



A SysML Based Approach to Perform FMEA

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Overview

1. Model Based Systems Engineering

- ▶ Core Elements
- ▶ SysML as modeling language
- ▶ Benefits

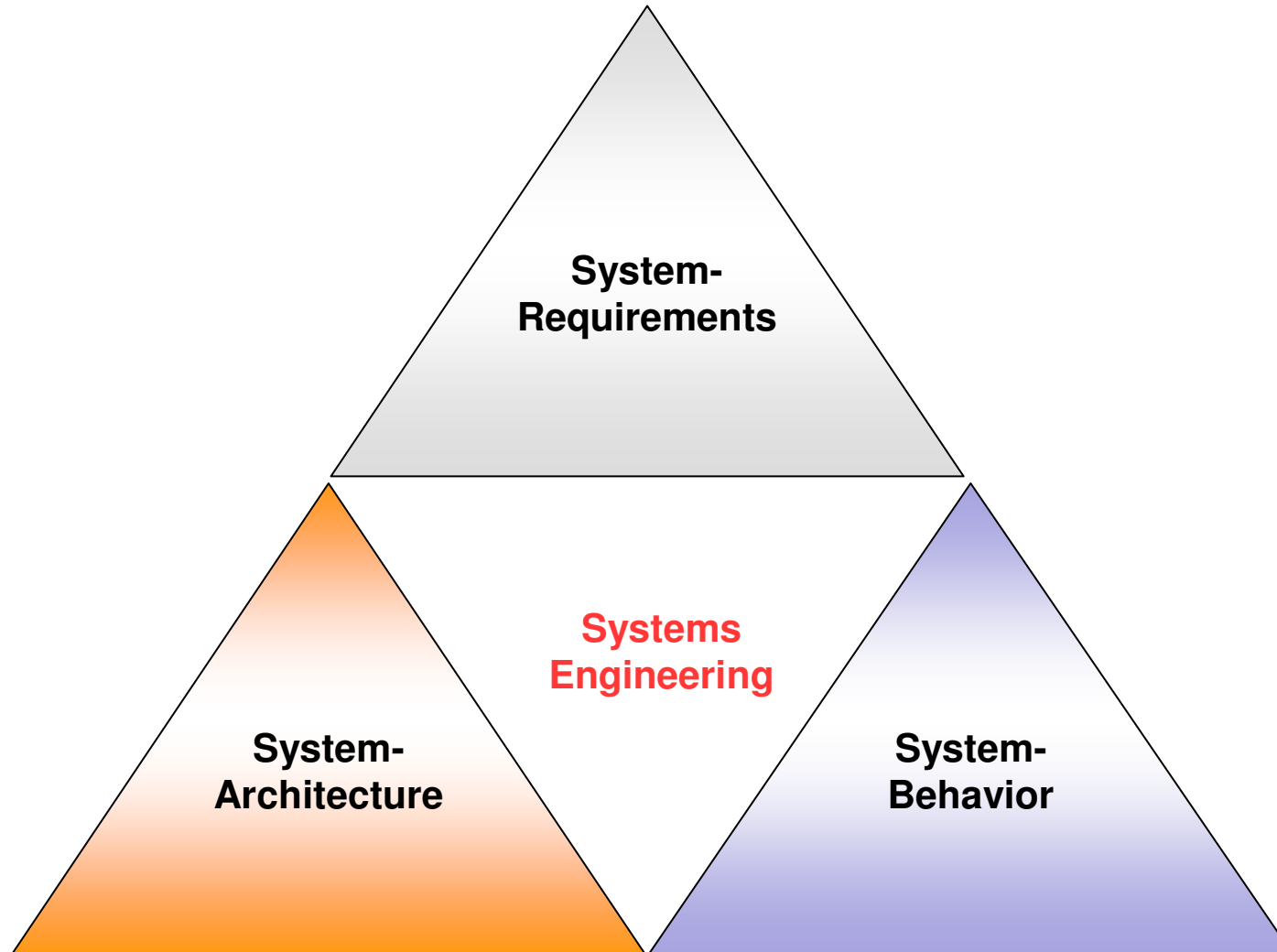
2. Model Based FMEA

- ▶ FMEA
- ▶ Approach based on VDA 4.3
- ▶ Perform FMEA driven by SysML

3. Results

- ▶ Implementation
- ▶ Conclusion

1. Model Based Systems Engineering: Core Elements

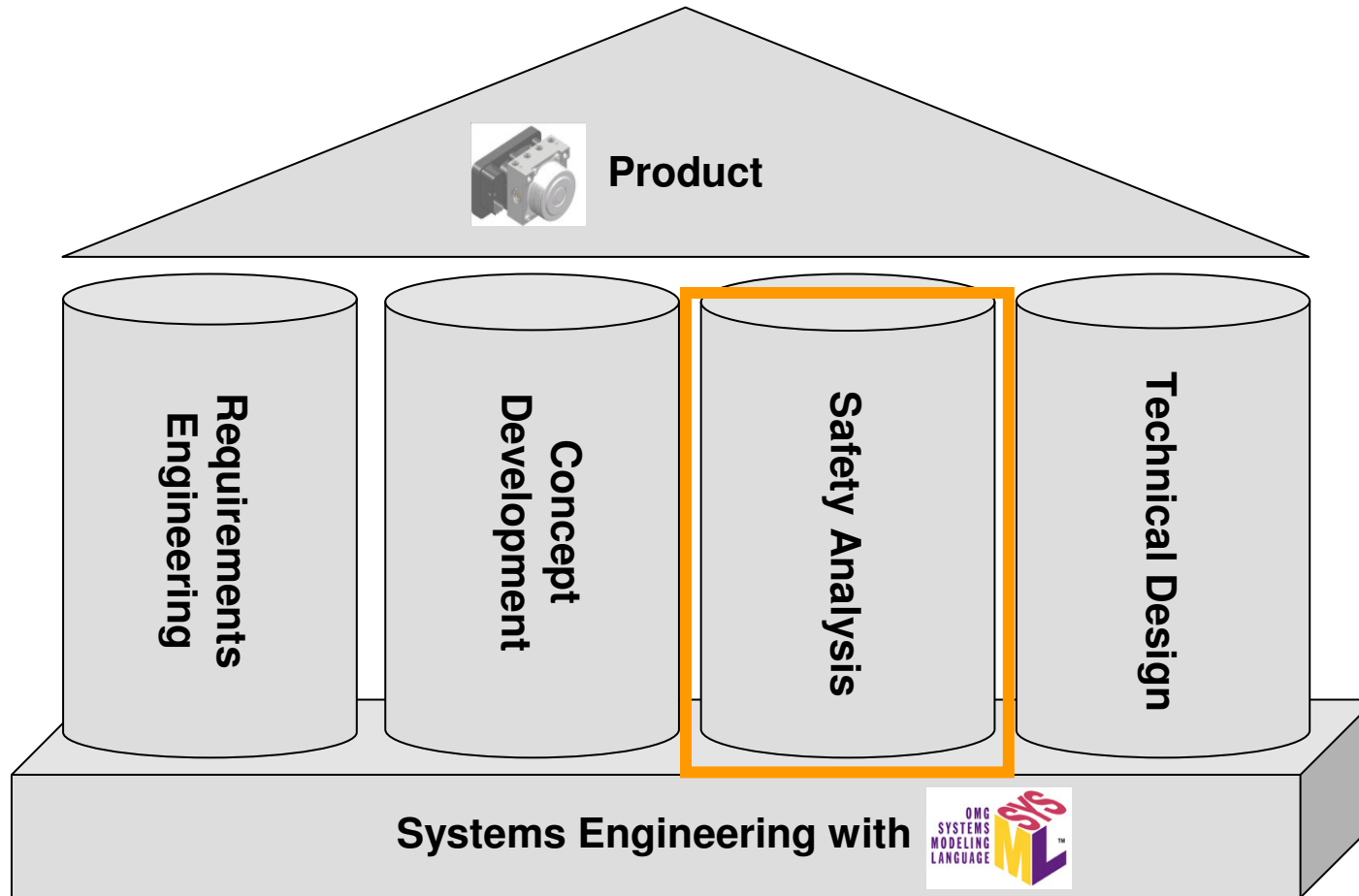


1. Model Based Systems Engineering: SysML as modeling language

- ▶ SysML (*Systems Modeling Language*) is a standardized, graphical language to describe different kind of technical systems
- ▶ SysML is based on the software modeling language UML (Unified Modeling Language)
 - ▶ Concepts of UML are reused but also extended
- ▶ SysML allows the description and the interconnection of the
 - ▶ system structure (architecture & design)
 - ▶ system behavior
 - ▶ system requirements
- ▶ SysML covers all parts of systems engineering

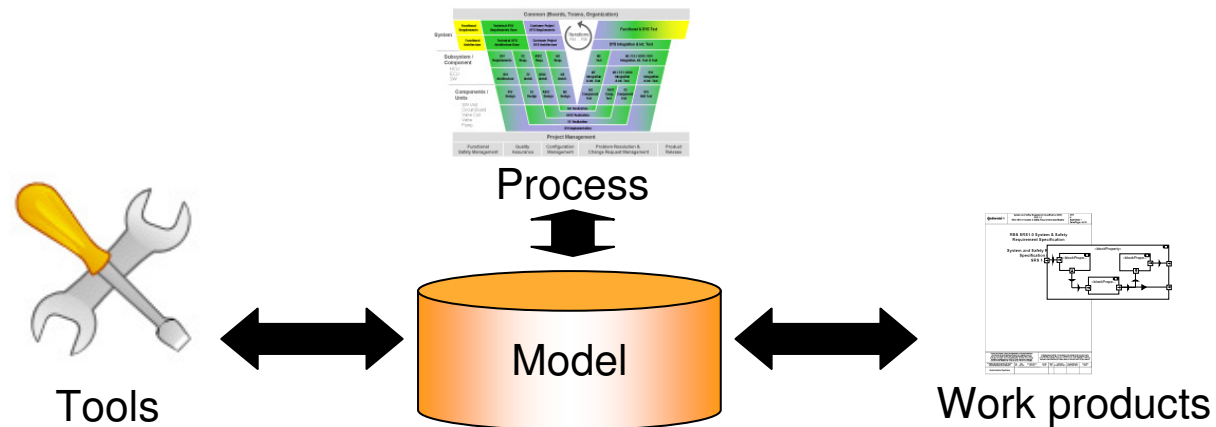


1. Model Based Systems Engineering: Benefits



1. Model Based Systems Engineering: Benefits

- ▶ The model-based approach satisfies the requirements of SPICE and industrial norms for Functional Safety (IEC 61508/ISO26262)
- ▶ All relevant development specifications are stored using data bases
- ▶ This allows a **simple creation of traceability links** between different work products
- ▶ Tool data integration brings different tools together (e.g. Architecture ↔ Requirement)
- ▶ Work products like documentation and traceability reports can be derived from the model on demand with automated tools



2. Model Based FMEA: FMEA

1. FMEA = Failure Mode and Effects Analysis

2. Analysis scope of a FMEA can be

- ▶ a technical concept
- ▶ a product
- ▶ a component of a product

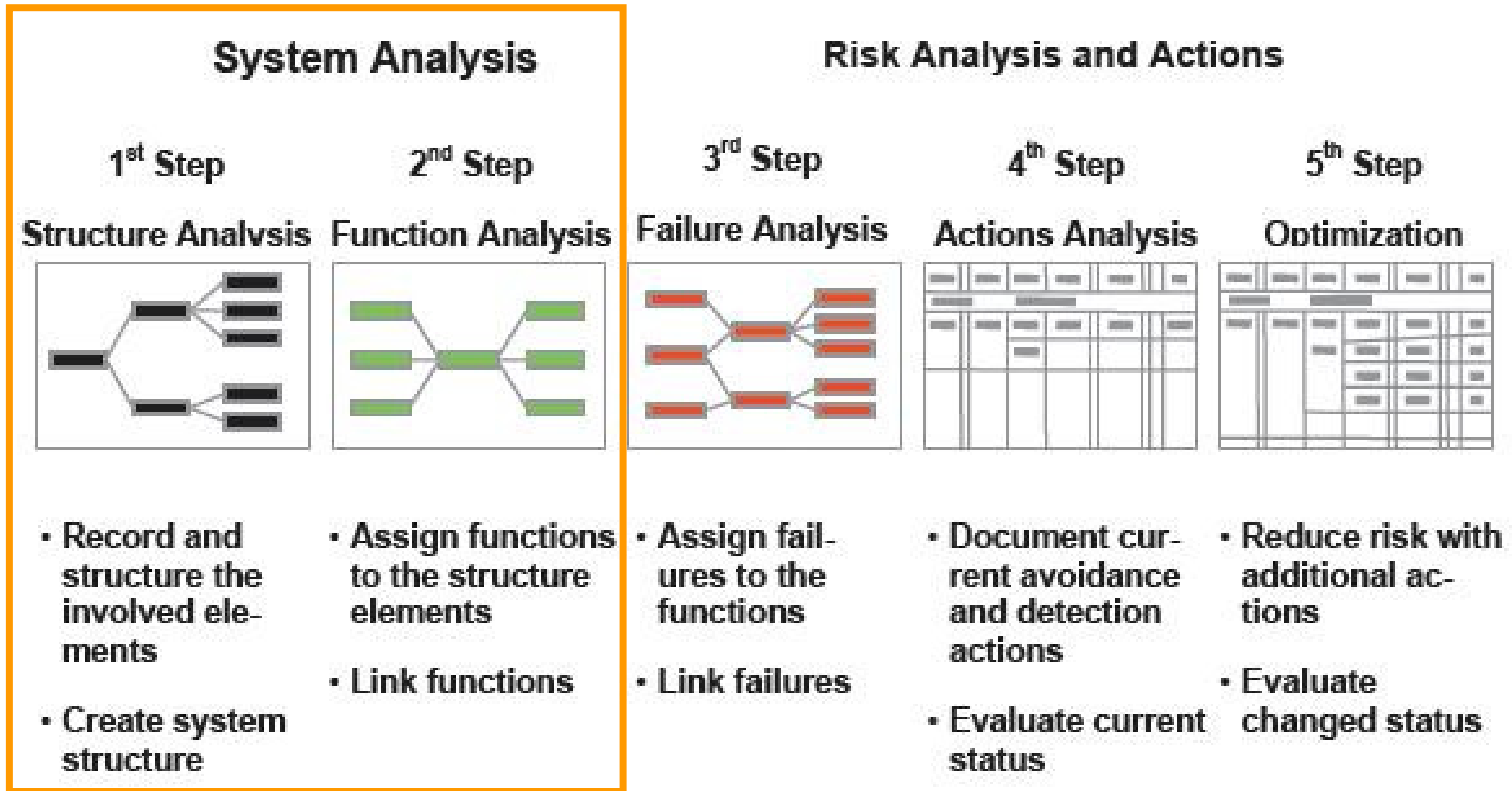
3. Contributions to the development by:

- ▶ identifying potential failure causes in a concept/design,
- ▶ prioritizing risks with Risk Priority Number (Severity x Occurrence x Detection) and
- ▶ mitigating risks by defining preventive measures and actions.

4. Benefits of performing FMEA:

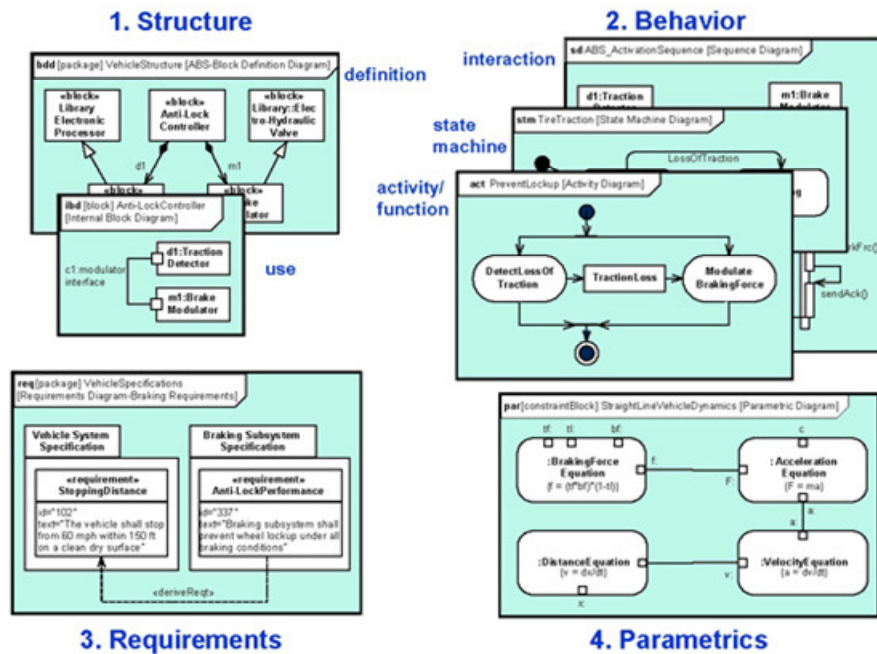
- ▶ Increased product safety and reliability
- ▶ Input for Supplier Quality Control
- ▶ Improved communication between heterogeneous development teams
- ▶ Improved customer orientation

2. Model Based FMEA: Approach based on VDA 4.3



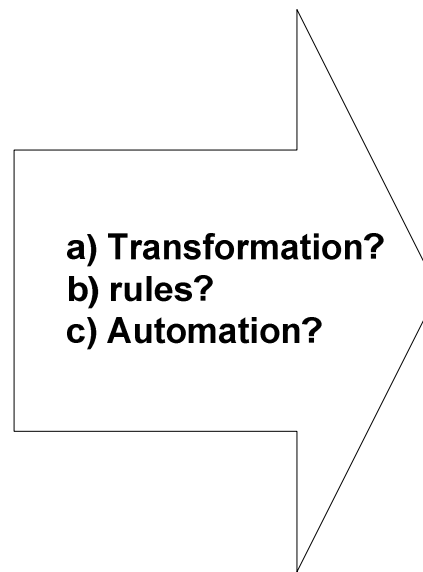
Driven by SysML Models

2. Model Based FMEA: Perform FMEA driven by SysML

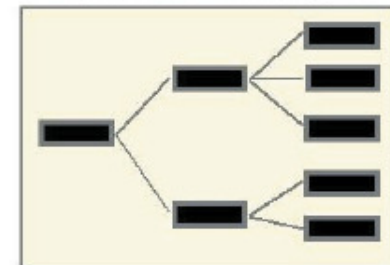


Note that the Package and Use Case diagrams are not shown in this example, but are respectively part of the structure and behavior pillars

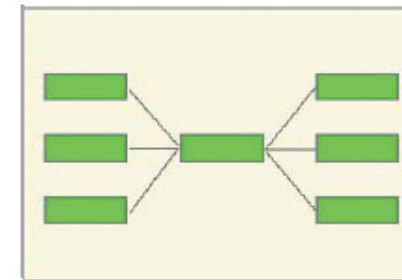
System Modelling with SysML



Structure Tree

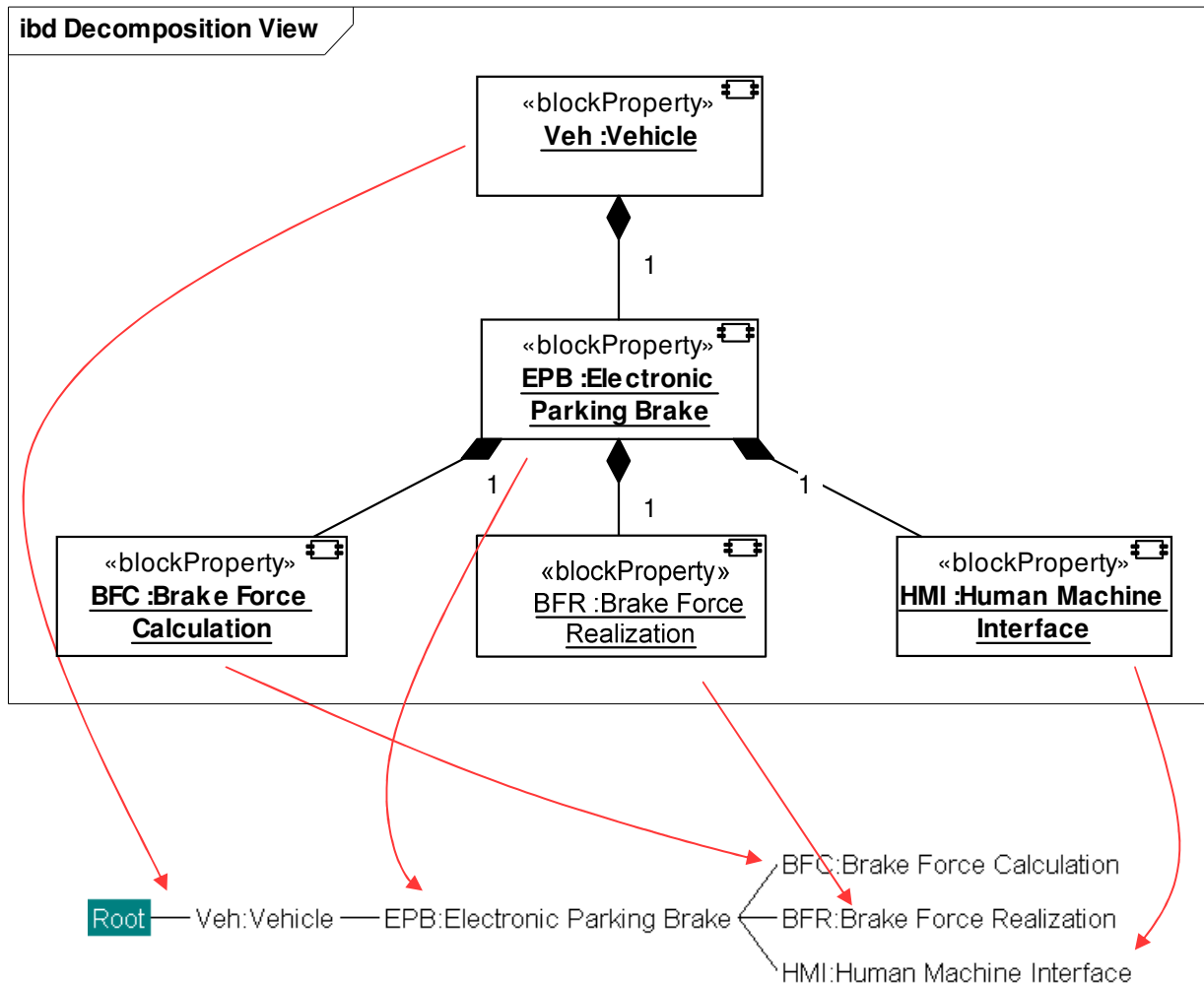


Function Structures



System Analysis in FMEA

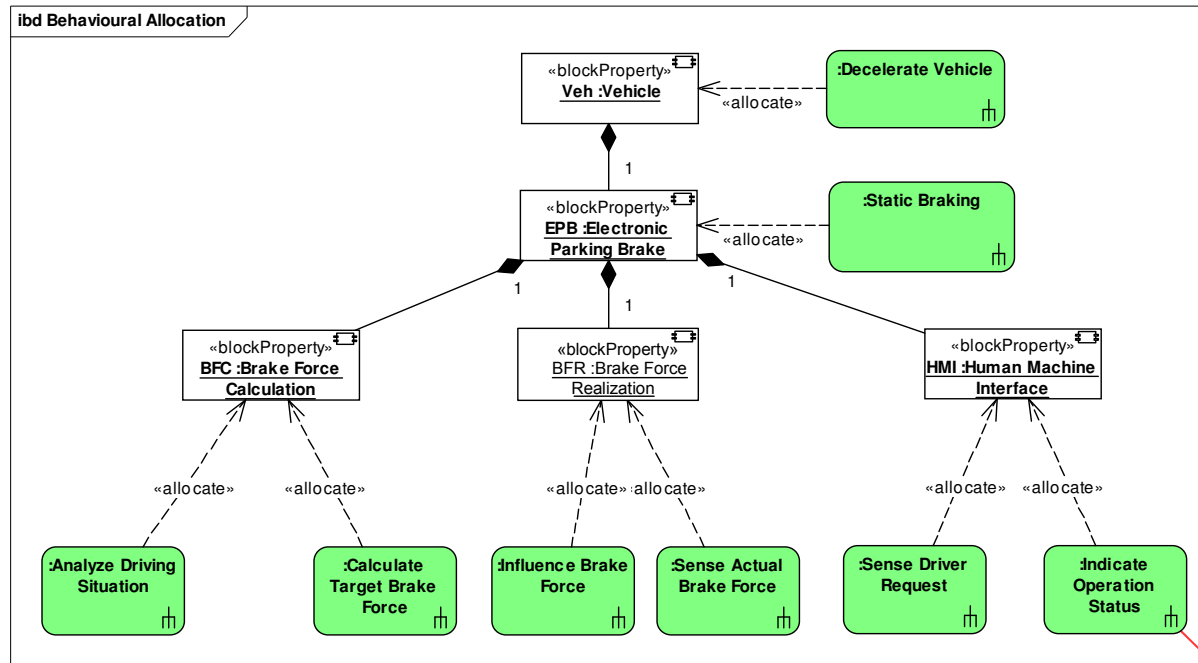
2. Model Based FMEA: Perform FMEA driven by SysML



SysML Model

FMEA
Structure Tree

2. Model Based FMEA: Perform FMEA driven by SysML

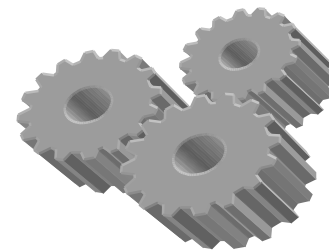
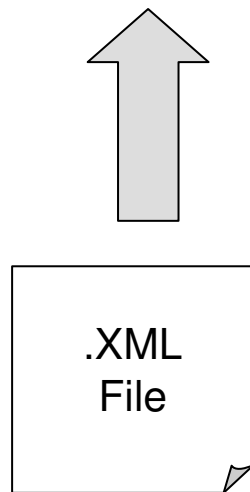
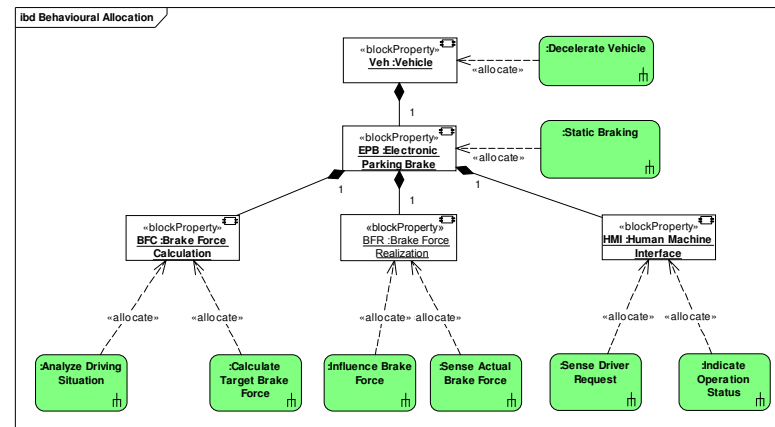
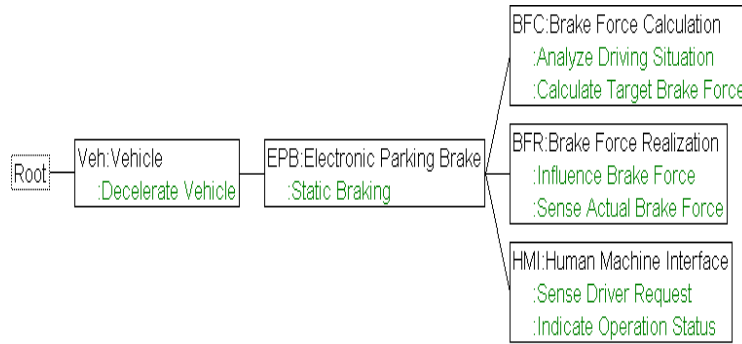


SysML Model

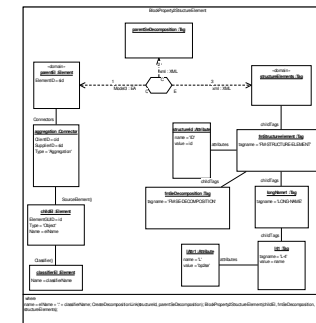


FMEA
Function Structure

3. Results: Implementation



QVT
Transformator



OMG QVT
Transformation
Rule Set

3. Results: Conclusion

Benefits of the model based FMEA:

- ▶ Acceleration of FMEA process by reusing existing system analysis
- ▶ Save of time and money, since system analysis in a classic FMEA is very time consuming.
- ▶ Consistent wording and terminology for describing the system and its behavior
- ▶ Improved traceability between system description and failure/safety analysis

Outlook:

- ▶ Optimization of the transformation rule set
- ▶ Realization of automatic generation of function structure
- ▶ Concept evaluation on other tool platforms

A SysML Based Approach to Perform FMEA

Thank you for your attention!

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