Structuring Variability in the Context of Embedded Systems during Software Engineering – Problem Statement

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Agenda

Variable Software of Embedded Systems

Context of Embedded Software

Example for Context Variability

Related Work

Open Issues and Future Work

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Software of Embedded Systems

- Todays embedded systems are often part of a system of systems

- Main functionality of Embedded Systems is **realized by software**

- Software is deployed in highly-complex and safety critical environments...

- ...and has a High **interaction** with environment by sensors and actuators

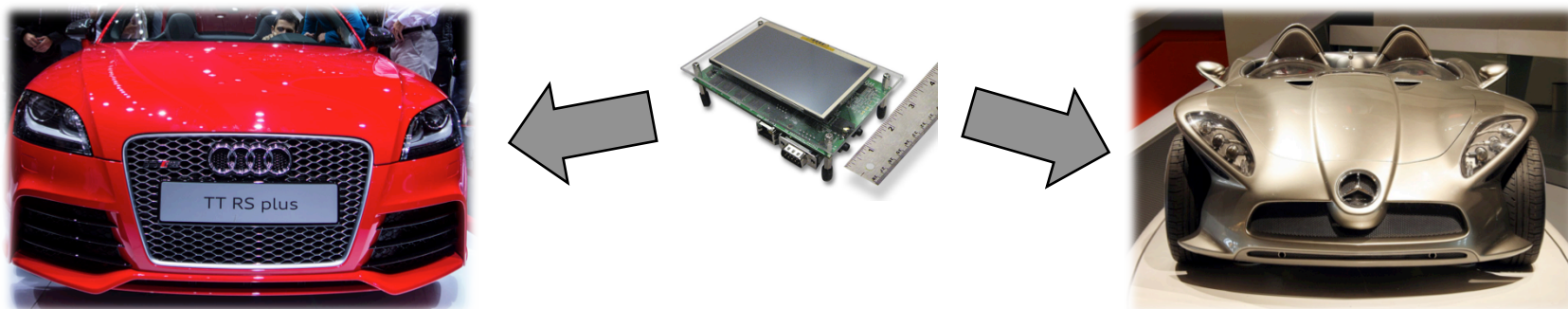The Ruhr Institute for Software Technology

Variability in Environment of Embedded Software

- Use of different hardware in supply chain of the embedded system
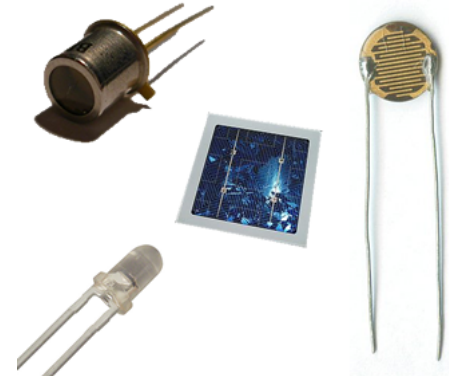
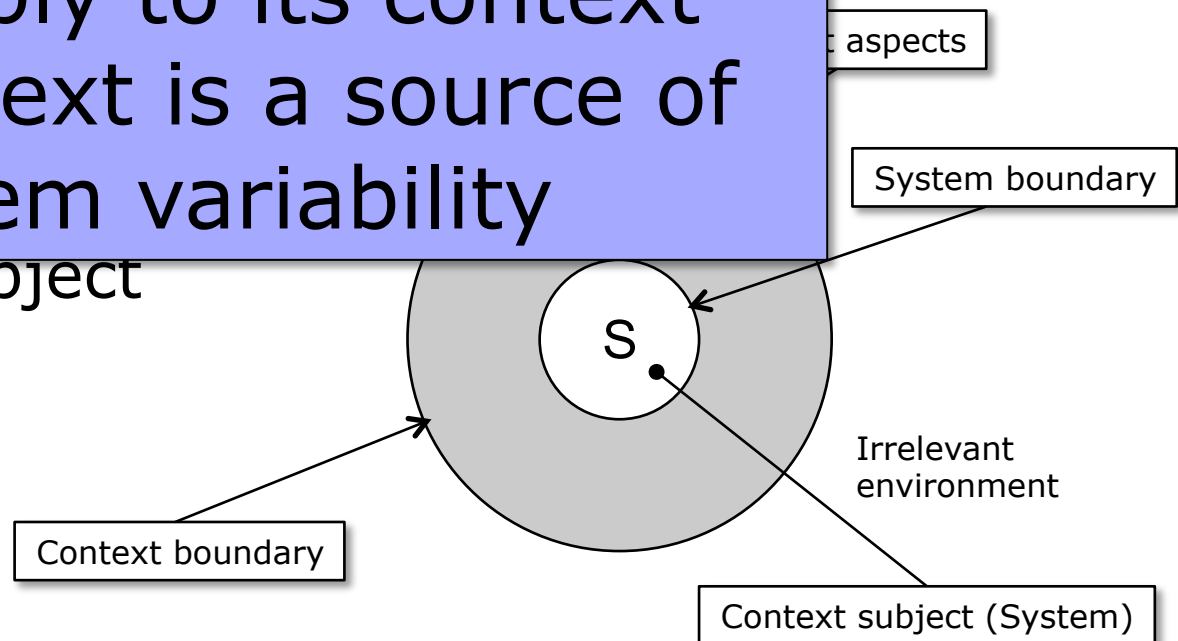- Use of a system (and software) at different OEMs

Context of Embedded Software

- Context is more than the system´s runtime environment

- Context [...] ect

- …and is [...] and sy[...]

- Context[...] elemen[...] of the context subject

> 1. Software has to comply to its context
> 2. Context is a source of system variability

[...] aspects

System boundary

S

Irrelevant environment

Context boundary

Context subject (System)

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A Framework for Structuring Context
Context Facets

Subject facet

Car itself

Driver

Technology to be used

Driver assistance system

Used operating system in the car

OSEK

IT system facet

...

...

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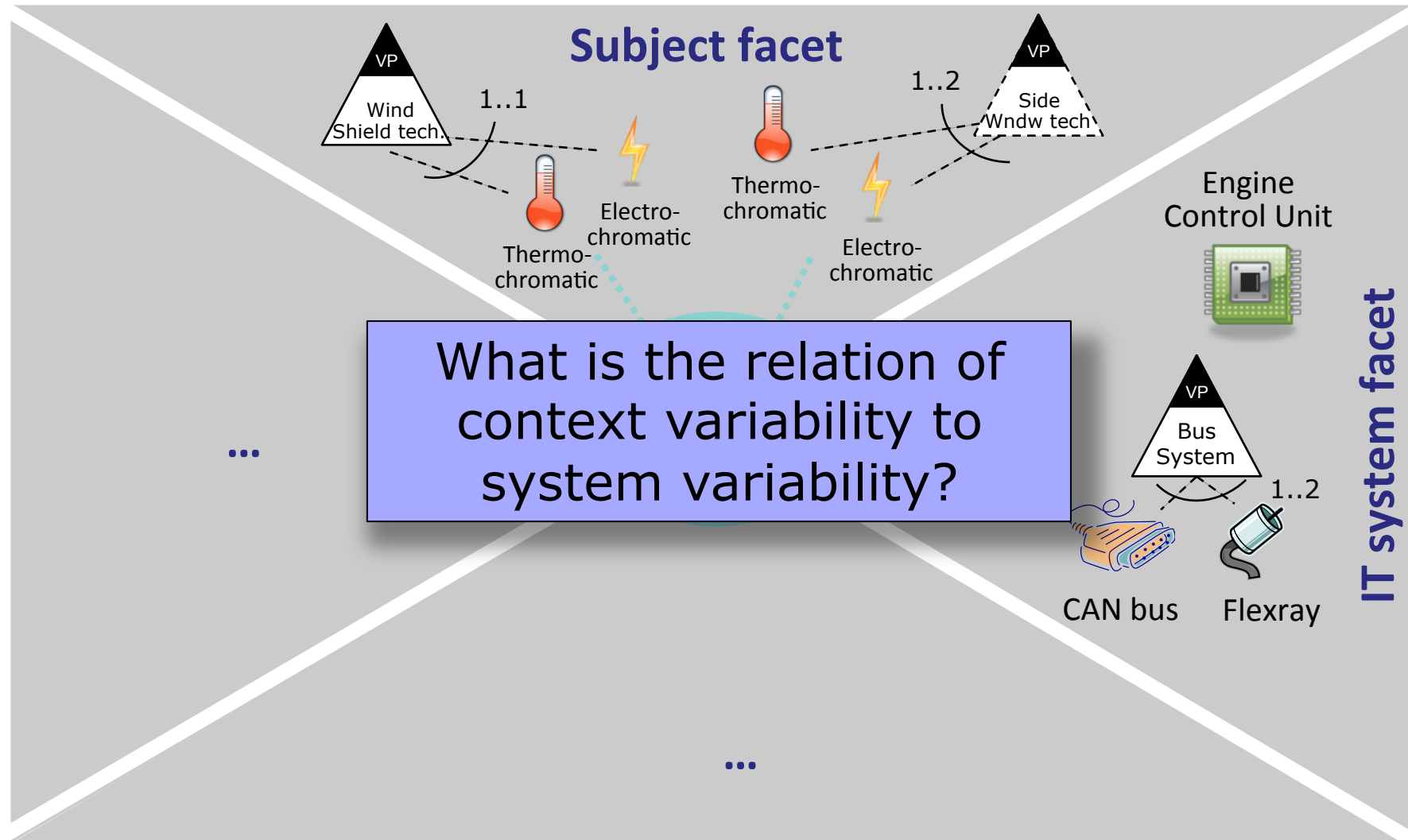The Ruhr Institute for Software Technology
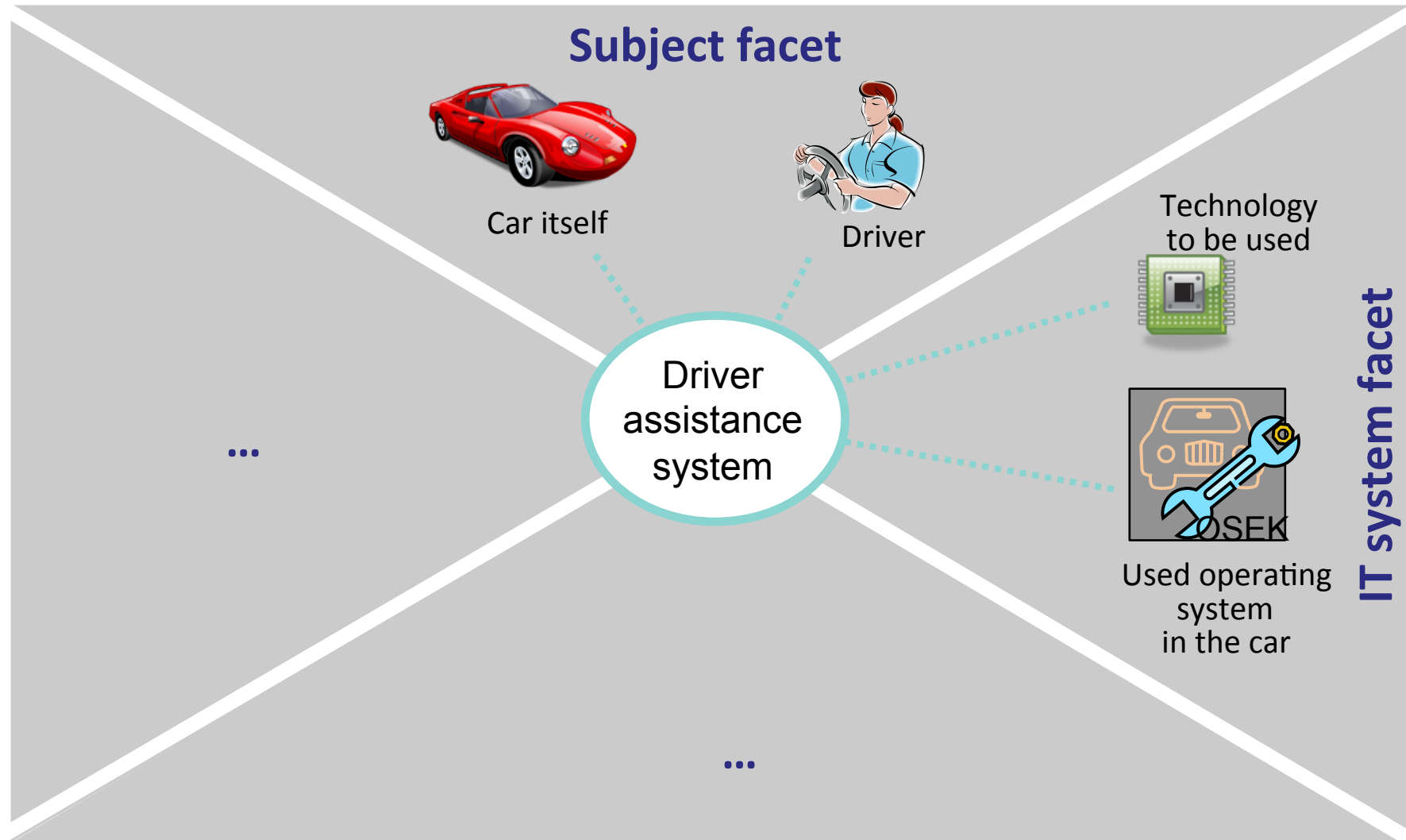
Context Variability by Example

- Software of dynamic tinting system
- Based on a case study from industry
- System should be used in different by different vendors
- Main functionalities
  - Tint windows depending on sun glare
  - Untint windows if car enters a tunnel (tunnel detection)

VP
Comfort

| V | Anti-theft protection |
| V | Heat Shield |

VP
Tinting

| V | Side windows |

VP
Sensor processing

| V | Tunnel detenction |
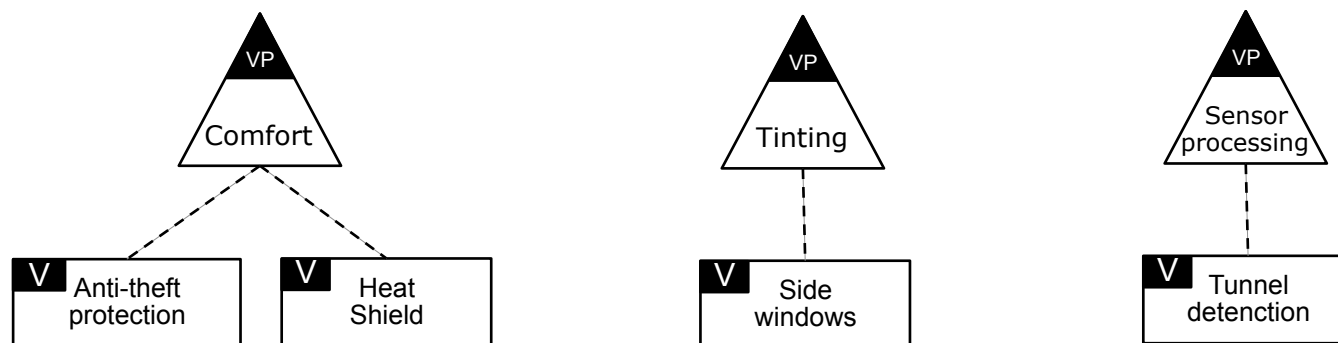
Context Variability of Example

Subject facet

VP — Wind Shield tech.
1..1
Thermo-chromatic
Electro-chromatic

Thermo-chromatic

VP — Side Wndw tech
1..2
Electro-chromatic

Engine Control Unit

IT system facet

VP — Bus System
1..2
CAN bus   Flexray

...

What is the relation of context variability to system variability?

...

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Relations of Variability in Context

Requires-Relation

Or-Relation

Context variability, i.e. variable context aspects, needs to be explicitly considered during engineering
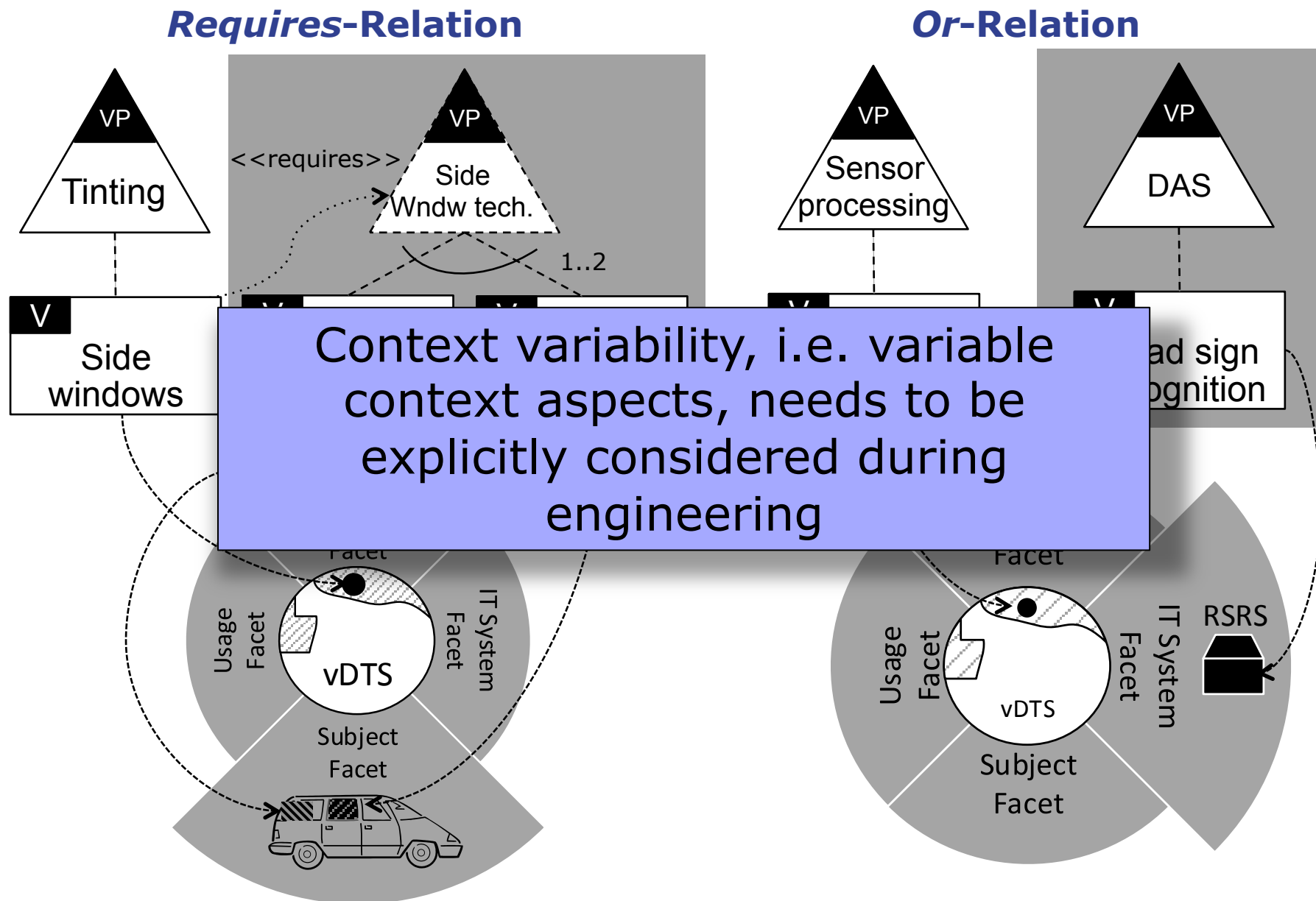
Open Issues

Support context variability in the
Engineering *of embedded software*

1. How can **sources of system variability systematically be documented** by analyzing the impact of context variability to system variabiliy?

2. How to does the **context subject change in a variable system?**

3. How can the **identifed relations contribute to a context theory** for variable embedded software?

Related Work of Modelling Context Variability

1. Most scoping approaches do not consider context explcitly
   - Clements & Northrop regard context but neglecting its variability

     [Clements & Nothrop 2001]
     [John & Eisenbarth 2009]

2. Pre-configuration of System Feature Model based on Context Feature Model
   - Pre-configuration based on conceptualization of Zave/Jackson-framework   [Tun et al. 2009]

     [Kang et al. 1990]
     [Kang & Lee 2013]
     [Lee & Kang 2010]
     [Hartmann & Trew 2008]

3. Formalization and consistency check of context behavior against system behavior

   [Ubayashi et al. 2010]
   [Ubayashi et al. 2012]

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Future Work

Extend or define engineering approach by a systematic consideration of context variability during software engineering

1. Extend current variability modeling approaches to deal with context variability
2. Define a context theory for variable (software) systems

- Refine problem statement based on feedback of industrial partners

Questions? Ideas? Feedback?

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