

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?

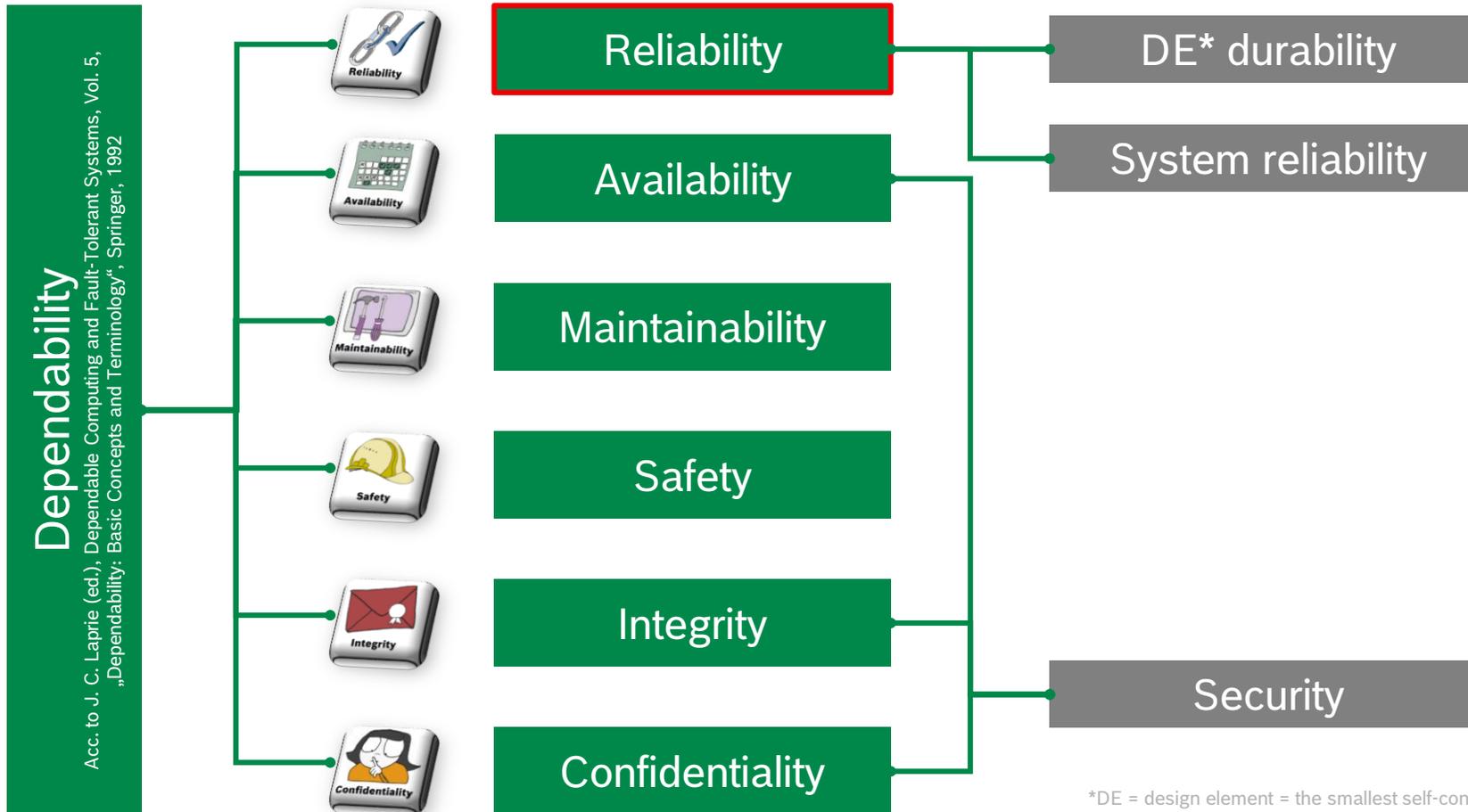


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What's reliability?

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 -

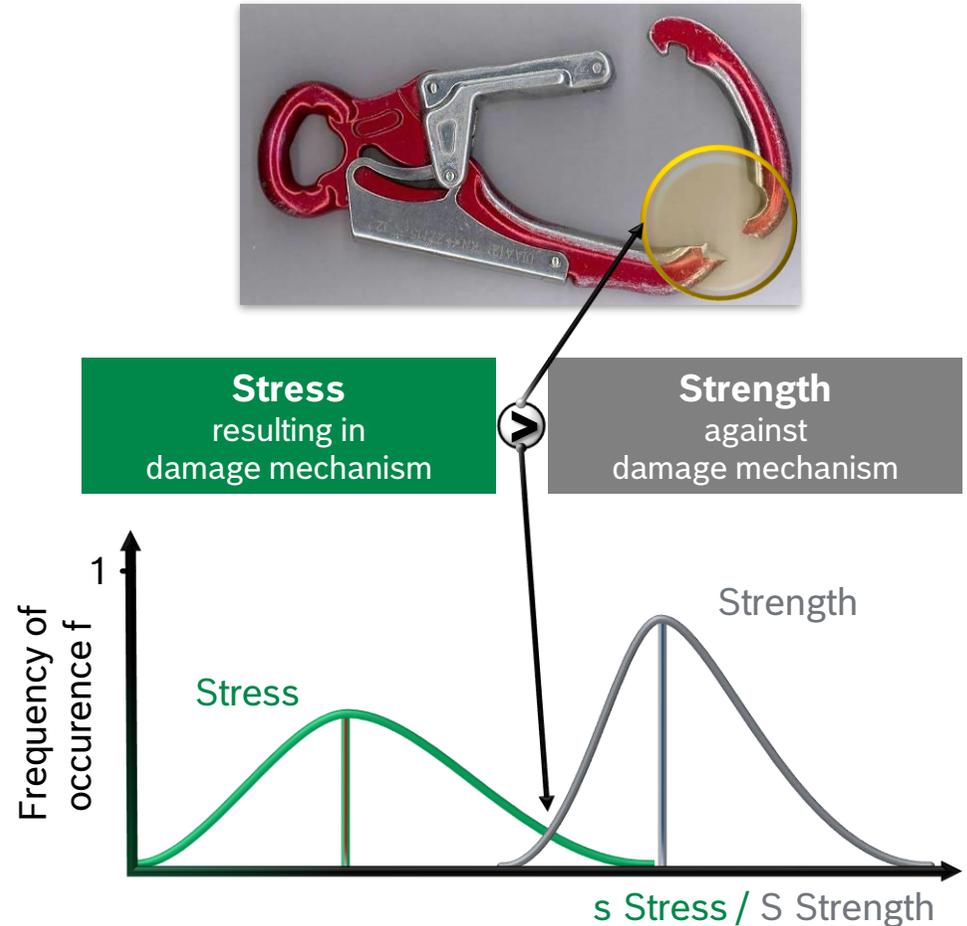
Product or manufactured item



What's reliability?

Failure model of reliability

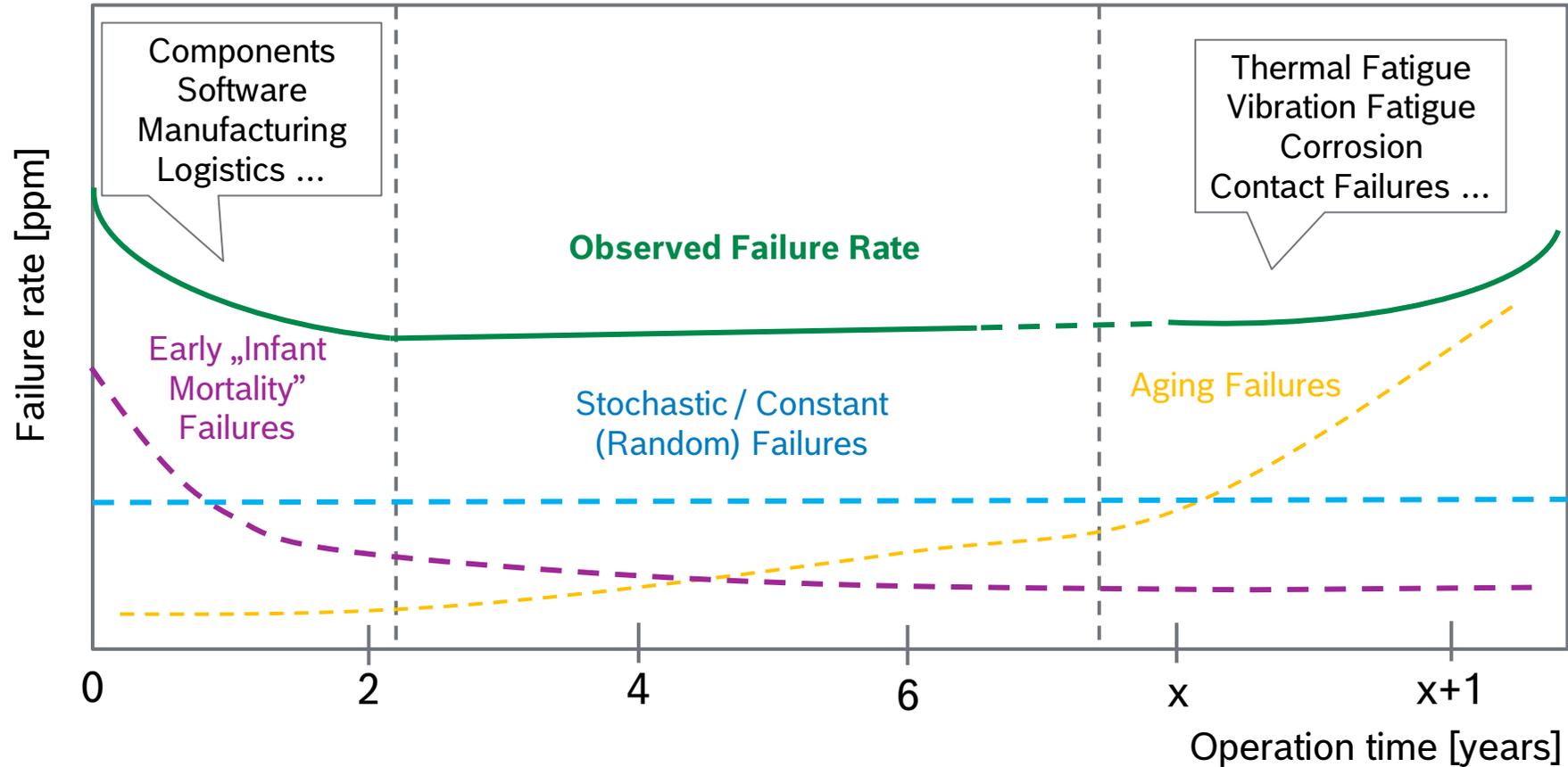
- Critical factors for failure are the local stresses and the local strength at the point of failure with regard to the damage mechanism in question.
- A component fails when the local stress at the location of failure exceeds the local strength.
- "Small real-world complication":
 - Stress and strength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



What's reliability? Bathtub model

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

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



02

Why do we need Reliability engineering?



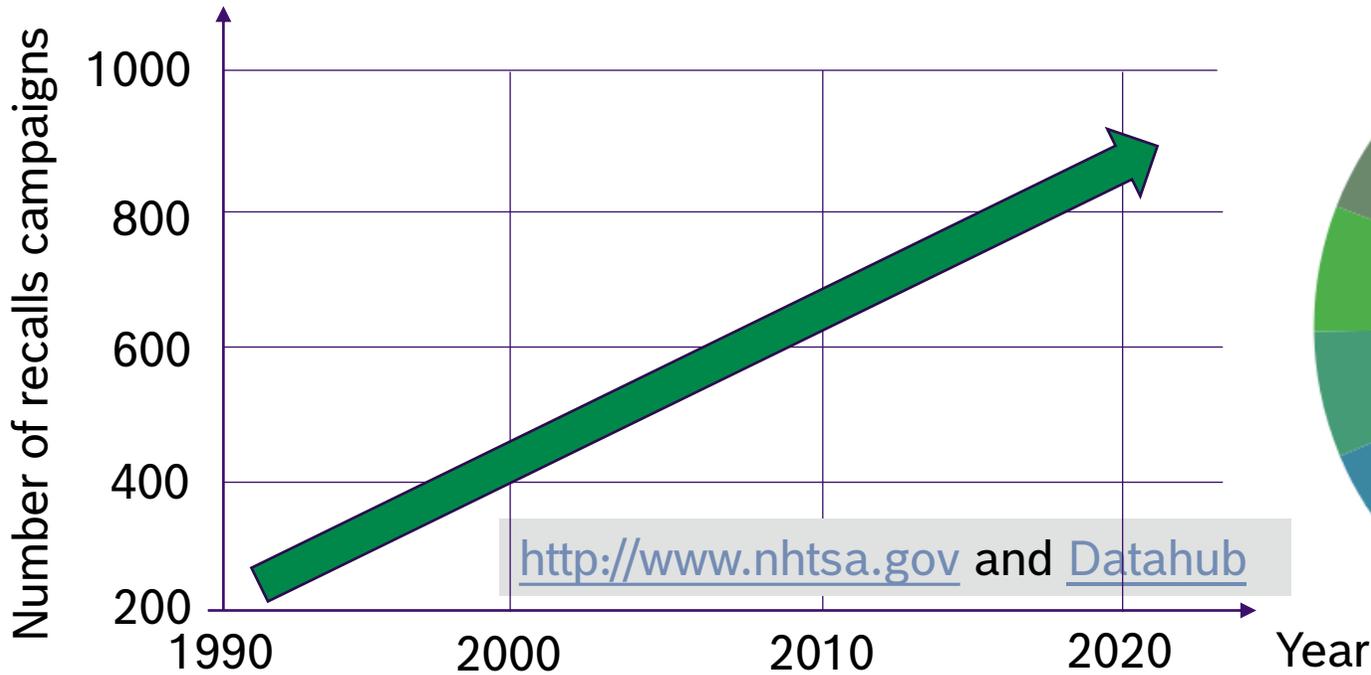
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Why do we need Reliability engineering?

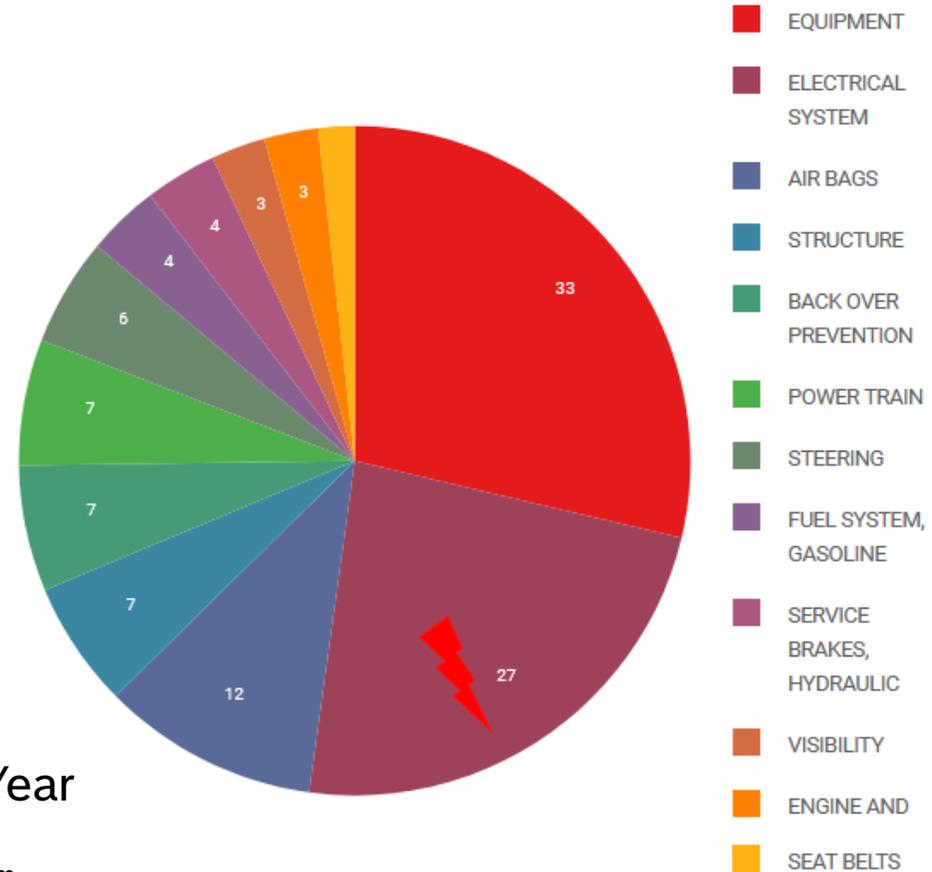
Why is reliability actually a topic of discussion?

Number of vehicle recall campaigns in USA



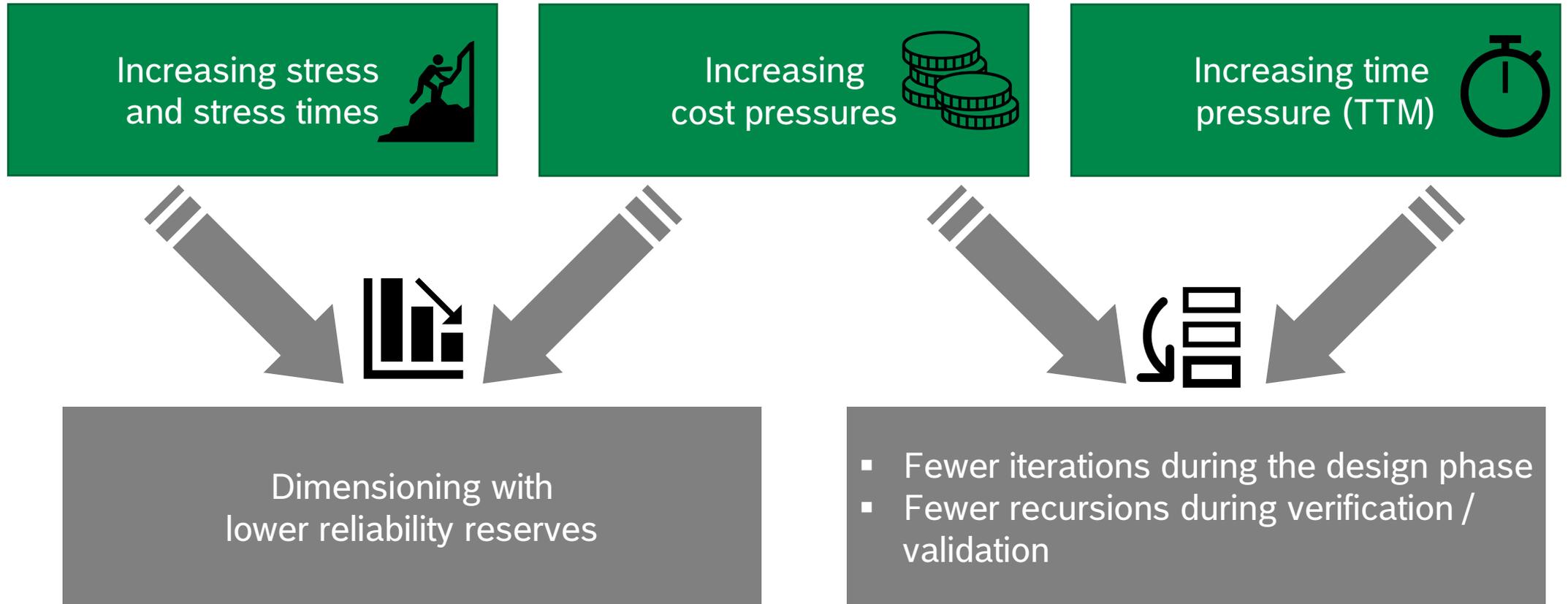
<http://www.nhtsa.gov> and [Datahub](#)

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?

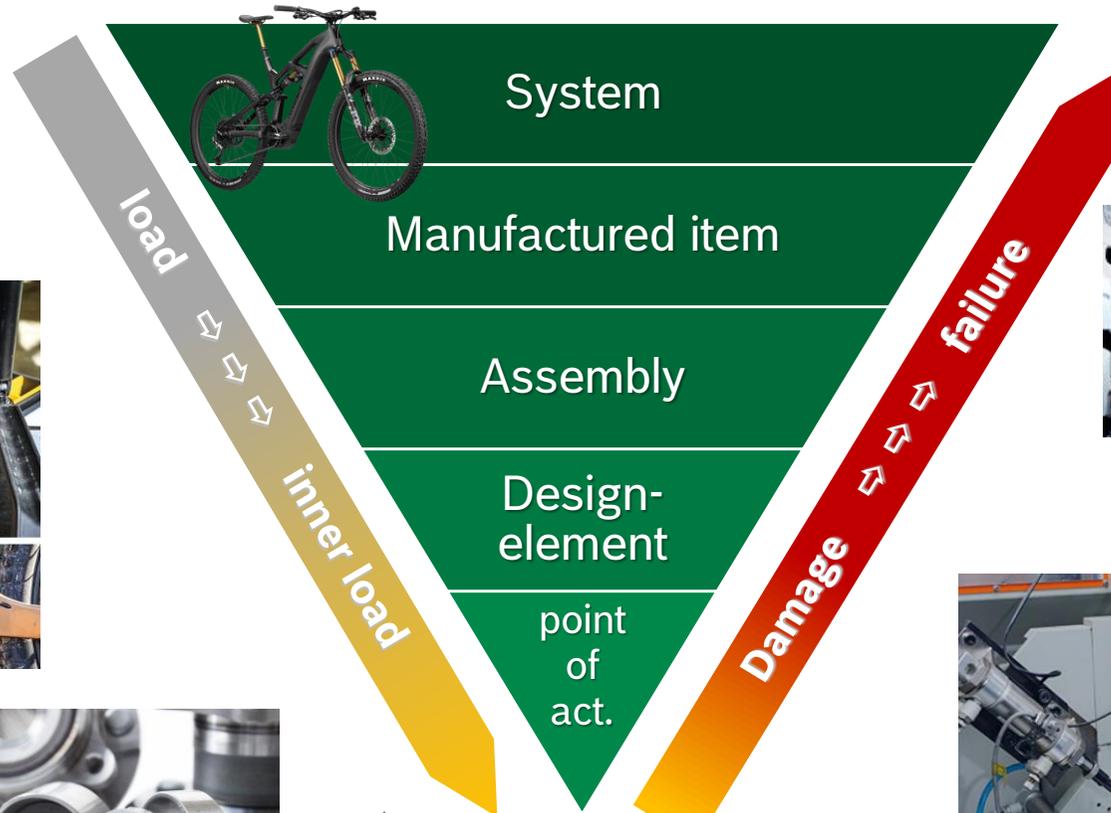


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What's the daily work of a Reliability colleague?

V diagram



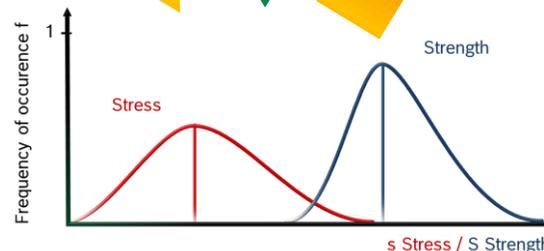
bike-magazin.de



qima.com

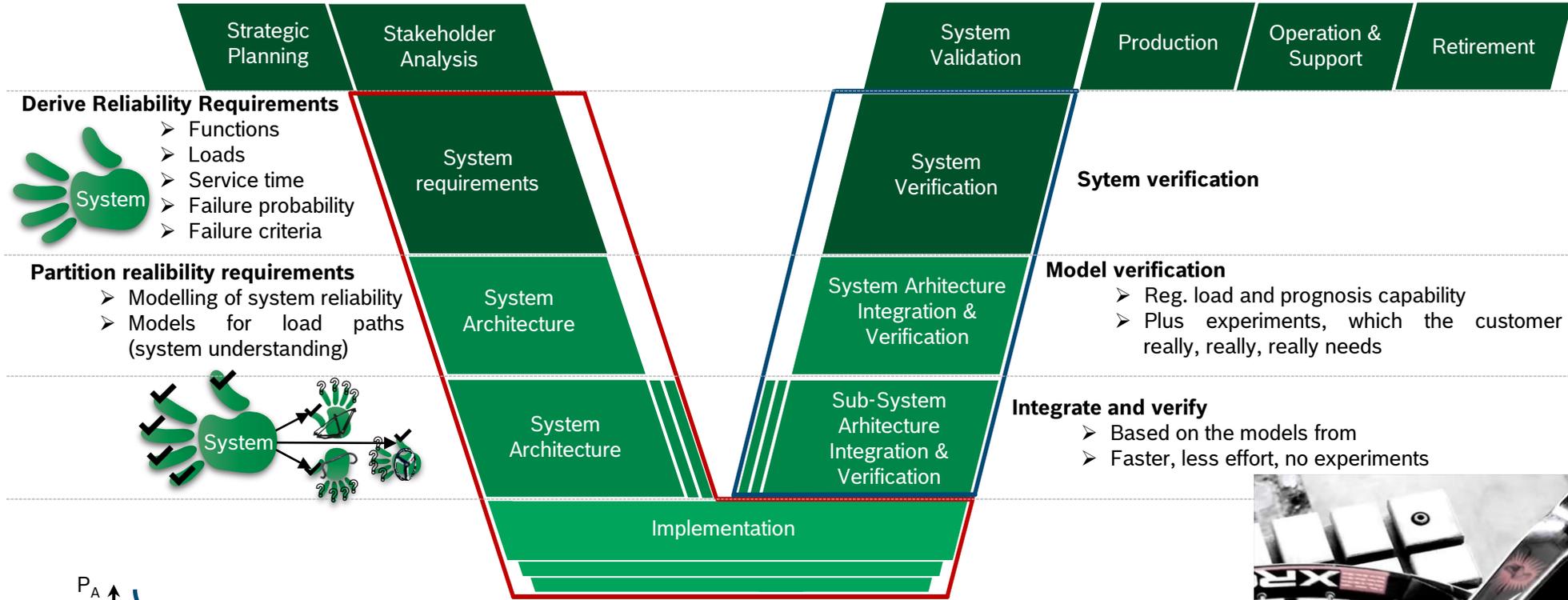


craft-bearings.com



What's the daily work of a Reliability colleague?

V diagram

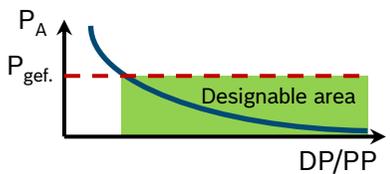
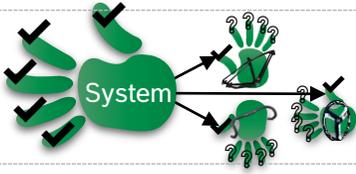


Derive Reliability Requirements

- Functions
- Loads
- Service time
- Failure probability
- Failure criteria

Partition reliability requirements

- Modelling of system reliability
- Models for load paths (system understanding)



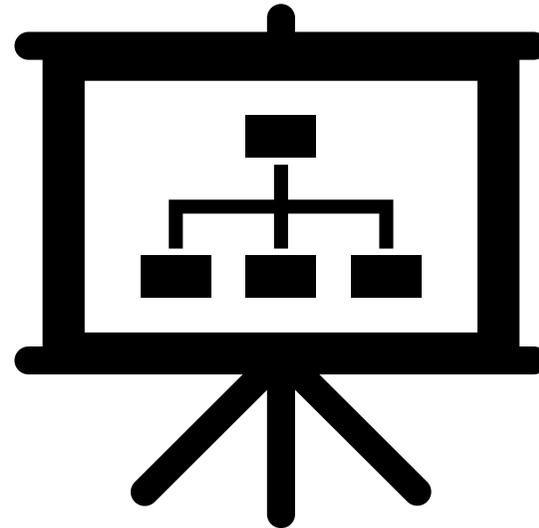
Design parts model based against damage mechanism (DM)

- Identify and understand DM's
- Derive design rules for failure probability P_A from experiments (!)



04

How is this class organized?



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How is this class organized?

Short overview



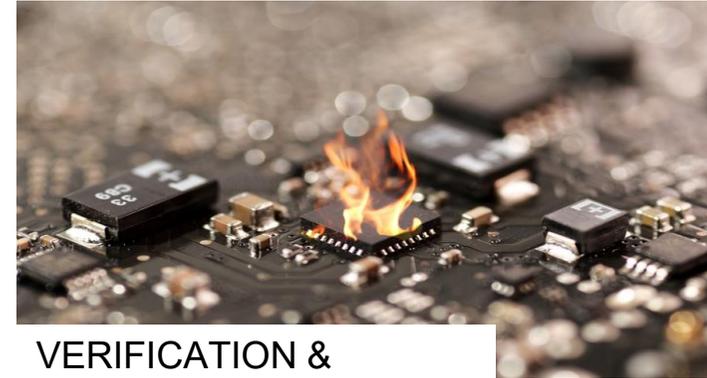
REQUIREMENTS

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

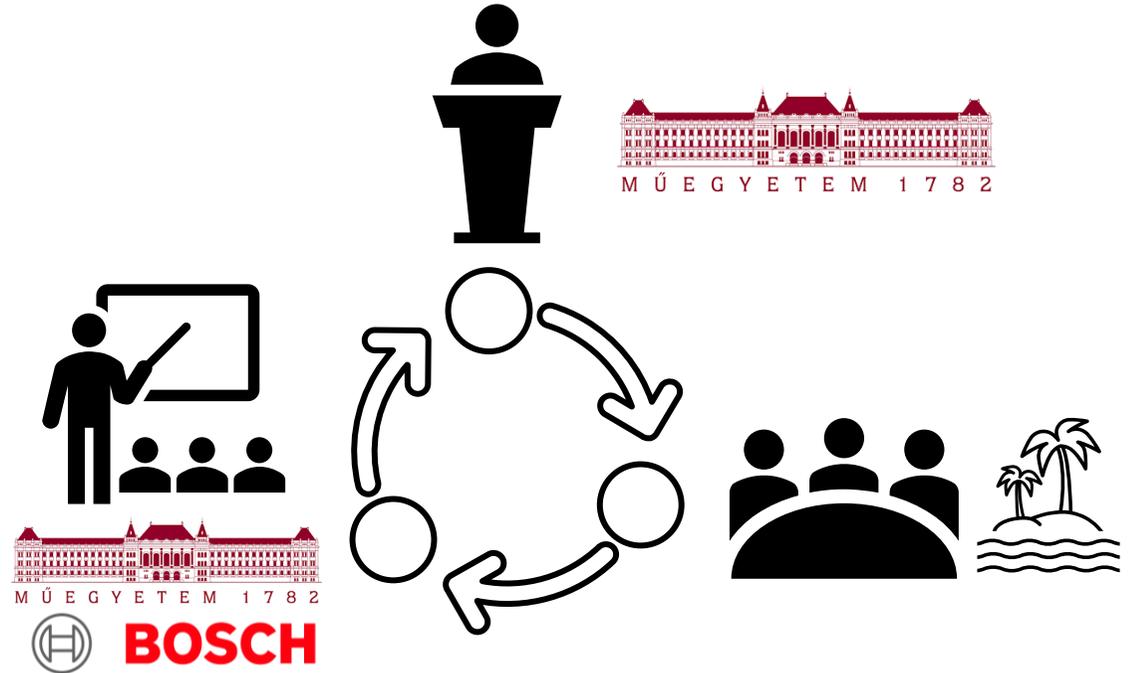
4. Summary of the project w/ final statement regarding the design rule

- 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**



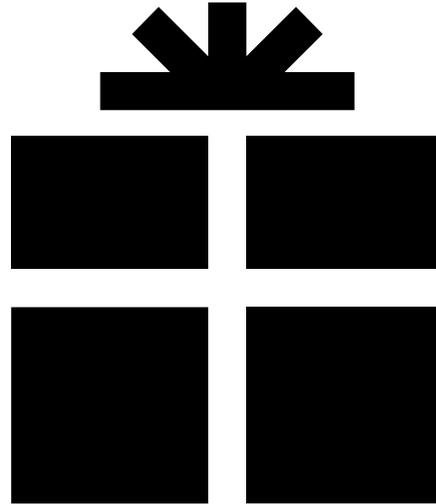
Calendar week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Lecture (chapter#)	1/2	3	3	4		5			6	7	7/8	9		9	
Project (presentation#)						1		2				3		4	

Introduction
& group orga

Labs visiting
@ Bosch

05

What can I take from this class?



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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!

Question?

Hints?

Recommendations?