Vehicle concepts & -systems

Module 4 Basics to software development

WS 2023/2024

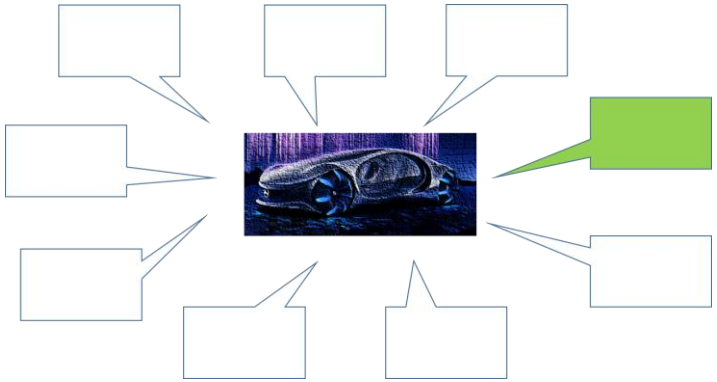
Schedule

• Presentation & Feedback Teamwork module 3	08:00 – 09:00
• Basics to software development	09:00 – 10:00
• *Coffee break*	*10:00 – 10:15*
• V-Model part 1	11:00 – 12:00
• *Lunch break*	*12:00 – 13:00*
• Teamwork	13:00 – 16:00

Teamwork Module 3

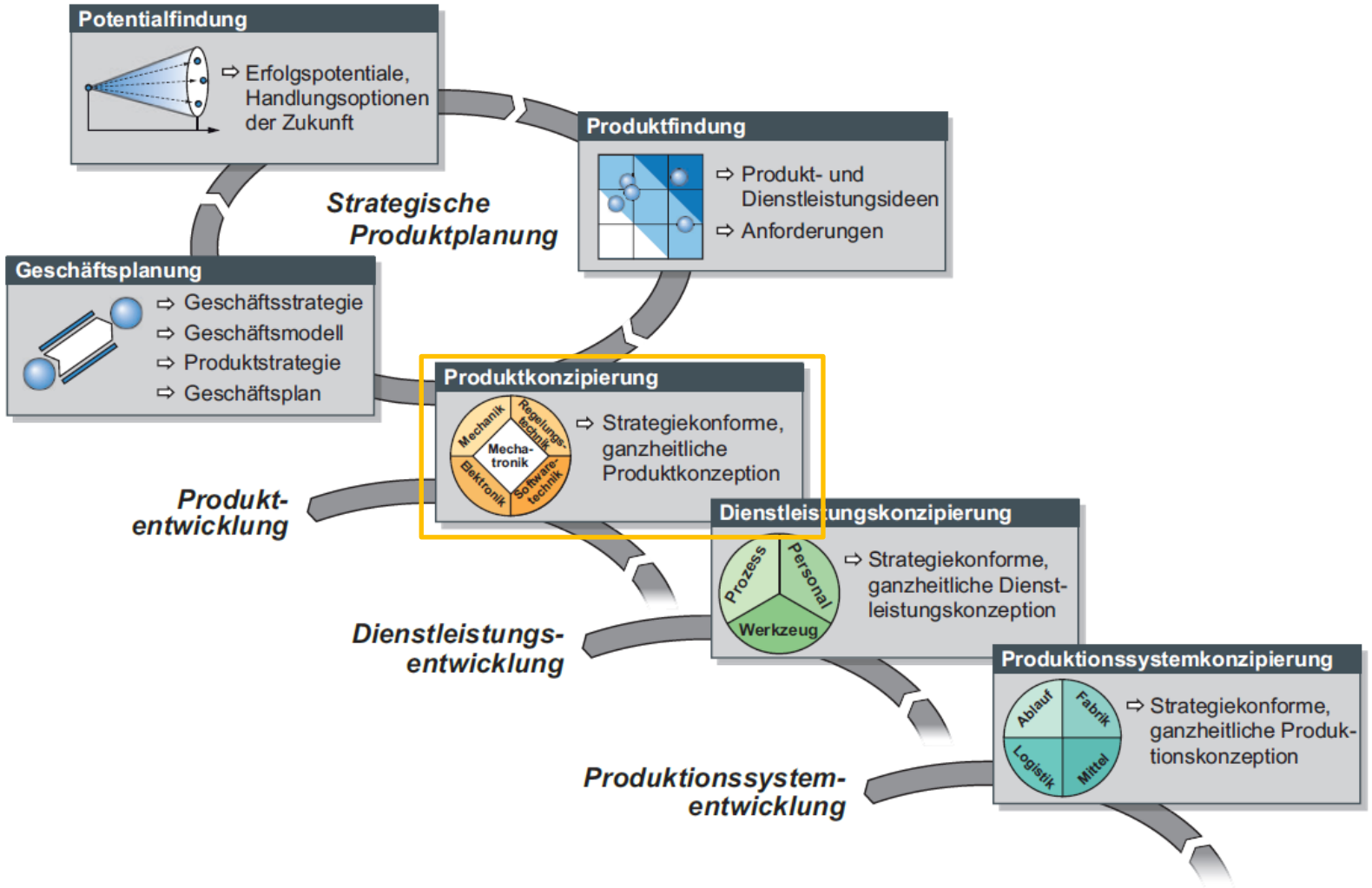
- Which variants of your product are promising (considering potential markets / customers)?
- Regarding your concept, please describe wan key module (e.g. powertrain, chassis, body) for:
  - Engineering from scratch (new)
  - Engineering adaptive (e.g. using componentes you can find already in competetive products)
  - Engineering variants (small change)
- Please draft the engineering process focusing hardware & software development of the most critical modules (including where do you have high uncertainty needing support e.g. from suppliers)
- What timeline is realistic from your point of view until Start of Production (SOP)

- => Please apply the methods you learned in this module.



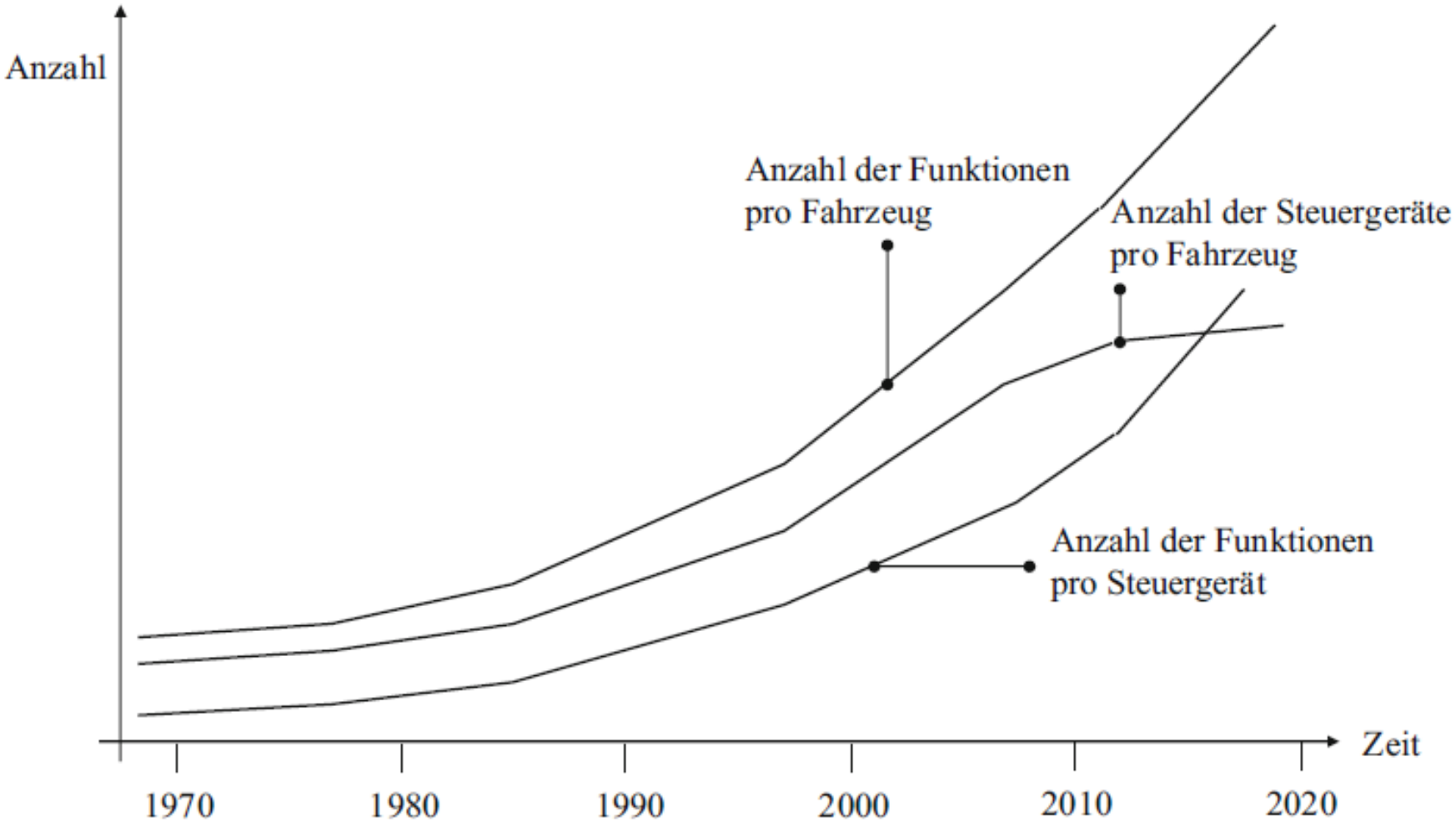
Basics to Software Engineering

Software Engineering in the reference model of GAUSEMEIER



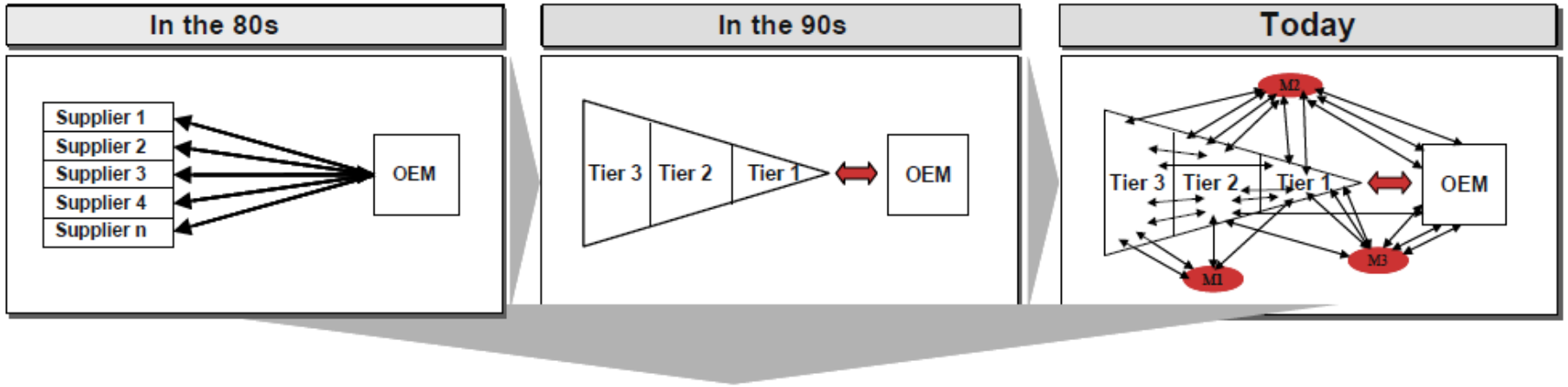
[GDP+19]

Software Engineering
Why challenging?

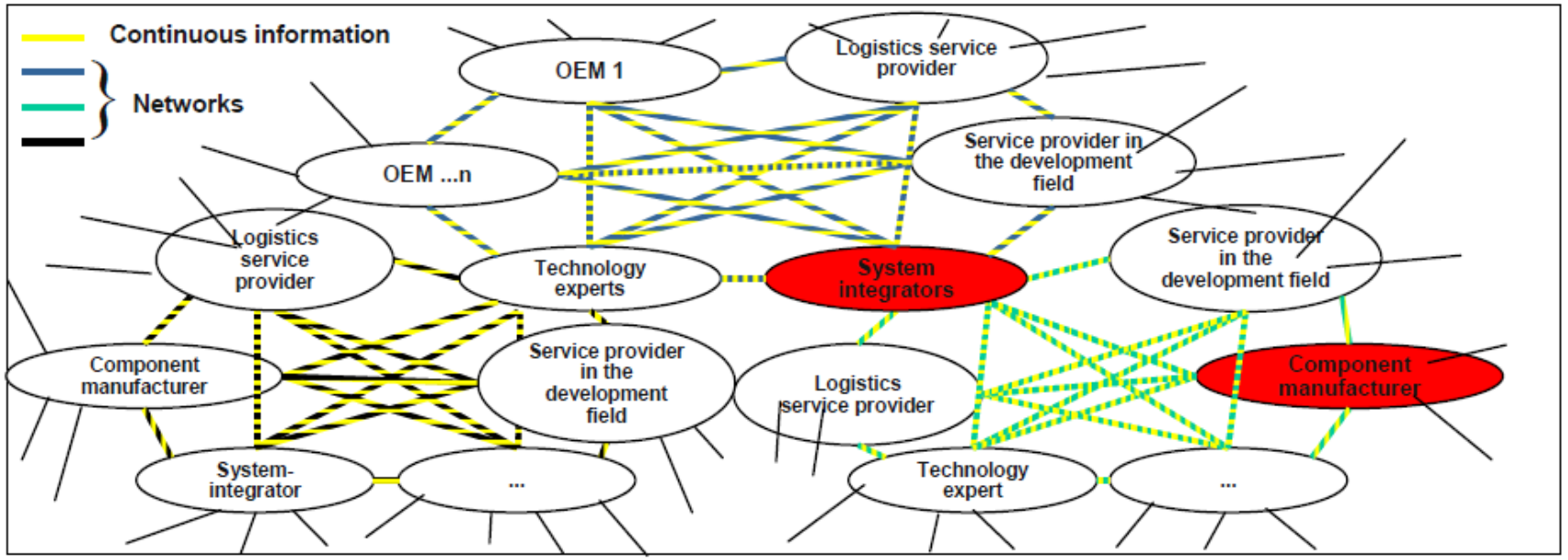


[Sch16]

Complexity – Cooperation between suppliers



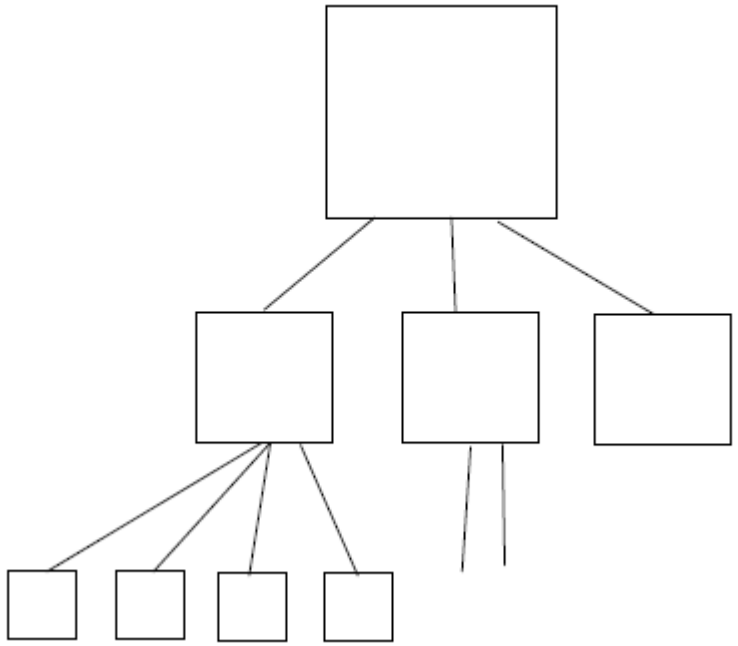
In the future



[Eig09]

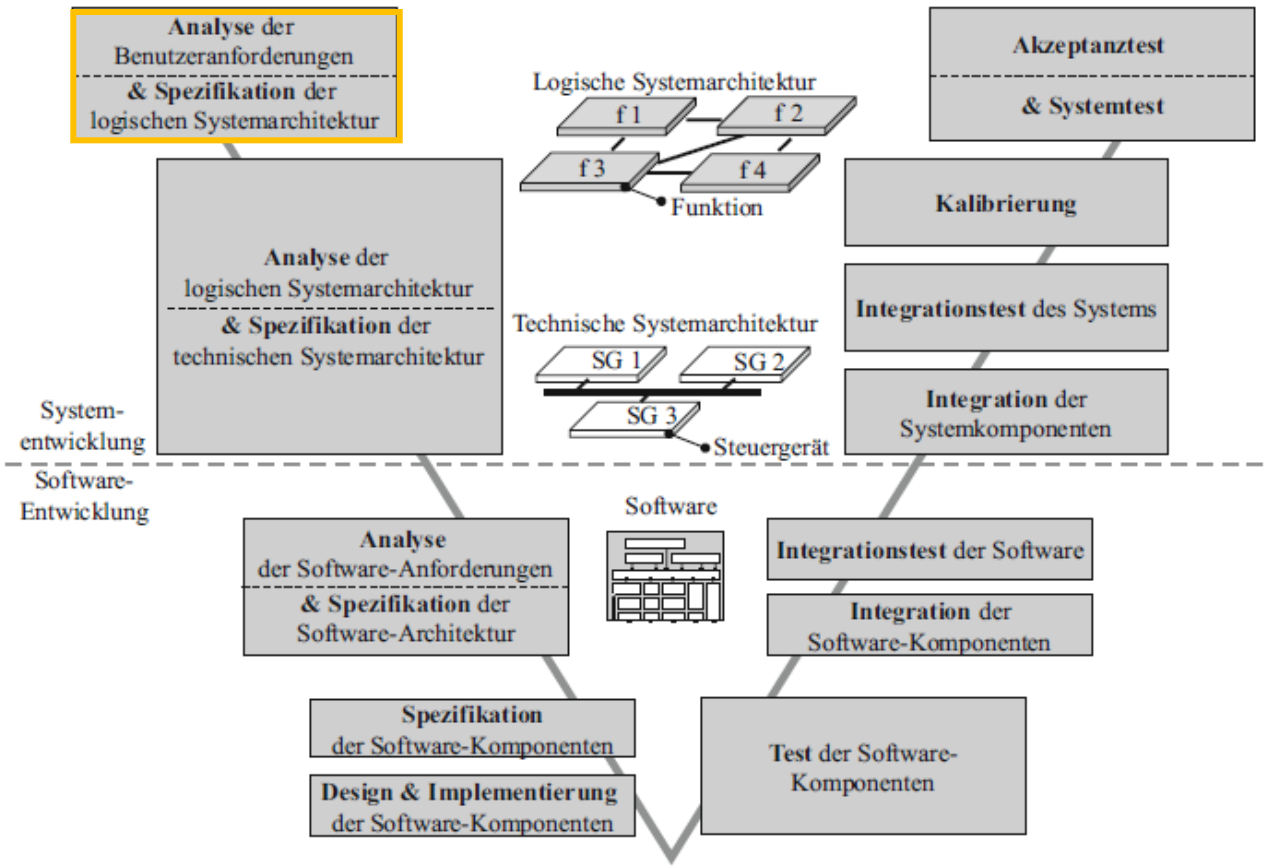
Principle: „Divide et Impera“ „Devide & control“

Devide a complex problem in independend & controllable „single problems“



[Gol18]

V- Model – one core method in software engineering



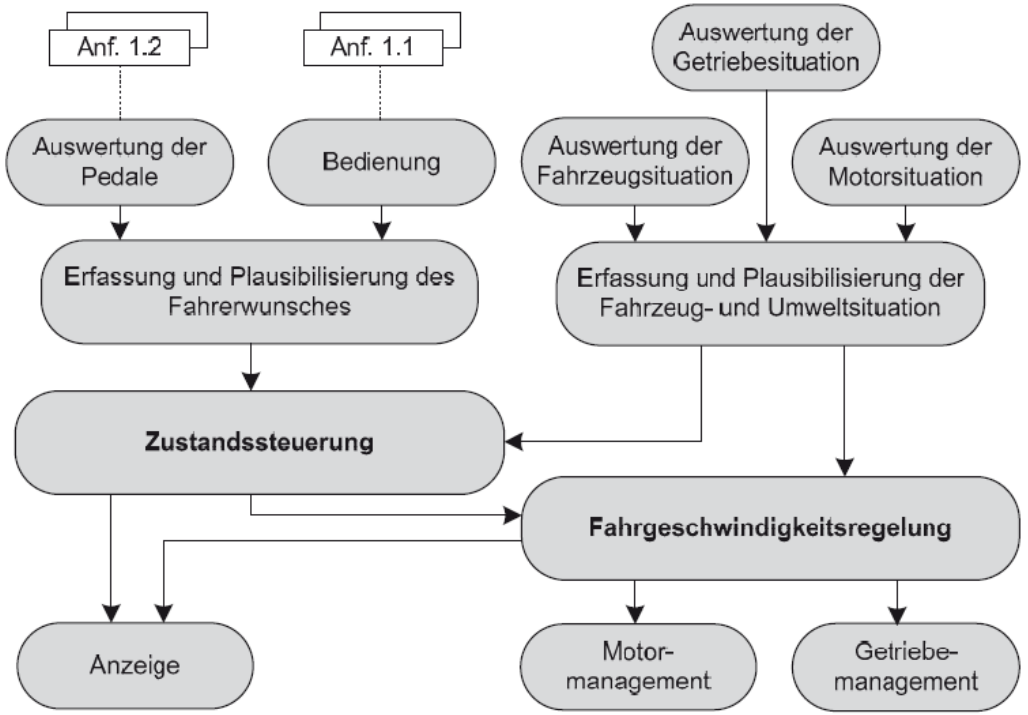
- Precise description of the tasks
- Description of requirements regarding the intended system
- Definition of a network of functions
- Definition of communication of functions
- NO description of technical solutions!

→ **WHAT**

[Sch16]

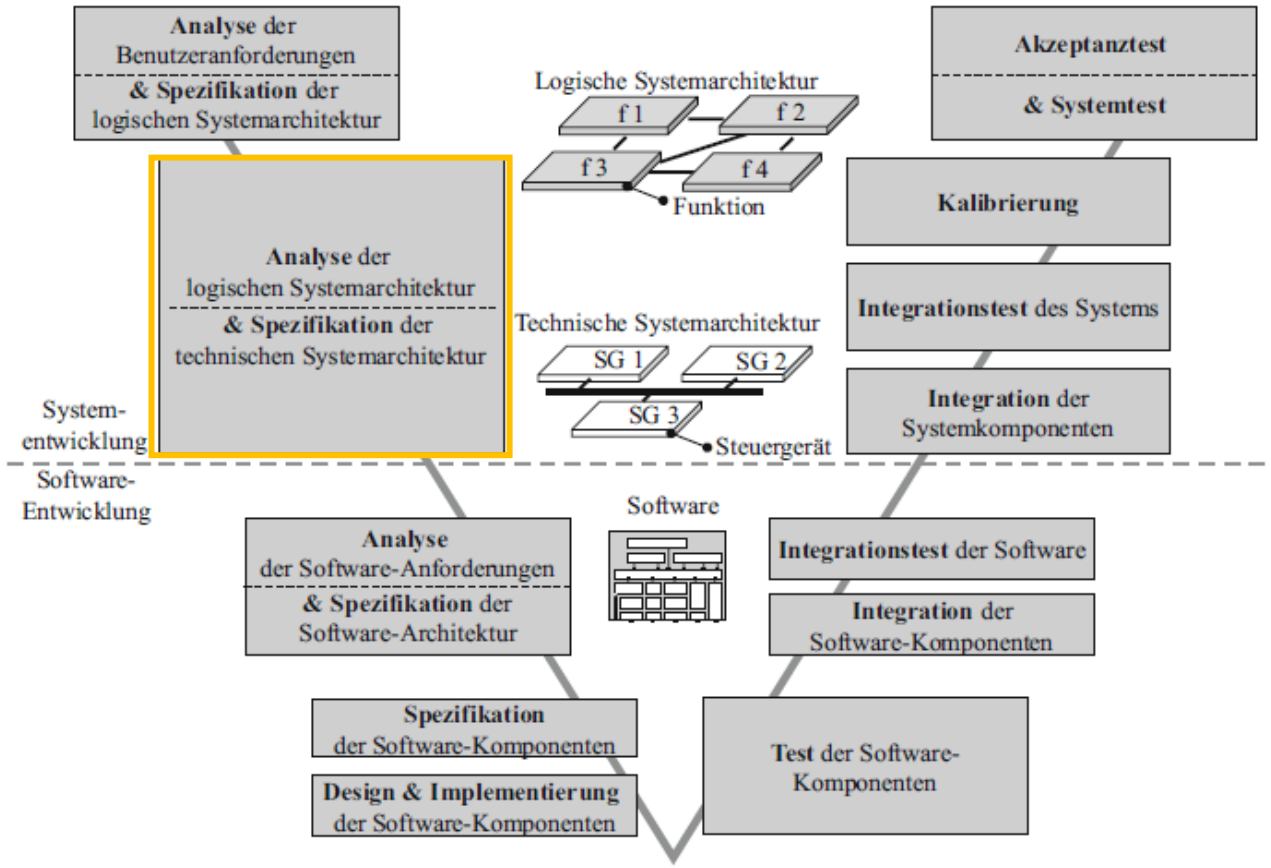
Requirements Engineering - expample

Kennung	Anforderung	Anforderer
1.1	Die Funktion muss durch ein Bedienelement („Einschalter“) aktiviert werden können.	Schulz
1.2	Bei Betätigung der Bremse muss die Funktion ohne merkliche Verzögerung deaktiviert werden.	Müller
1.3	Bei Aktivierung der Funktion wird die zu diesem Zeitpunkt aktuelle Fahrzeuggeschwindigkeit als Sollgeschwindigkeit gesetzt.	Meyer
1.4	Die gesetzte Sollgeschwindigkeit ist mit einer Genauigkeit von ... automatisch einzuregeln.	Meyer



[Rei12]

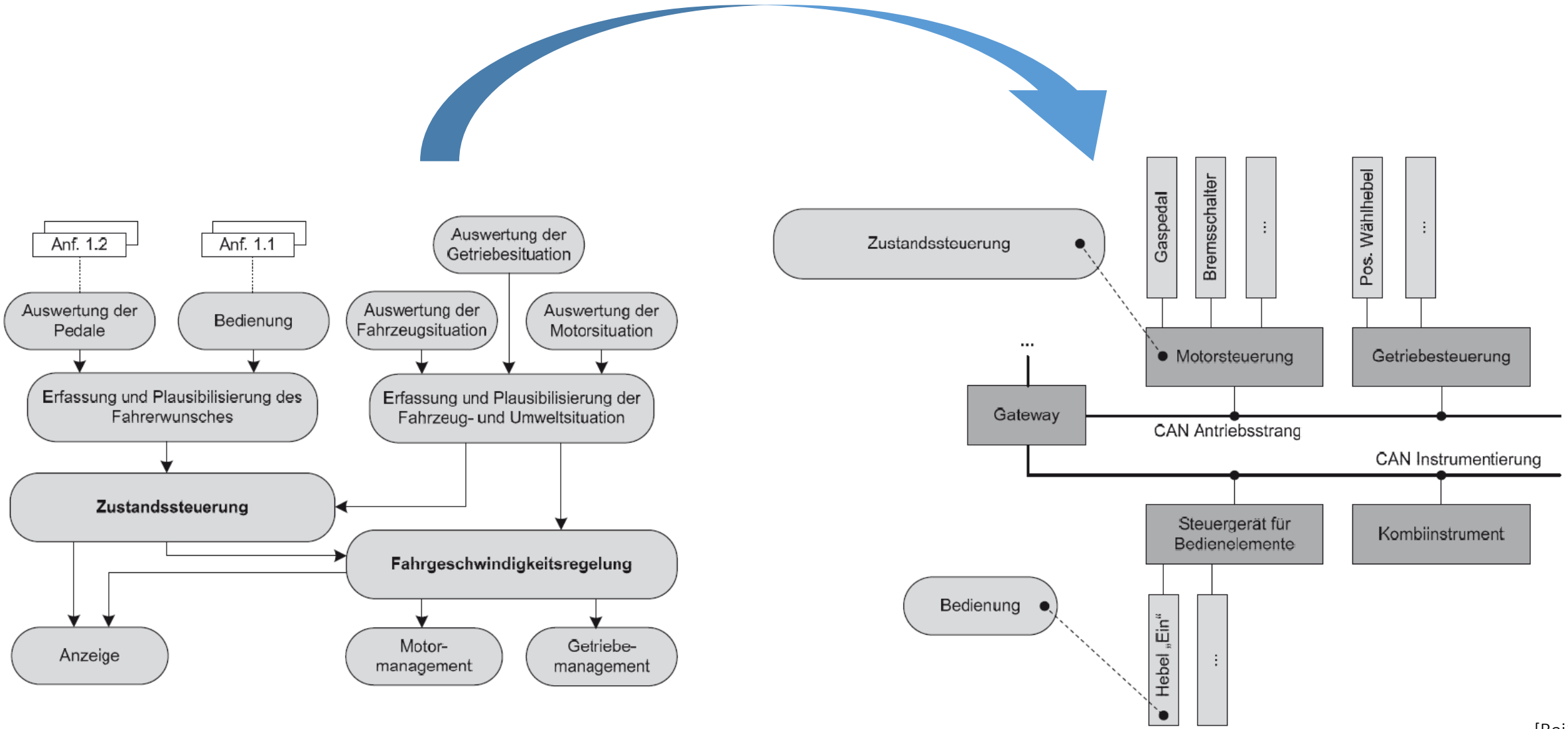
Analysis & specification on system level



- Derive a technical system architecture
- Definition of involved control units and the technicla connection
- Assign functions to the control units
- Definition of communication interfaces (BUS)

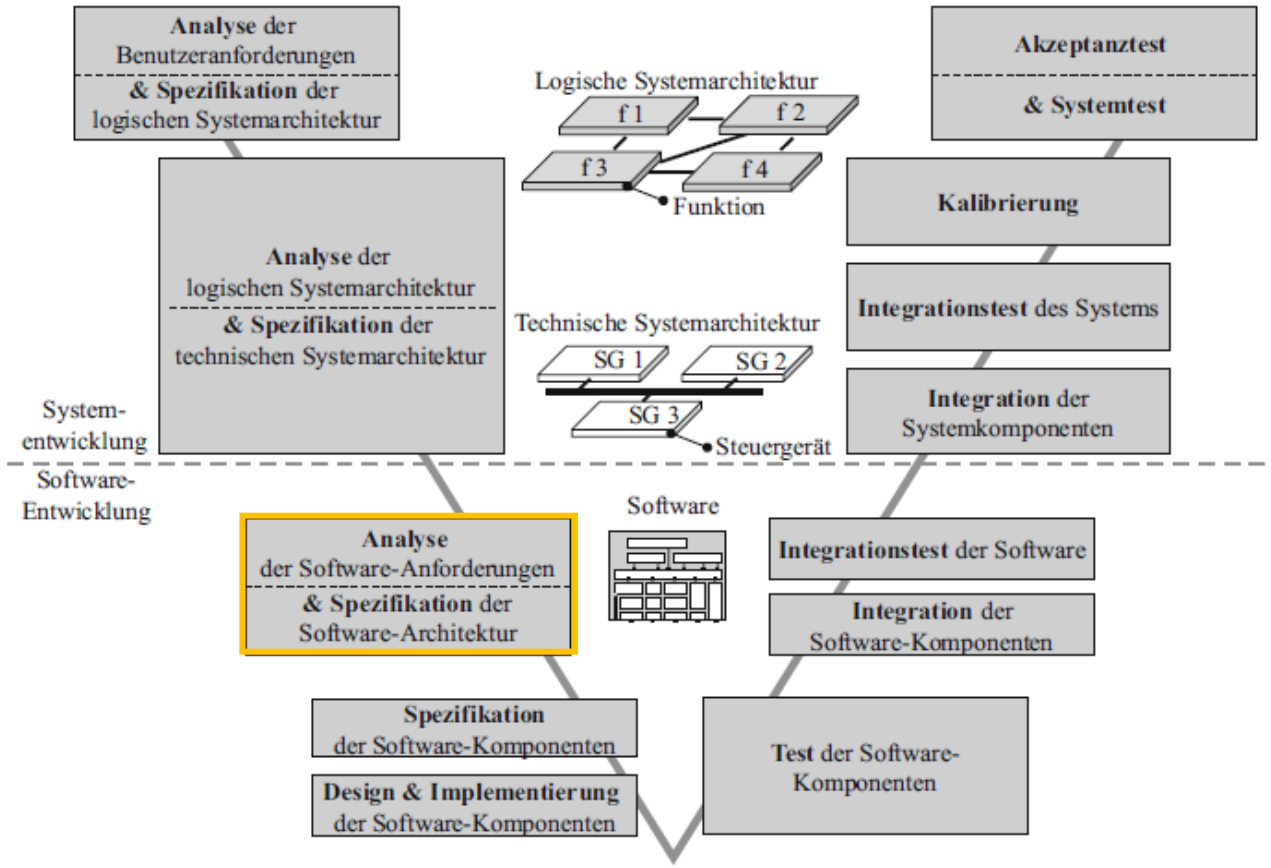
[Sch16]

Analysis & specification on system level - example



[Rei12]

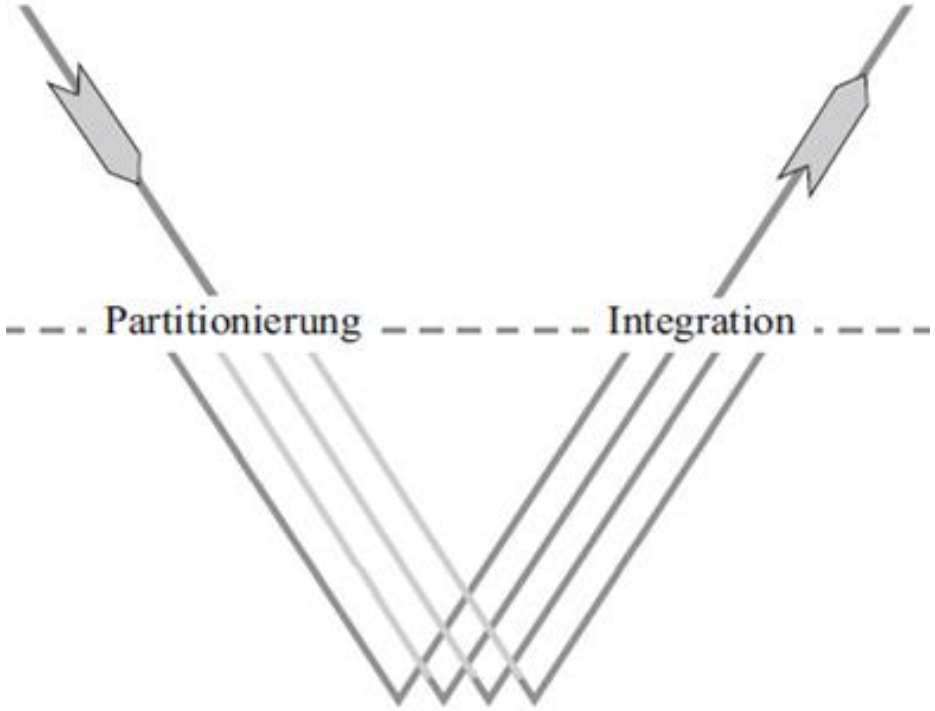
Analysis & specification on components level



- Definition of interfaces for the software modules
- Consideration of relevant standards
- Definition of operating conditions for the software

[Sch16]

Standards for software engineering in automotive industry

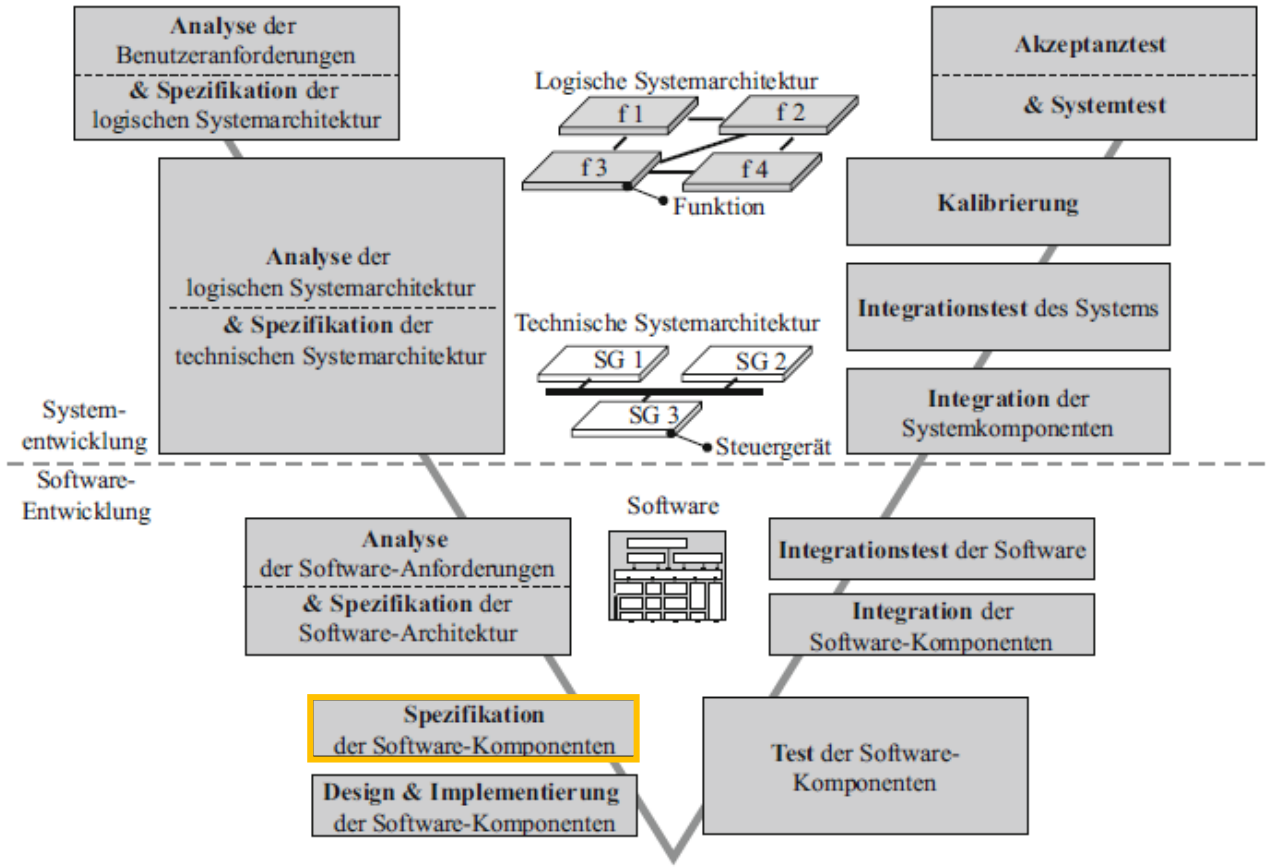


- ASAM
- OSEK
- JASPAR
- AUTOSAR

AUTOSAR: Automotive Open System Architecture
ASAM: Arbeitskreis für die Standardisierung von Automatisierungs-und Messsystemen
OSEK: Offene Systeme und deren Schnittstellen für die Elektronik
JASPAR: Japan Automotive Software Platform and Architecture

[Sch16]

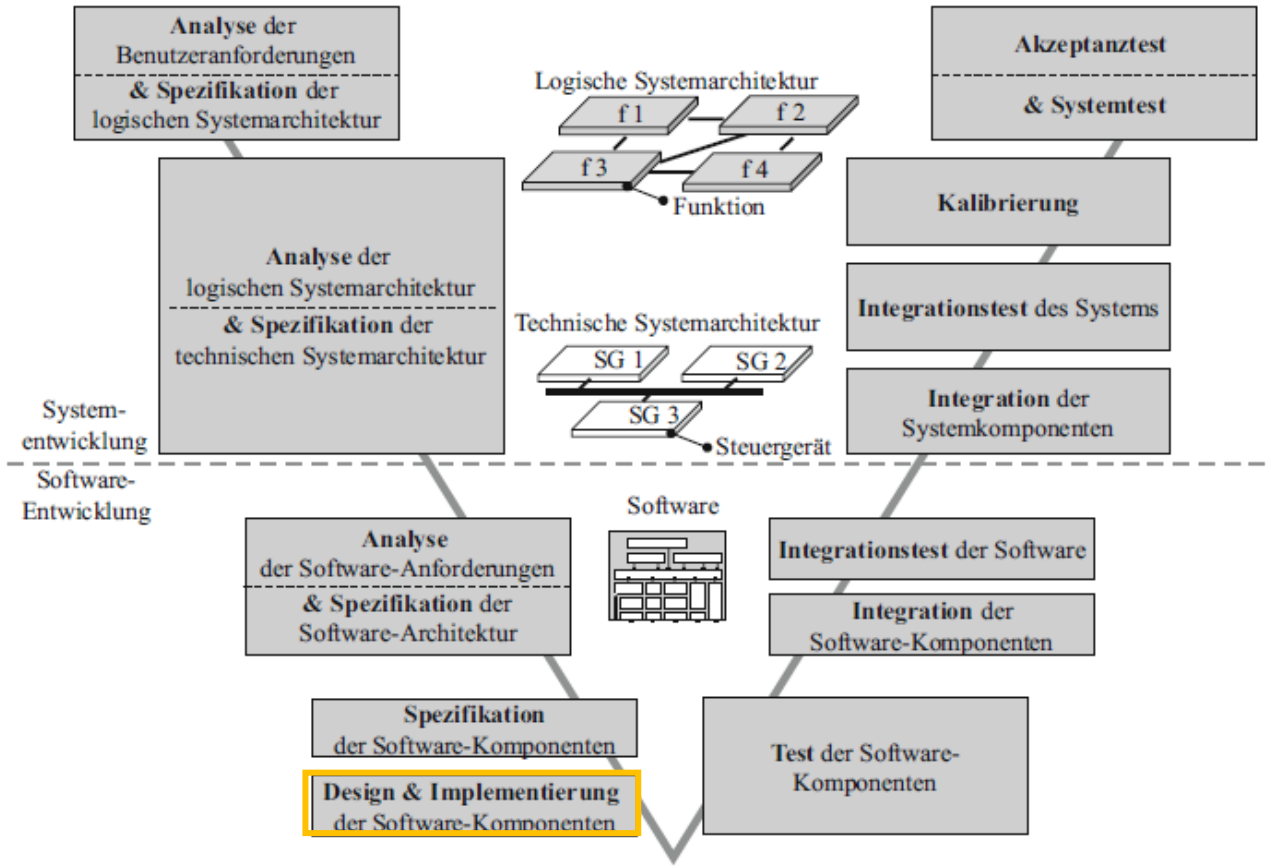
Specification of software components



- Definition of data structure
- Definition of data processing
- Determination of real time behaviour of the relevant component

[Sch16]

Design und Implementation of software components



- Determination of the necessary data memory type (volatile or non-volatile)
- Definition of adjustable parameters
- Splitting program and data level
- Conventional programmming (C) or model based programming by using Computer Aided Software Engineering (CASE) Tools

[Sch16]

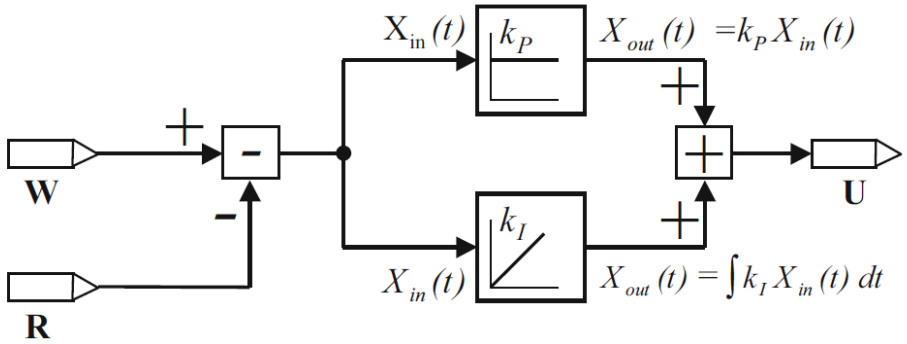
Design und Implementation of software components

Common CASE-Tools:

- ASCET (ETAS)
- MATLAB/Simulink (Mathworks)
- TargetLink (dSpace)

W = Führungsgröße
R = Regelgröße
U = Ausgangsgröße

Beispiel: ASCET ®



[Sch16]

PID controller - basics

P-Anteil:

- Nur proportionaler Anteil (Verstärkung Kp). Ausgangssignal (u) ist proportional zum Eingangssignal €

$$u(t) = K_p \cdot e(t)$$

- Kein Zeitverhalten; daher sofortige Regelung

I-Anteil:

- Integrierender Regler; zeitliche Integration der Regelabweichung e(t) auf die Stellgröße mit der Gewichtung durch die Nachstellzeit (Tn)

$$u(t) = \frac{1}{T_N} \int_0^t e(\tau) d\tau$$

- Langsamer, genauer Regler

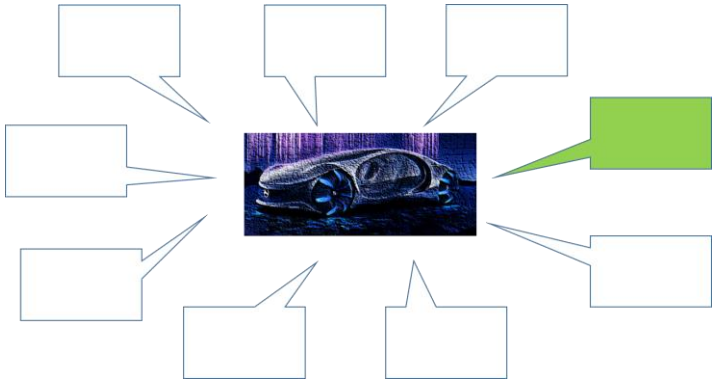
D-Glied:

- Differenzierer, der in Verbindung mit P/I Regler eingesetzt wird; Reaktion nur auf Änderungsgeschwindigkeit, nicht Regelabweichung

$$u(t) = T_\mathrm{V} \frac{\mathrm{d}}{\mathrm{d}t} e(t)$$

Teamwork module 4

- Please choose one key mechatronic system of your vehicle concept and describe it from a customer perspective (requirements)
- Please describe on the basis of logical and technical layers the key function of this mechatronic system
- Which sensors do you need?
- Which voltage level(s) do you need? Why?
- For one function: please describe a (simple) PID controller



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