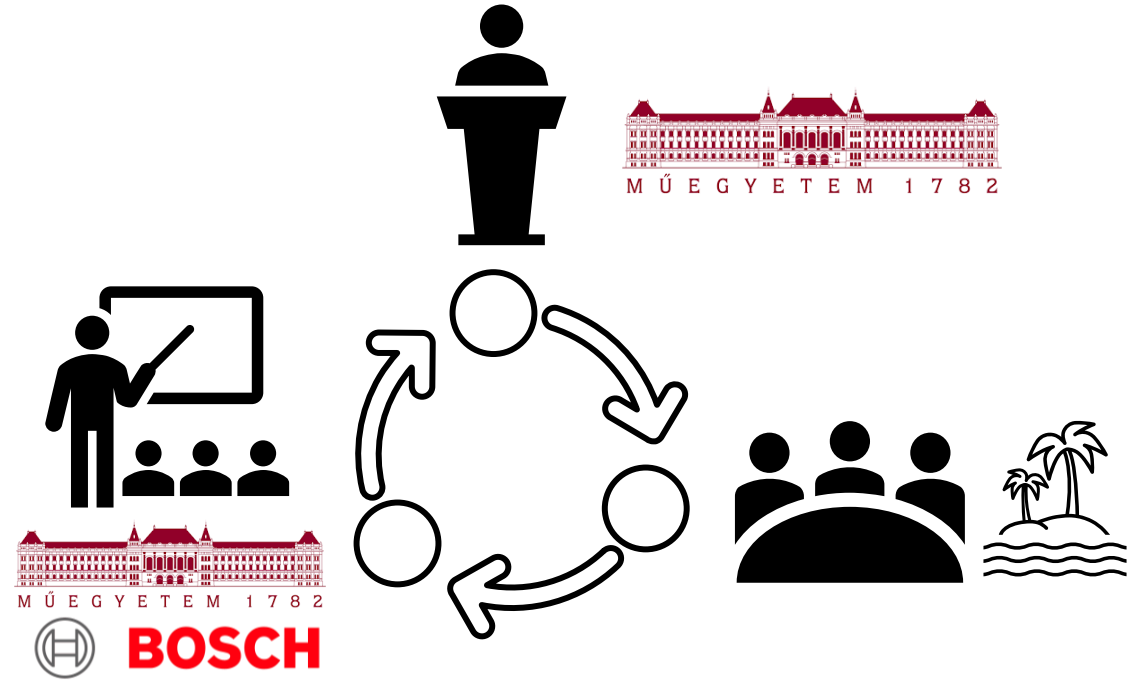
4. Summary of the project w/ final statement regarding the design rule

- For each working period, the starting and boundary conditions are same for each group
- One common product example for each group
- Final presentation is a summary of the whole project → Graded for the class

# How is this class organized?

## Lecture overview in blocks

- **Class / project work / final presentation**
- **3 ECTS – 15 units each 90 min:**
  - **10 chapters**, for **each** chapter **one lecture** unit
  - **4 units** for **project review / consulting**
  - **1 unit** for **final presentation**
- **No written exam → final presentation**



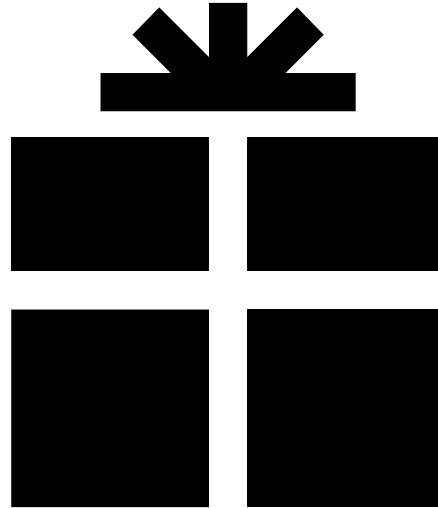
Calendar week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Lecture (chapter#)	1/2	3	3	4		5			6	7	7/8	9		9	
Project (presentation#)						1		2				3		4	

Introduction  
& group orga

Labs visiting  
@ Bosch

# 05

**What can I take from  
this class?**



**Reliability in Product Engineering (RPE)**

*Dr. Kemmler, Stefan*

# What can I take from this class?

State of the art of competence for industry

Big picture of Reliability for product engineering

Essential engineering contribution in mobility related product development

How to organize and work in project team

Present complex engineering related content in a management committee

Visiting a industrial engineering center and see how daily engineering works

Creating relationship with one of the biggest automotive supplier in Hungary

# Reliability in Product Engineering

## Where is the journey heading and what does it mean for design?



Sources: Xpeng / Tesla

**Thank you very much for your attention!**

